Supplier, Customer and Collaboration Orientations: A Longitudinal Perspective

Chad R. Allred, Ph.D.
Assistant Professor, Marketing
Brigham Young University
chad_allred@byu.edu
(801) 376-5559

Stanley E. Fawcett, Ph.D.
Professor, Global Supply Chain
Brigham Young University
stan_fawcett@byu.edu
(801) 422-5890

Cynthia Wallin, Ph.D.
Assistant Professor, Global Supply Chain
Brigham Young University
cynthia.wallin@byu.edu
phone: (801) 422-4933

Gregory M. Magnan, Ph.D.
Associate Professor, Marketing
Albers School of Business
Seattle University
gmagnan@seattleu.edu
(206) 602-6466

Abstract: Market success requires companies to offer a compelling value proposition and then develop the efficient processes needed to deliver to promise. Yet, findings from a multi-method, longitudinal research study show that strong functional orientations promote silo thinking, which leads to counterproductive decision-making. The failure to align supply- and demand-side processes creates gaps, undermines value creation, and hinders a company's ability to meet customer needs. However, establishing a collaboration orientation can help bridge these service gaps and improve operational performance. This research shows that companies can develop a collaboration orientation to mitigate dysfunctional silo effects. As companies do so, they are able to deliver higher levels of customer value and business performance. Approaches to cultivating such a collaboration orientation are also discussed.

Key Words: Collaboration, Market Orientation, Resource-based View, Multi-method, Multi-period study

Introduction

To achieve superior market performance, companies must coordinate value-added activities across both internal and external boundaries to build non-imitable competencies and deliver unique customer value (Barney, 2001; Ketchen, Hult, and Slater, 2007). However, achieving the coordination necessary to improve business performance remains a pervasive challenge (Johnson and Borger, 1977; Ellinger, Keller, and Hansen, 2006). Stevens (1989) identifies a fundamental issue underlying the challenge as follows "The objective of managing the supply chain is to synchronize the requirements of the customer with the flow of materials from suppliers in order to affect a balance between what are often seen as conflicting goals of high customer service, low inventory management, and low unit costs."

Conflicting goals are found throughout the supply chain. Stevens's example highlights the dilemma that occurs within a firm: marketing's quest for outstanding customer service conflicts with logistics' mandate to minimize inventory and transportation costs. As these two functions pull in different directions, relationships are strained and tensions build (Ellinger et al., 2006). Similarly, across the supply chain, customers' efforts to lower prices collide with suppliers' desire to protect margins, diminishing trust and the willingness to work together (Fawcett, Magnan, and Williams, 2004). Because these conflicts arise from traditional organizational structures and cultures, they are pervasive. Bowersox, Closs, and Stank (1999) called the conflict between the downstream, customer-oriented functions and the upstream, supplier-oriented functions within a firm the "great divide." Fawcett and Magnan (2002) noted that the prevalence of gaps among supply chain members make meaningful collaboration among "partners" the exception rather than the rule. The reality is that wherever conflicting goals are found, they lead decision makers to compete rather than to combine efforts (Churchman, 1971; Min, Mentzer, and Ladd, 2007; Narver and Slater, 1990).

Unfortunately, the counterproductive competition that often accompanies conflicting goals threatens to diminish both firm and supply chain performance—a potentially dangerous outcome in a "flat" world (Friedman, 2006). The question thus emerges, How can modern supply chain managers mitigate inter-functional and supply chain conflict? Several researchers have identified a collaborative orientation as the "missing" mechanism that is needed to bridge existing gaps across functions and among firms (Barratt, 2004b; Ellinger et al., 2006; Moberg, Speh, and Freese, 2003; Nicovich, Dibrell, and Davis, 2007). To explore collaboration's role as a bridge, we collected data in two time periods, six years apart, to assess how effectively companies are learning to collaborate and improve their ability to create value across organizational boundaries. Elements of internal (cross-functional) and external (supply chain) collaboration were incorporated into a multi-faceted measure of collaboration orientation.

Organizational Orientations and Value Creation: A Conceptual Model

Constituency Based Theory (CBT) suggests that companies organize along functional lines to take advantage of in-depth knowledge and skills that arise from specialization (Anderson, 1982). CBT also warns that "specialist" functions (e.g., marketing and logistics) tend to pursue their own goals because they are rewarded on disparate metrics, operate with distinct reporting structures, and are often located in physically separated work areas. Although this functional-orientation allows each function to perform well according to its respective metrics,

tension and conflict are likely to occur, leading to sub-optimal performance for both the firm and the supply chain (Fawcett, Magnan, and Ogden, 2007).

Forrester (1958) recognized the counterproductive nature of functional organizations—that is, functional orientations impose costs and disruptions that impede value creation—and predicted the emergence of process-driven organizations. The fulfillment of his prediction has yet to be realized. Despite its drawbacks, the functional organization structure persists because companies need "groups" with specific and deep skills to take responsibility for managing specific tasks. Even so, as value-creation processes have become more complex and intertwined, the costs imposed by functional orientations have increased. Managers thus face a dilemma: How can they obtain the deep skills associated with functional specialization while avoiding the costs imposed by conflicting goals and metrics? A mechanism is clearly needed to mitigate the downsides of functional organizations (Ellinger et al., 2006).

Because companies struggle to combine deep functional skills to build a valued competency, the resource-based (RB) view of competition provides a useful lens for defining such a mechanism (Ketchen et al., 2007). The underlying principle of RB theory is that a firm's (or a supply chain's) resources do not determine competitiveness; rather, it is *how* managers exploit resources across functions (or the supply chain) that leads to the creation of non-imitable competencies (Barney, 1991; Newbert, 2007; Wernerfelt, 1984). Prahalad and Hamel (1990) focused on the "how," noting that "core competencies are the *collective* learning in the organization, especially how to *coordinate* diverse production skills and *integrate* multiple streams of technologies." Stalk, Evans, and Schulman (1992) further emphasized the collaborative nature of a valued competency: "Critical capabilities are *collective* and *cross-functional*—a small part of many people's jobs, not a large part of a few." It is the *collaborative* aspect of competencies that enables them to create unique customer value and makes them hard to replicate. RB theory thus suggests that a collaboration orientation may be the vital ingredient needed to bridge the gaps created by entrenched functional orientations.

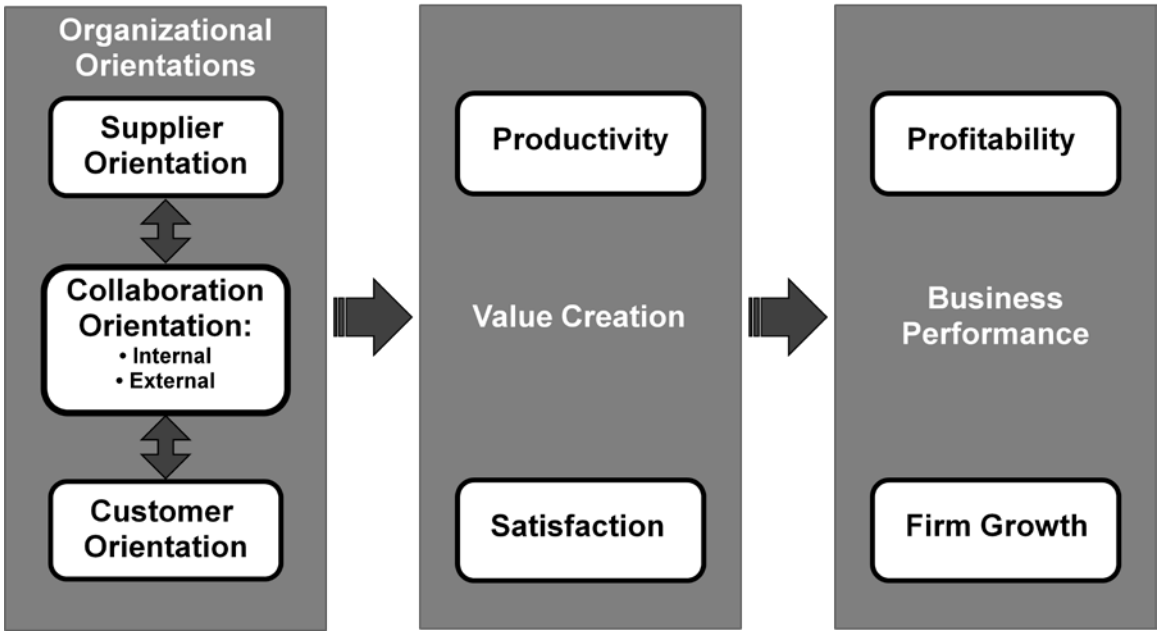
The conceptual model shown in Figure 1 integrates essential elements of CBT and RB theories. The model consists of four basic elements—functional orientations, a collaboration orientation, value creation, and business performance. Specifically, functional orientations are represented by supplier and customer orientations. At most organizations, supply management is the process owner for upstream supplier relationships (Fawcett et al., 2007; Monczka, Handfield, Giunipero, and Patterson, 2008). Similarly, marketing acts as the interface and gatekeeper for downstream customer relationships (Lusch, 2007; Mentzer, Stank, Esper, 2008; Ringold and Weitz, 2007). The conceptual model suggests that capabilities housed in these functions not only create value but also provide the building blocks for collaboration. As a collaboration capability emerges, the counterproductive impact of strong functional orientations are mitigated. That is, Figure 1 highlights three core propositions:

Proposition 1: *Strong functional orientations are needed to build the deep skills necessary to create and deliver high levels of customer value.*

Proposition 2: *A collaborative orientation incorporates deep functional skills to build unique competencies while simultaneously mitigating conflicts among functions that diminish value creation.*

Proposition 3: *Unique value creation capabilities can provide a non-imitable competency that leads to superior business performance.*

Figure 1
A Resource-Based Perspective of Organizational Orientations and Firm Performance



The Role of Functional Orientations

Extensive research (e.g., the market orientation literature) suggests that companies must develop two functional orientations to effectively create customer value (Heikkila, 2002; Hendricks and Signhal, 2005; Jaworski and Kohli, 1993; Kohli and Jaworski, 1990; Ireland and Webb, 2007; Slater and Narver, 1994). First, companies must seek to understand customer desires and expectations—represented in this research by a customer orientation (Hult, Ketchen, and Slater 2005). Second, companies need to establish efficient processes that are capable of creating and delivering the value customers desire—evaluated here via a supplier orientation. Competitive success requires bringing customer and supplier orientations together. The question is, How? To set the stage for exploring the role of collaboration in bringing these two distinct orientations together, it is important to briefly discuss the nature and influence of customer and supplier orientations.

A Customer Orientation. The first step in consistently satisfying the real needs of customers is to understand those needs (Drucker, 2001; Mentzer et al., 2001; Ohmae, 1988; Zokaei and Hines, 2007). Typically, this task falls to the marketing function within a firm. To be effective, marketing must span boundaries. Focusing downstream, marketing is best positioned to understand customer needs when it builds close customer relationships (Fassnacht and Kiose, 2006; Green, McGaughey, and Casey, 2006; Grzeskowiak, Blut, and Kenning, 2007; Javalgi, Martin, and Young, 2006; Yim, Anderson, and Swaminathan, 2004). For example, by seeking customer feedback and establishing dedicated customer account teams, a company can refine its value proposition and justify the development of a flexible and rapid customer response capability (Bowersox et al., 1999; Fawcett et al., 2007). Turning upstream, marketing can use

its intimate customer knowledge to influence internal process design and management (Min et al., 2007). To the extent that the marketing function builds these skills, firm performance should improve. These expectations establish the foundation of this study's first hypothesis.

Hypothesis 1: *A customer orientation is positively related to a firm's value creation capability as measured by customer satisfaction and productivity.*

A Supplier Orientation. The second step in winning the competitive battle is to establish efficient processes, which is the responsibility of a company's operations and supply function. Because externally sourced products and services account for 55% of every revenue dollar, the supply function must effectively bridge boundaries to upstream members of the supply chain (Monczka et al., 2008). At most companies, a desire to drive productivity up and costs down dominates a supplier orientation (Attaran and Attaran, 2004; Daugherty, Richey, Genchev, and Chen, 2005; Ferdows, Lewis, and Machuca, 2004; Hult, Ketchen, and Slater, 2004; Lee, 2004). However, the ability to consistently deliver innovative, high-quality products on time is also part of a supplier orientation (Cook and Garver, 2002; Fawcett et al., 2007). Removing process variability and eliminating waste both within the firm and in the supply base is vital to achieving these goals (Friedman, 2005; Trent and Monczka, 2005). In effect, supply managers not only manage purchase transactions but also the capacity and capabilities of suppliers worldwide. To summarize, although the primary influence of a supplier orientation is expected in the area of productivity, some customer satisfaction benefits are likewise expected. These performance expectations are captured by our second hypothesis.

Hypothesis 2: *A supplier orientation is positively related to a firm's value-creation capability as measured by customer satisfaction and productivity.*

The Role of a Collaboration Orientation

Although both customer and supplier orientations are needed for success, their different focal points create potential conflicts. Specifically, as a profit center, marketing's job is to find a way to maximize revenue by increasing perceived value and customer satisfaction. But if marketers make promises to customers without adequate coordination with their supply management counterparts, these promises may actually have a negative impact on both the productivity and profitability of the firm (Fawcett, Ellram, and Ogden 2006). Similarly, because supply management is a cost center, decision makers focus on price reduction and cost minimization to meet efficiency standards. As a result, decisions made by supply managers may undermine the value proposition being communicated by the marketing function, reducing customer benefits.

A collaboration orientation offers the potential to bridge the gaps created by functional organizations and orientations (Eng, 2005; Eng, 2006; Fawcett et al., 2006; Green, McGaughey, and Casey, 2006; Min et al., 2007). Collaboration mitigates silo thinking by promoting goal alignment, more frequent and open information sharing, higher levels of managerial interaction, the exchange of expertise and resources, and a willingness to share risks and rewards (Min et al., 2007; Stonebraker and Afifi, 2004). Such efforts are needed both within the firm and among members of the extended supply chain; that is, customers and suppliers (Barratt, 2004a; Moberg et al., 2003; Morgan, 1997; Tyndall, Gopal, Partsch, and

Kamauff, 1998). Thus a fully developed collaboration orientation should be multi-dimensional, consisting of both internal and supply chain-oriented facets.

By helping customer- and supplier-oriented sides of the company work together, a collaboration orientation should lead to improved process effectiveness and efficiency (Barratt, 2004b; Moberg et al., 2003). Simultaneous integration with both upstream and downstream supply chain members has also been associated with the largest rates of significant performance improvement (Frohlich and Westbrook, 2001). Potential performance benefits include better quality, lower inventory levels, faster new product development cycles, higher productivity, lower materials and manufacturing costs, and shorter delivery lead times (Ferdows et al., 2004; Frohlich and Westbrook, 2001; Hult et al., 2004; Ireland and Webb, 2007; Lee, 2004). Higher levels of customer satisfaction have also been seen when levels of collaboration are high (Fawcett et al., 2007; Frohlich and Westbrook, 2001). Our third hypothesis thus states,

Hypothesis 3: *A collaboration orientation is positively related to a firm's value creation capability as measured by customer satisfaction and productivity.*

The relationship between functional orientations and a collaboration orientation is likely interactive and iterative (thus, the two-way arrows in Figure 1). Constituency theory (Anderson, 1982) and resource-based theory (Barney, 1991; Ketchen et al., 2007; Newbert, 2007) suggest that the deep capabilities that are built in the presence of strong functional orientations are vital inputs into a collaboration capability. Without strong functional capabilities, a company does not have the necessary building blocks to create value through collaboration (Prahalad and Hamel, 1990; Stalk et al., 1992). In other words, the functional orientations have nothing of real value to bring to the collaboration. Yet, the relationship among these orientations does not end as deep skills are brought together. The interaction that takes place throughout the collaboration process likely influences its participants. As they collaborate, they learn more about the value-added contributions of other functions, build relationships of trust, and begin to view colleagues from other areas as resources rather than simply as competitors (Barratt, 2004a; Fawcett et al., 2007; Moberg et al., 2003). Investing in the open communication, goal alignment, and risk/reward sharing that are components of a collaboration orientation should help foster the development of the right "deep" functional capabilities, mitigating the counterproductive aspects of functional orientations.

Moreover, a collaboration orientation has been shown to mediate the relationship between functional orientations and performance (Min et al., 2007). That is, the collaborative ability to capture and amplify functional capabilities that reside in diverse functions and supply chain members enables the development of inimitable competencies that influence value creation. Our fourth hypothesis addresses this mediating role of a collaboration orientation:

Hypothesis 4: *A collaboration orientation mediates the relationship between functional orientations (customer and supplier) and a firm's value creation capability as measured by customer satisfaction and productivity.*

Value Creation's Influence on Business Performance

A generally accepted principle is that unique competencies that customers value and that competitors cannot copy lead to better market performance and higher profitability (Barney, 1991; Barney, 2001; Newbert, 2007; Prahalad and Hamel, 1990; Wernerfelt, 1984; Wernerfelt, 1995). Therefore, an improved customer satisfaction capability coupled with higher productivity levels should lead to better overall organizational performance. Such performance is often measured via two profit-statement effects: top-line growth and bottom-line profitability. Companies that grow the top line while keeping costs in line so that margins are at or above industry averages tend to perform well over time. Our final hypothesis tests the relationship between our value-creation indicators (customer satisfaction and productivity) and overall organizational performance.

Hypothesis 5: *A firm's value-creation capability as measured by customer satisfaction and productivity is positively related to organizational performance as measured by profitability and market growth.*

The Evolution of a Collaboration Orientation over Time

As noted in the introduction, one of the goals of this research is to assess whether, over time, companies are learning to collaborate and improve their ability to create value across organizational boundaries. Specifically, although Constituency and Resource-based theories are the foundation for the conceptual model, Resource-Advantage (R-A) Theory raises an additional and very important question (Hunt and Davis, 2008). R-A theory extends RB theory by looking at it through the lens of heterogeneous-demand theory. In essence, R-A theory evaluates how the process of competition contributes to organizational learning, emphasizing the importance of innovation and learning in the creation and maintenance of inimitable competencies. From this perspective, R-A theory raises the question, If a collaboration orientation influences competence development, has the competitive process led companies to learn how to collaborate more effectively? By collecting data at two different points in time, our study provides a unique opportunity to examine this question.

Given the recent emphasis on cross-functional as well as supply chain collaboration, we expect to find that collaboration orientation has strengthened in recent years. However, it is not clear how increased collaboration orientation would affect the other relationships in the proposed model, including the relative strength of functional orientations over time. Further, the myriad factors that affect overall firm performance in a dynamic marketplace make it difficult to hypothesize how changing orientations influence performance over time. We therefore approach this aspect of the study from an exploratory perspective.

Research Methods

Survey Data Collection

The cross-functional and inter-organizational nature of a collaboration orientation together with the desire to perform the study at different intervals over time required careful and consistent selection of the survey's key informants. The preliminary interviews and advisory board

discussions suggested that participants be limited to senior-level managers with broad organizational accountability, cross-functional interactions, and access to overall firm-level performance data.

In each time period, the mailing list was compiled with the assistance of three supply chain oriented professional associations: the Council for Supply Chain Management Professionals, the Institute for Supply Management, and APICS. Working with each association, senior-level managers (e.g., *director, vice-president, CEO, etcetera)* were randomly selected from industries actively involved in SCM. The random samples Periods 1 and 2 were designed to mirror each other in terms of geography, industry, and management position. The research team then went through each list to remove contact information for managers who did not meet the selection criteria. This process yielded a list of seasoned managers who were likely to have experience 1) with the challenges of managing across functional silos and 2) as members of cross-functional and supply chain teams.

Table 1
Survey Response Rates

	Period 1			**Period 2**		
Professional Association	Completed Surveys	Response Rate	*Percent of Total P1 Sample*	Completed Surveys	Response Rate	*Percent of Total P2 Sample*
APICS	171	12.1%	*36%*	159	17.9%	*31%*
ISM	138	10.6%	*29%*	156	19.0%	*31%*
CSCMP	166	11.6%	*35%*	190	19.3%	*38%*
Overall	475	11.4%	*100%*	505	16.7%	*100%*

In both time periods, the survey process followed Dillman's Total Design Method; that is, three mailings of a cover letter, an instruction sheet, and the survey. To increase the response rate, pre-notification phone calls were made to invite managers to participate. Managers were also offered a copy of the study findings and the opportunity to be entered into a drawing for one of several iPod Nanos. Overall, 980 usable surveys were returned for a response rate of 14.13%. Table 1 provides detailed response rates broken down by time period and professional organization. Importantly, the relative sample sizes and proportions from each of the three professional associations were consistent across the two time periods suggesting sample equivalence. Further, an independent t-test was performed on the control variable of firm size as measured by number of employees. No significant difference was found, which again indicates sample comparability.

Non-response bias was evaluated in both time periods. Two methods were used. First, a comparison of early versus late responses revealed no problematic response patterns (Armstrong and Overton, 1977). Second, to more clearly verify that the respondents and non-respondents were not uniquely different, the demographic profiles of the two groups were compared. In Period 1, because responses were anonymous, we called managers on the mailing list until we had spoken with 300 non-respondents (100 from each managerial group) to ask why they had not participated and to gather basic demographic data so that respondent and non-respondent profiles could be compared. Interestingly, three primary reasons were given for not participating: 1) managers were too busy to spend time filling out surveys, 2) they received so many surveys that it no longer made sense to participate, and 3) their companies

had instituted policies against survey participation. No significant differences in demographic profile were found. Finally, non-respondent managers were also asked to respond to the first question on the survey, which examined managerial perceptions of the importance of supply chain management strategies. No significant differences were found between respondents and non-respondents.

In Period 2, respondents were tracked so that mailing and survey administration costs could be minimized. Non-respondents could also therefore be identified. Demographic profiles for 100 randomly selected non-respondents were developed using Dun and Bradstreet databases. These profiles were compared to those of the respondents. No significant differences were found.

Finally, since respondents from different associations may have different functional perspectives based on their training and experience, we needed to verify that the survey responses could be pooled for data analysis. Therefore, invariance of the structural weights was tested within a multi-group Structural Equation Model (SEM). That is, a multi-group SEM was constructed to test for variability in the estimated marginal effects associated with each of the three sample groups for each time period. The baseline model allowed effects to vary across groups and periods. Each estimated marginal effect was then constrained to be equal across the three groups and a Chi-Square CMIN difference test was conducted to determine if the fit of each constrained (nested) model differed significantly from that of the unconstrained (reference) model. For example, in one test the direct effect of customer orientation on productivity in the first period was held equal across all three groups. The fit of this constrained model was compared to that of the baseline model in which the unique effect of customer orientation on productivity was estimated in that period for each of the sample groups. The individual tests are conservative since they are not adjusted for multiple comparisons. Results showed no significant difference between the various constrained models and the unconstrained model at $p < .01$. Together, the balanced composition of the overall sample and the results of Chi-Square difference tests provided sufficient justification to pool survey responses from all three groups.

Analysis: Construct Evaluation and Model Fit

To test the hypothesized relationships, survey questions, and subsequently, constructs were developed based on the literature review and feedback from the advisory board. Table 3 reports descriptive statistics for the purified constructs as well as the individual measures that comprise them. The Bonferroni adjusted *p*-values for multiple independent-sample *t*-tests of mean differences across samples reveal that companies are making significant improvements in the areas of *External Collaboration*, *Customer Satisfaction*, *Productivity*, and *Profitability*. No significant change in construct score was found for *Firm Growth*, *Internal Collaboration Orientation*, and *Supplier Orientation*. Interestingly, the *Customer Orientation* score decreased significantly. We comment in detail on changes in construct scores below. Standardized measures were used in the confirmatory factor analysis (CFA) and structural modeling (SEM).

Table 3
Descriptive Statistics: Means and Differences Across Periods

Questions/Measures	P1 [n=475] Mean (SD)	P2 [n=505] Mean (SD)	Sig. Diff.*
Orientations:[1]			
Customer Orientation[2]	**5.36 (1.06)**	**5.09 (1.08)**	**0.00**
My firm is flexible in terms of accommodating customers' special requests	5.49 (1.23)	5.44 (1.19)	1.00
My firm uses dedicated customer account teams to support its best customers	5.36 (1.39)	5.08 (1.58)	0.01
My firm aggressively and frequently solicits customer feedback	5.23 (1.31)	4.71 (1.50)	0.00
Supplier Orientation[1]	**4.38 (1.13)**	**4.42 (1.25)**	**0.57**
My firm aggressively shares resources to help suppliers improve their capabilities	3.69 (1.47)	4.20 (1.39)	0.00
Supplier performance is closely monitored and is the basis for future business	4.62 (1.39)	4.59 (1.46)	1.00
Supplier scorecards are used to communicate expectations for performance levels	4.83 (1.40)	4.47 (1.73)	0.00
External Collaboration Orientation[1]	**4.17 (1.26)**	**4.78 (1.04)**	**0.00**
Frequent, open information sharing among supply chain members	4.59 (1.57)	5.21 (1.22)	0.00
Efforts to establish common goals among supply chain members	4.30 (1.58)	4.84 (1.30)	0.00
Senior level managerial interaction among supply chain members	4.20 (1.65)	4.77 (1.45)	0.00
Sharing of technical expertise with customers and suppliers	4.24 (1.41)	4.79 (1.26)	0.00
A defined and accepted approach to sharing risks and rewards	3.83 (1.58)	4.40 (1.37)	0.00
Use of clear guidelines to manage supply chain relationships	3.85 (1.56)	4.65 (1.37)	0.00
Internal Collaboration Orientation[1]	**4.38 (1.00)**	**4.44 (1.08)**	**0.37**
Information applications are highly integrated w/in the firm & the supply chain	3.45 (1.41)	3.78 (1.49)	0.00
Middle managers are more empowered to make operating decisions than 5 years ago	4.70 (1.41)	4.50 (1.46)	0.14
More process oriented performance measures are tracked today than 5 years ago	5.08 (1.33)	4.99 (1.36)	1.00
Our company culture promotes collaboration across functional areas	4.54 (1.17)	4.40 (1.50)	0.50
Workers are more empowered to make operating decisions than 5 years ago	4.11 (1.40)	4.52 (1.41)	0.00
Mediators: Value Creation and Delivery			
Productivity[3]	**4.10 (1.10)**	**4.31 (1.01)**	**0.02**
Cost of purchased items	4.57 (1.46)	4.58 (1.30)	1.00
Overall product and supply chain costs (productivity)	4.34 (1.20)	4.59 (1.15)	0.01
Overall product quality	4.14 (1.48)	4.32 (1.38)	0.22
New product development capability (e.g., cost, time, uniqueness)	3.61 (1.35)	3.93 (1.45)	0.00
Transportation Costs	3.87 (1.56)	4.13 (1.35)	0.03
Customer Satisfaction[4]	**4.66 (1.24)**	**4.86 (1.07)**	**0.08**
Responsiveness to customer requests or unexpected challenges	4.68 (1.36)	4.86 (1.18)	0.09
On-time delivery/Due-date performance	4.67 (1.45)	4.81 (1.31)	0.31
Overall customer satisfaction	4.64 (1.36)	4.90 (1.16)	0.00
Outcomes: Business Performance			
Firm Growth[3]	**4.87 (1.13)**	**4.91 (1.06)**	**0.52**
Sales growth in the last three years	4.98 (1.31)	5.02 (1.19)	1.00
Market share growth in the last three years	4.85 (1.30)	4.90 (1.19)	1.00
Growth in Return on Assets (ROA) in the last three years	4.77 (1.28)	4.82 (1.21)	1.00
Profitability[3]	**4.50 (1.37)**	**4.65 (1.20)**	**0.02**
Firm profitability	4.50 (1.37)	4.65 (1.20)	0.08

* T-Tests assume equal variance. Bonferroni p-value adjustments applied to raw measures within constructs. P-values for summated construct are unadjusted.
[1] Mean (SD) for composite measures calculated for summated constructs.
[2] Indicate the extent to which you agree with each of the following statements as they relate to your firm's supply chain: (1=Strongly Disagree; 7=Strongly Agree).
[3] To what extent has SC integration improved your firm's performance in the following areas? (1= Not a Facilitator; 7=Effective Facilitator)
[4] Indicate your firm's position relative to leading competitors in your primary industry along the following dimensions: (1=Much Less; 7=Much Greater)

Construct Evaluation

Construct acceptability was evaluated using reliability/validity tests proposed by Fornell and Larcker (1981). Table 4 reports the key statistics. First, the Composite Reliability Rho was calculated to assess construct reliability. Thirteen of the 14 reliability scores exceeded the recommended threshold of .70. The one exception was *Customer Orientation* in Period 2 (.62).

Table 4
Factor Loadings and Measurement Properties of Predictive Latent Constructs and Summated Indices

Construct / Item	CFA Std. Loadings		Average Variance Extracted		Reliability ρ		Average Variance Shared γ^2	
	P1	P2	P1	P2	P1	P2	P1	P2
Market Orientation								
Customer Orientation			**0.50**	**0.36**	**0.75**	**0.62**	**0.11**	**0.24**
My firm is flexible in terms of accommodating customers' special requests	0.75	0.52						
My firm uses dedicated customer account teams to support its best customers	0.63	0.58						
My firm aggressively and frequently solicits customer feedback	0.73	0.68						
Supplier Orientation			**0.50**	**0.53**	**0.75**	**0.77**	**0.25**	**0.29**
My firm aggressively shares resources to help suppliers improve their capabilities	0.52	0.61						
Supplier performance is closely monitored and is the basis for future business	0.78	0.85						
Supplier scorecards are used to communicate expectations for performance levels	0.79	0.71						
External Collaboration Orientation			**0.59**	**0.54**	**0.90**	**0.88**	**0.25**	**0.16**
Frequent, open information sharing among supply chain members	0.75	0.72						
Efforts to establish common goals among supply chain members	0.82	0.78						
Senior level managerial interaction among supply chain members	0.71	0.66						
Sharing of technical expertise with customers and suppliers	0.72	0.67						
A defined and accepted approach to sharing risks and rewards	0.79	0.77						
Use of clear guidelines to manage supply chain relationships	0.81	0.81						
Internal Collaboration Orientation			**0.45**	**0.46**	**0.80**	**0.81**	**0.26**	**0.28**
Information applications are highly integrated w/in the firm & the supply chain	0.54	0.57						
Middle managers are more empowered to make operating decisions than 5 years ago	0.68	0.75						
More process oriented performance measures are tracked today than 5 years ago	0.67	0.68						
Our company culture promotes collaboration across functional areas	0.76	0.65						
Workers are more empowered to make operating decisions than 5 years ago	0.70	0.75						
Operational Performance								
Productivity			**0.54**	**0.48**	**0.85**	**0.82**	**0.30**	**0.31**
Cost of purchased items	0.65	0.71						
Overall product and supply chain costs (productivity)	0.89	0.83						
Overall product quality	0.76	0.67						
New product development capability (e.g., cost, time, uniqueness)	0.74	0.69						
Transportation Costs	0.61	0.55						
Customer Satisfaction			**0.69**	**0.66**	**0.87**	**0.85**	**0.31**	**0.32**
Responsiveness to customer requests or unexpected challenges	0.83	0.76						
On-time delivery/Due-date performance	0.81	0.81						
Overall customer satisfaction	0.85	0.86						
Business Performance								
Growth			**0.68**	**0.71**	**0.86**	**0.88**	**0.03**	**0.08**
Sales growth in the last three years	0.92	0.92						
Market share growth in the last three years	0.93	0.93						
Growth in Return on Assets (ROA) in the last three years	0.59	0.64						
Profitability (Single item construct omitted from CFA)								

χ^2 (d.f.) = 1789.294 (658); N =1182; CFI = .92; IFI = .92
N Period 1 (P1) = 475, N Period 2 (P2) = 505
NCP (90% CI) = 113.294 (1009.358 – 1260.855)
RSMEA (90% CI) = .042 (.040 - .044)
All loadings significant at p < .001
Reduced Balanced Dataset

Table 5
Coefficients for Nomological Relationships
Market Orientations, Mediating Effects and Business Performance

Variables	Period 1		Period 2		χ2 Difference P1 vs. P2	R^2	
	Estimate	Significance	Estimate	Significance		P1	P2
Unmediated Model:							
Customer Orientation ⇨ Productivity	0.00	ns	0.10	p ≤ .05	p = .10	***0.27***	***0.28***
Supplier Orientation ⇨ Productivity	0.51	p ≤ .01	0.38	p ≤ .01	p ≤ .05		
Customer Orientation ⇨ Satisfaction	0.18	p ≤ .01	0.14	p ≤ .01	ns	***0.54***	***0.48***
Supplier Orientation ⇨ Satisfaction	0.11	p ≤ .05	0.14	p ≤ .01	ns		
Productivity ⇨ Satisfaction	0.71	p ≤ .01	0.56	p ≤ .01	p ≤ .01		
Productivity ⇨ Profitability	0.72	p ≤ .01	0.76	p ≤ .01	ns	***0.51***	***0.52***
Satisfaction ⇨ Profitability	0.19	p ≤ .01	0.13	p ≤ .01	ns		
Productivity ⇨ Growth	0.05	ns	0.22	p ≤ .01	p = .05	***0.04***	***0.10***
Satisfaction ⇨ Growth	0.15	p ≤ .01	0.14	p ≤ .01	Ns		
Mediated Model (Structural Level):							
Customer Orientation ⇨ Productivity	-0.14	p ≤ .01	-0.10	ns	ns	***0.49***	***0.44***
Supplier Orientation ⇨ Productivity	0.09	ns	0.07	ns	ns		
Collaboration Orientation ⇨ Productivity	0.82	p ≤ .01	1.15	p ≤ .01	ns		
Customer Orientation ⇨ Satisfaction	0.06	ns	-0.06	ns	p = .10	***0.62***	***0.62***
Supplier Orientation ⇨ Satisfaction	-0.10	ns	-0.11	ns	ns		
Collaboration Orientation ⇨ Satisfaction	0.64	p ≤ .01	1.30	p ≤ .01	p ≤ .05		
Productivity ⇨ Satisfaction	0.47	p ≤ .01	0.31	p ≤ .01	ns		
Productivity ⇨ Profitability	0.72	p ≤ .01	0.76	p ≤ .01	ns	***0.51***	***0.52***
Satisfaction ⇨ Profitability	0.19	p ≤ .01	0.13	p ≤ .01	ns		
Productivity ⇨ Growth	0.05	ns	0.22	p ≤ .01	p = .05	***0.04***	***0.10***
Satisfaction ⇨ Growth	0.15	p ≤ .01	0.14	p ≤ .01	ns		
Mediated Model (Measurement Level):							
Collaboration Orientation ⇨ External Collaboration	1.00 (Fixed)		1.00 (Fixed)			***0.52***	
Collaboration Orientation ⇨ Internal Collaboration	.78	p ≤ .01	1.35	p ≤ .01	p ≤ .01		

Unmediated Model:
χ2 (d.f.) = 59.419 (10)
N Period 1 = 475, N Period 2 = 505
CFI = .975, IFI = .975;
NCP (90% CI) = 49.419 (28.797 – 77.545)
RMSEA (90% CI) = .071 (.054 - .089)

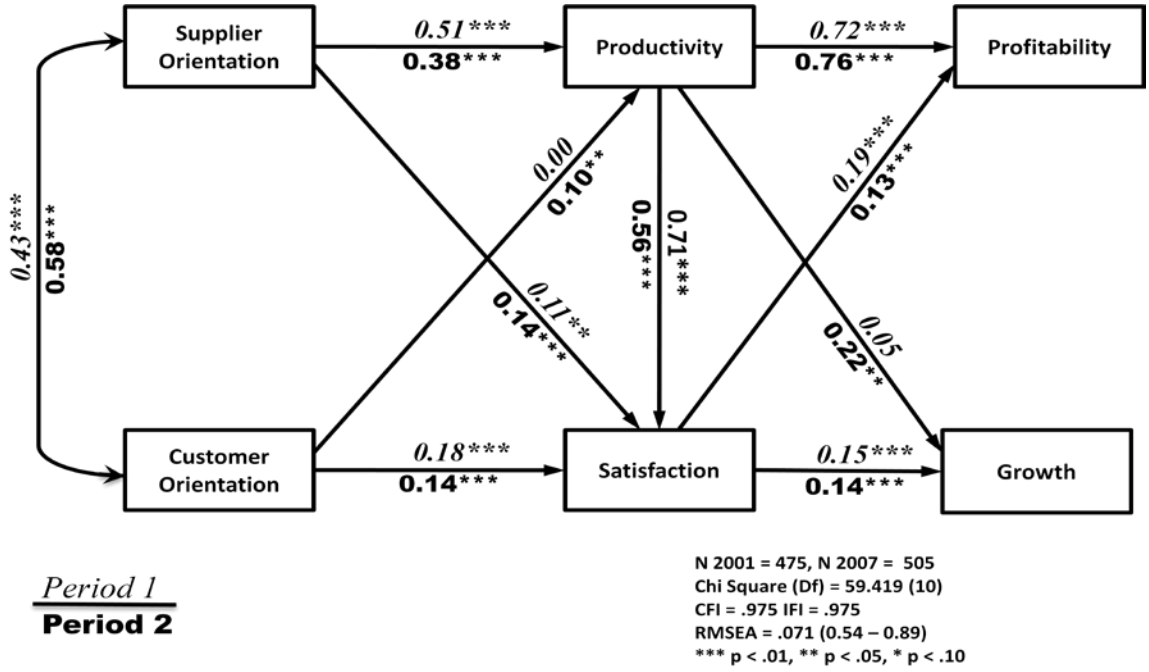
Mediated Model:
χ2 (d.f.) = 84.467 (24)
N Period 1 = 475, N Period 2 = 505
CFI = .979, IFI = .979;
NCP (90% CI) = 60.467 (36.170 – 92.355)
RMSEA (90% CI) = .051 (.039 - .063)

Of note, scores above .60 are considered acceptable for exploratory research (Nunnally 1978; Churchill 1979). Given *Customer Orientation's Rho* score of .75 in Period 1, the lower Period 2 reliability does not appear to be sufficiently low to affect interpretation of the results.

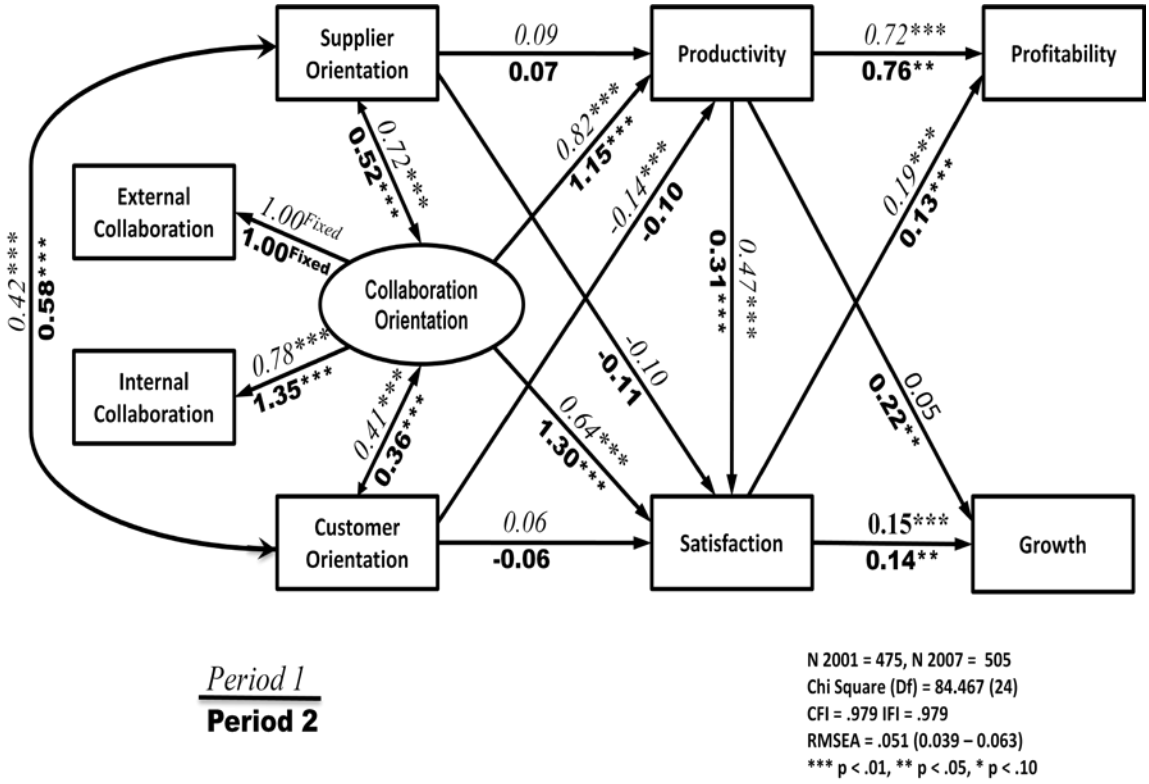
Second, Confirmatory Factor Analysis (CFA) was used to evaluate construct validity. The standardized loadings were all significant and relatively large, exceeding the .50 threshold. Likewise, the average variance extracted exceeds .50 for 10 of the 14 constructs. The exceptions were *Customer Orientation* in Period 2 (.36), *Internal Collaboration Orientation* in both time periods (P1=.45; P2=.46), and Productivity in Period 2 (.48). However, the average shared variance scores were all relatively small and did not exceed average variance extracted for any of the modeled constructs. Moreover, the overall CFA model statistics (CFI = .92, IFI =

Figure 2
Estimated Model of Organizational Orientations, Value Creation, and Firm Performance

Panel A: Unmediated Model



Panel B: Mediated Model



.92 and RSMEA = .04) suggest that the construct structure fits the data well. To summarize, the constructs are theoretically unique and possess good reliability as well as adequate convergent and discriminant validity. We can be reasonably confident that the measured items reflect the theoretical constructs they are designed to measure. Further, the use of rigorous tests to establish convergent and discriminant validity that show the factors to be distinct and unique allows us to conclude that common methods bias does not unduly affect the interpretability of the findings (Podsakoff, MacKenzie, Lee, and Podaskoff, 2003).

Model Fit and Estimates

To test the hypothesized relationships across the two time periods, a set of multi-group Structural Equation Models (SEM) was used. Results of the analysis are reported in Table 5 and shown graphically in Figure 2. The proposed unmediated model fits the data well (CFI = .98, IFI = .98, RMSEA = .07). To test the mediation effect of collaboration on value creation, the latent collaboration construct was included in the estimation (see Panel B in Figure 2). The proposed mediated model also fits the data well (CFI = .98, IFI = .98, RMSEA = .05). Chi Square differences between the mediated and unmediated models were highly significant (CMIN = 863.382, 12 d.f., $p < .001$), validating the importance of specifying a latent collaboration orientation within the model. A comparison of the models for both periods clearly shows *Supplier Orientation* and *Customer Orientation* effects on Productivity and Satisfaction to be mediated through the *Collaboration Orientation*. Finally, differences in each of the hypothesized relationships within the model (as measured by the β coefficient) were evaluated across periods evaluated using a Chi-Square difference tests. P-values from the tests are reported in Table 5. Four of the reported effects differ significantly from Period 1 to Period 2. All other effects are consistent across periods.

Discussion of Hypotheses

Customer Orientation's Influence

Hypothesis 1 examined the relationship between a firm's customer orientation and its value-creation capability as measured by satisfaction and productivity. The unmediated models in both periods show that *Customer Orientation* is positively and significantly related to *Satisfaction* (see Panel A in Figure 2). The strength of the relationship is remarkably stable across the two periods (β= .18 in Period 1 $p < .01$ versus β= .14 in Period 2 $p< .01$). This is particularly noteworthy given the significant decrease in *Customer Orientation* over time (5.36 to 5.09; p = 0.00). Apparently, a threshold for *Customer Orientation* exists. As long as companies surpass this threshold, they achieve relatively high levels of customer satisfaction as measured by their internal systems. In fact, the mean *Satisfaction* score increased significantly from Period 1 to Period 2 (4.66 to 4.86; p = .08). We should note that the construct for *Customer Orientation* obtained the highest means of all the constructs evaluated in both time periods.

Customer Orientation's influence on *Productivity* is more subtle and less consistent over time. In Period 1, no significant relationship existed (β= .00; p = ns). However, the relationship strengthened somewhat over time such that by Period 2, *Customer Orientation* exerted a positive and significant influence on *Productivity* (β= .10, $p < .05$). It is interesting to observe that the strengthened relationship emerges as the *Customer Orientation* score

weakens. Indeed, the *Productivity* score actually increases in the presence of a slightly lower *Customer Orientation* (4.10 to 4.31; $p < .05$). This finding appears to confirm the belief that too much customer focus can create chaos and diminished productivity in the supply side of an organization.

Supplier Orientation's Influence

Hypothesis 2 assessed the relationship between a firm's supplier orientation and its value creation capability as measured by satisfaction and productivity. Not surprisingly, as shown in Panel A of Figure 2, *Supplier Orientation* has a strong, positive influence on *Productivity* in both time periods ($\beta = .51$, $p < .01$; $\beta = .38$, $p < .01$). The surprise is that the strength of the relationship appears to be diminishing. However, because the change in β-coefficient is not significant, data needs to be collected at a future point to verify the existence of a meaningful trend. *Supplier Orientation's* influence on *Satisfaction* is slightly different: the relationship is significant in both time periods, but the magnitude of the β-coefficient has increased slightly ($\beta = .11$, $p < .05$; $\beta = .14$, $p < .01$). This possible trend also merits future assessment.

Collaboration Orientation's Influence

Hypothesis 3 evaluated the relationship between a firm's collaboration orientation and its value creation capability as measured by customer satisfaction and productivity. The *Collaboration Orientation* construct was operationalized as a latent construct comprising two observable indicators: *External Collaboration* and *Internal Collaboration*. Of note, the *Internal Collaboration* score remained consistent across the two time periods (mean = 4.38, rank = 5 in Period 1 compared with mean = 4.42, rank = 6 in Period 2). By contrast, the *External Collaboration* score increased dramatically and significantly over time. The increase of .61 from 4.17 to 4.84 ($p = 0.00$) was the largest change among the eight measured constructs (rank = 6 in Period 1; rank = 4 in Period 2). The responses clearly suggest that establishing the mechanisms to share information, mitigate conflicts, and collaborate across organizational boundaries is difficult; many companies find it easier to build collaborative mechanisms with supply chain partners than it is to build them between functions within their own organizations.

Focusing on the hypothesized relationships, Panel B in Figure 2 shows that *Collaboration Orientation* is positively and significantly related to both *Satisfaction* and *Productivity*. *Collaboration Orientation's* influence on *Productivity* ($\beta = .82$, $p < .01$) in Period 1 is somewhat stronger than on *Satisfaction* ($\beta = .64$, $p < .01$). Over time, both of these relationships strengthen: *Productivity* ($\beta = 1.15$) and *Satisfaction* ($\beta = 1.30$). These are the largest β-coefficients in the structural models, suggesting that a *Collaboration Orientation* is increasingly important to a company's value-creation capability and that managers must embrace the challenge of removing barriers to more effective collaboration identified above.

Collaboration's Mediating Role

Hypothesis 4 suggested that a collaboration orientation mediates the relationship between functional orientations and value creation. This mediation effect was analyzed by comparing the differences in the relationships between the functional orientations and value

creation, with and without the collaboration orientation included in the model (compare Panels A and B in Figure 2). In Panel A, the *Collaboration Orientation* paths are constrained to zero. In Panel B, the *Collaboration Orientation* construct is allowed to enter the analysis. The constrained and unconstrained models are significantly different, indicating a need to evaluate the mediating role of collaboration (CMIN = 863.382, 12 d.f., $p < .001$).

The results displayed in Figure 2 confirm the importance of a strong collaboration capability. In Period 1, significant relationships exist between both *Customer Orientation* and *Supplier Orientation* and *Collaboration Orientation* ($\beta = .41$, $p < .01$; $\beta = .72$, $p < .01$ respectively). *Collaboration Orientation* in turn fully mediates *Customer Orientation's* relationship with both *Satisfaction* and *Productivity*. The β-coefficient for the *Satisfaction* relationship falls to .06 while the β-coefficient for *Productivity* actually becomes negative, suggesting a counterproductive influence on internal and upstream productive processes. *Collaboration Orientation* plays a similar mediation role with *Supplier Orientation*. The β-coefficient for the *Productivity* relationship falls to 0.09 while the β-coefficient for *Satisfaction* becomes negative. In Period 2, these basic relationships remain consistent. The analyses suggest that investing in a multi-faceted collaboration capability is critical to harnessing and meshing together the deep skills engendered through *Customer* and *Supplier Orientations* in the quest to create superior levels of unique value. One final analytical note: comparing the Period 1 and 2 models reveals that *Collaboration Orientation* is increasingly influenced by internal collaboration initiatives rather than external mechanisms (see Table 5). Given *Internal Collaboration's* low scores across both time periods, more managerial effort needs to focus on mitigating functional conflicts in order to promote higher levels of cross-functional collaboration.

Value Creation and Business Performance

Our final hypothesis, Hypothesis 5, explored the relationship between the operational performance constructs *Satisfaction* and *Productivity* and firm performance as measured by *Profitability* and *Growth*. *Satisfaction* exerts a consistent positive influence across both *Profitability* (Period 1: $\beta = .19$, $p < .01$; Period 2: $\beta = .13$, $p < .05$) and *Growth* (Period 1: $\beta = .15$, $p < .01$; Period 2: $\beta = .14$, $p < .05$). *Productivity's* influence on firm performance manifests itself primarily through a strong, positive, and highly significant relationship with *Profitability*. This relationship is consistent across both time periods (Period 1: $\beta = .72$, $p < .01$; Period 2: $\beta = .76$, $p < .01$). However, although *Productivity* is not statistically related to *Growth* in Period 1, by Period 2 *Productivity* had begun to drive *Growth* at a moderate level (Period 1: $\beta = .05$, $p <$ ns; Period 2: $\beta = .22$, $p < .01$). This change in relationship may be the result of a shift in marketplace values. Finally, to validate our implied assumption that the functional and collaboration orientations' effect on firm performance is fully mediated by productivity and satisfaction, we tested the model with direct effect paths between the orientations and firm performance constructs. The direct paths were all insignificant.

To summarize, strong functional and collaboration orientations are important to firm performance. Of note, many of the relationship results did not change remarkably over time, suggesting that 1) the samples were comparable and 2) the model itself is a good reflection of the constructs and relationships. The cross-sectional study across time periods revealed that companies are building their collaboration capabilities and achieving greater

balance across customer and supplier orientations. This finding suggests that although strong functional orientations are important, it is possible for them to be too strong. When this occurs, decision-making myopia may lead to counterproductive outcomes. Evidence for this idea emerged from the fact that even though the mean score for *Customer Orientation* decreased significantly over time, its impact on *Productivity* actually increased.

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Involving Suppliers in New Product Development: Coordination Fit, Goal Congruence and Collaboration Quality

Tingting Yan, Doctoral Candidate
Arizona State University
831-295-4120, tingting.yan@asu.edu

Kevin Dooley, Professor
Arizona State University
480-236-9588, Kevin.Dooley@asu.edu

Abstract. Original equipment manufacturers (buyers) are increasingly involving component suppliers in new product development as a means to be efficient and expand capabilities. To realize such benefits, however, both *incentives* and *actions* of the buyer and supplier need to be aligned. This study draws from Information Process Theory to propose that there is an optimal level of procedural coordination that maximizes design performance, i.e. higher task interdependency requires more procedural coordination. The positive effects of goal congruence on design performance are built upon team/group management literature and agency theory. Finally we use Hackman's theory of work group effectiveness to propose that collaboration quality, an *emerging* state, mediate the effects of coordination fit and goal congruence, two organizational d*esign* factors. Theoretical contributions, practical implications and future directions are discussed.

Keywords. new product development, supplier involvement, work group effectiveness, procedural coordination, goal congruence, collaboration quality

1. Introduction. More and more original equipment manufacturers (OEMs, referred to as buyers in the remaining text) are starting to involve their component suppliers (referred to as suppliers in the remaining text) in NPD projects. This practice is found to be one of the key differentiators between leaders and lagging companies in the midst of the recent economic crisis in the North America automobile industry (Harbour-Felax, 2009). Supplier involvement in product development has commonly been defined as the extent to which a buyer organization shares responsibility with a supplier organization for the development and design of subsystems (or components) of a new product (Takeishi, 2001). Suppliers could provide innovative product or process technologies that are critical to the novelty of the final product (Swink and Mabert 2000, Handfield et al. 1999, Azadegan et al. 2008). This type of arrangement gives OEMs access to skills they may not have in-house and allows them to leverage scarce engineering talent, in addition to shorter development cycle time. Suppliers may benefit from assured demand and the chance to develop specialized expertise. Outsourcing product design has helped companies like IBM, HP and Motorola to freeze their R&D budgets by making use of supplier-developed concepts (Koch, 2005). In addition, suppliers may provide information regarding their manufacturing process capability, which should be integrated into product design from the outset to ensure high product manufacturability (Swink 1999).

To realize such benefits, however, both *incentives* and *actions* of the buyer and supplier need to be aligned. Goal congruence, the extent to which a buyer and a supplier perceive the

possibility of common goal achievement, is an indicator of incentives alignment (Jap 1999). On one hand, both positive effects of goal congruence (Zeng and Chen 2003, et al.) and negative effects of goal conflicts (Park and Ungson 2001, et al.) have been identified by the literature. On the other hand, benefits associated with a mediate level of goal incongruence, in terms of maximizing problem solving capability, have also been found (Weick 1979, Thomsen 1998). In the context of buyer-supplier product design, Peterson et al. (2003) found that inter-firm agreements on key targets improve project team effectiveness. However, such firm-level agreements are not the same as group-level goal congruence. Thus it is still not clear whether goal congruence between two groups of people, one group representing one firm, is effective or counter-productive in improving project outcomes. This study attempts to fill this gap by examining effects of inter-firm goal congruence on project performance, mediated by collaboration process effectiveness.

Aligned actions are realized through procedural coordination, defined as the day-to-day exchange of information between employees from two firms (Doz, Hamel and Prahalad, 1989:136, Sobrero and Schrader 1998). Some studies found that frequent information sharing lowers transaction costs (Dyer 1997), enables inter-organizational collaboration (Chae et al. 2005), improves both buyers' and suppliers' performances (Cai et al. 2006, Sanders 2007, Peterson et al. 2003), increases project success rates (Baltontin et al. 1999), and improves design quality (Takeishi 2001, Jayaram 2008). Some other studies, however, found that communication frequency and intensity are either not significant predictors of better performance (Kahn 1996, Hoegl et al. 2004, Hartley et al. 1997) or negatively (Hoegl et al. 2004) or curvilinearly (Hoegl and Wagner 2005) associated with performance. Not only differing in frequency, procedural coordination mechanisms also varies on richness of media, ranging from electronically mediated to face-to-face communication (Sobrero and Schrader 1998). Antioco et al.(2008) found that communication channels and information content affects the information use of product designers, which ultimately affect design performance. The literature, however, doest not tell us how procedural coordination should be properly structured, in terms of at the right frequency and using the right media, to maximize performance of a project involving a buyer and a supplier. This study, adopting the information processing theoretic perspective, proposes that coordination mechanisms should structurally fit the inter-firm task structure in order to be both effective and efficient.

In addition to be aligned in incentives and actions, the effectiveness of the collaboration process, or collaboration quality, is also a key factor in affecting group performance (Zeng and Chen 2003, Das and Teng 1998, Kahn 1996, Gomes et al. 2003, etc.). Three main indicators of a high quality collaborating process are: high quality communication, mutual supports and commitments ((Hackman 1987, Campion et al. 1993, Gray 1985, 1989, Wood and Gray 1991, Amabile et al. 2001, Jassawalla and Sashittal 1998, Tjosvold 1984, 1995). An effective collaboration process exhibits high values on all the three dimensions. Hoegl and Wagner (2005), for the first time, studied collaboration quality as a single construct measured by all the three indicators. They found that high collaboration quality improves NPD project outcomes, after controlling for the curvilinear effects of communication frequency and intensity. It is not clear, however, what factors contribute to the emergence of a high quality process when a buyer and a supplier collaborates on product design.

Although the literature implies the importance of inter-firm alignment in action and incentives as well as a high quality collaboration process, the discussion is generally scattered and

disorganized. A systematic investigation of the relationship among inter-firm action and incentive alignment, collaboration quality and NPD project performance is lacking. We fill this gap by answering four research questions, in the context of buyer-supplier product design, adopting Hackman's work group effectiveness theory (Hackman 1987):

(1) Is more procedural coordination between a buyer group and a supplier group always better, or could procedural coordination be too much?
(2) What are the effects of inter-firm goal congruence on NPD project performance?
(3) What are the effects of inter-firm collaboration quality on NPD project performance?
(4) Does collaboration quality fully or partially mediate the effects of coordination fit and goal congruence on NPD project performance?

With this study we contribute to the literature by studying the causal relationships between inter-organizational *design* factors and *emerging* process characteristics. Specifically we proposed that over-coordination, a situation where the coordination mechanisms provides more than necessary information processing capacity, lowers project process efficiency without improving design quality. Adopting a dyadic perspective, we propose that the *match* between two firms in both actions and incentives is an important project success factor. Specifically, the match in both activities and incentives helps building a high quality collaboration process. Finally we extend Hackman's work group effectiveness theory to an inter-organizational product design context for the first time.

2 Research Context and Scope.

2.1 Problem Context and Unit of Analysis. The research questions are studied in a context where OEMs, as buyers, involve their suppliers into the detailed design phase of NPD projects. According to Ulrich (1995)'s four-stage model for NPD projects, the detailed engineering phase is after the concept development and system-level design and before product text and refinement This stage is mainly concerned with the process of developing a fully defined product design from a clear set of requirements while creating deliverables and documentation appropriate for product manufacturing.

The unit of analysis is a buyer group-supplier group (BG-SG) dyad, in the context of a project to complete a component's detailed design (Figure 2-1). Each dyad is composed by two groups of people, one group from one firm. The two groups assume different types and levels of design responsibilities. The buyer group may or may not be directly involved in the core design work for a component. It is, however, always responsible for making sure that the component design fits into the whole product and is manufacturable. The supplier group is always actively involved in the core design job for a component. Production for the component could be either done internally by the buying firm, or outsourced to the same supplying firm who is involved in design, or to a third-party contractor.

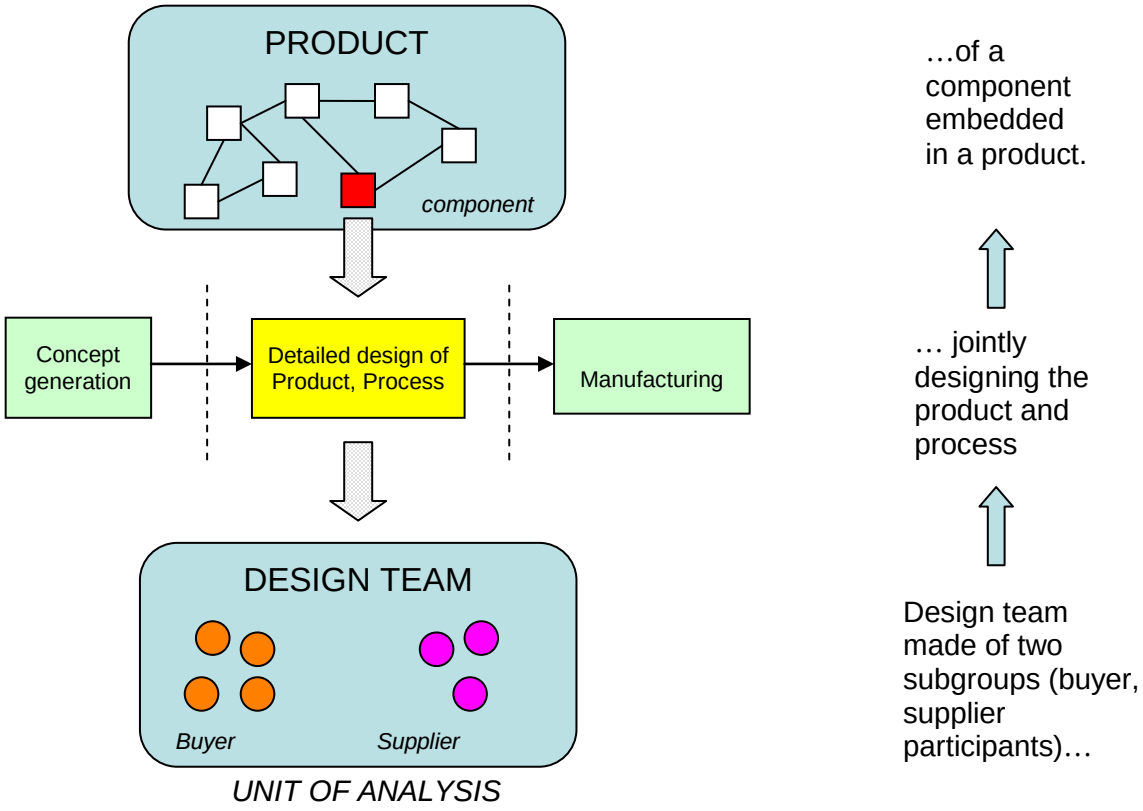

Figure 2-1 Problem context and scope

2.2 Component, Work Group, Task Interdependency and Design Performance. In this study a component is defined as a product unit of which a single supplier is involved in the majority of value-added activity in the design process. Thus one component only involves one buyer-supplier dyad, as one work group. For example, if two suppliers are involved in the design of an automobile door, one working on the electronic control part and one working on the body design part, then the door, instead of being one single component, is treated as two components, each of which involves only one supplier. Thus each component suggests one BG-SG dyad, which is the unit of analysis in this study. Multiple dyads, each of which works on a different component, may share one common supplier.

In the detailed engineering phase of a NPD project, a work group is composed by engineers and other professionals from both firms, designing the same component. According to Hackman and Wageman (2005)'s definition, this set of people can be distinguished reliably from other people in the project due to their common task. Each engineer has specialized roles within the group and is interdependent on each other in performing individual tasks. They, as a collective, operate in the larger social system: the whole project. What is unique about a work group studied in this study is there are two sub-groups,one sub-group representing the buying firm's participants and one sub-group representing the supplier firm's participants. The two sub-groups are interdependent on each other to deliver a component design that (1) fits into the overall product architecture, (2) fits with target customers' requirements, (3) is manufacturable, (4) consumes the least amount of time and cost in the design process. Three sources of task interdependency are discussed below.

First, the two sub-groups are interdependent due to the dependency between a component design and the overall product architecture. For instance, the design of an engine is interdependent with the overall architecture of the CCS (climate control system) on its interface with auxiliary heaters. The engine and auxiliary heaters should provide a constant total amount of warm water to the CCS system (Terwiesch et al. 2002). The buyer group, acting as the system integrator, is always responsible for integrating individual component designs into the overall product architecture (Parker and Anderson 2002). Supplier groups are responsible for a part or all of the detailed design work for individual components. Thus the two sub-groups are interdependent on each other for delivering a design that does not interfere with other interrelated component designs in the final product.

Second, the two sub-groups are interdependent due to the way the component design task is decomposed between them. When two sub-systems of the focal component designed separately by the two sub-groups share strong design interfaces, one group's design activities significantly affect design outcomes of the other group. In this case, the two sub-groups need to exchange design information in an on-going way to avoid design interferences within the focal component.

Third, design-manufacturing interdependency may cause tasks of the two sub-groups to be interdependent. When a design is "thrown over the wall" to manufacturing without integrating production capability and limitations early into design considerations, the result is often a design that is not "producible" (Adler 1995). The sequential dependency relationship between design and manufacturing makes it necessary to integrate the two sets of information early in the design process.

We consider two types of design performance. The first one is component design quality, which measures the degree to which the component met performance goals related to its fitness for use (Swink and Calantone 2004). There are five dimensions: dimensional integrity, durability, functionality, manufacturability (Swink 1999), and fits target customers' needs. The second one focuses the efficiency of the design process, which measures the extent to which resources are fully utilized on productive design activities (Hoegl and Gemuenden 2001). Two types of resources are considered: money and time. Thus two dimensions of process efficiency are: development cost and time.

3 Theoretical Bases and Hypotheses.

3.1 Coordination Fit: Choosing the Right Level of Procedural Coordination.

3.1.1 Theoretical Basis. The propositions regarding the fit between procedural coordination and task interdependency are built upon Information Processing Theory, which has its roots in organizational design and coordination literature.

The organizational design literature has been proposing the alignment between organizational structure and task environments for a long time (Lawrence and Lorsche, 1967; Thompson, 1967). Uncertainty, complexity and interdependencies are three major characteristics of a task. Galbraith (1973) defines uncertainty as "the difference between the amount of information required to perform the task and the amount of information already possessed by the organization". Complexity and interdependence in a business unit's task environment drive task uncertainty (Tushman and Nadler, 1978). High task uncertainty prevents organizations from being able to plan or make decisions about their task before it is executed (Milliken, 1987).

Daft and Lengel (1986) found that formal organization structures determine both the amount and richness of information provided to managers. The right organizations should be designed to both reduce task uncertainty and resolve task equivocality.

In addition to formal organizational structure, informal coordination mechanisms, such as unplanned face-to-face contacts between members from different teams, could also be used to manage task interdependencies. Malone and Crowston (1994) propose that coordination can be seen as a process of managing dependencies among activities. They claim that different coordination processes should be designed for different kinds of dependencies. Coordinating different types of interdependencies, such as functional, cognitive and structural interdependencies, affects the effectiveness of workgroups in different ways (Haag, 2006).

Organizational coordination literature has proposed several types of coordination mechanisms to manage different levels of interdependencies. March and Simon (1958) argued that schedules and feedback mechanisms are required when interdependence is unavoidable. Thompson (1967) extended March and Simon's work by matching three mechanisms: standardization, plan, and mutual adjustment, to stylized categorizations of dependencies such as pooled, sequential, and reciprocal. Van de Ven et al. (1976) added a fourth approach, the team, which they distinguish from Thompson's mutual adjustment by the simultaneity of multilateral interactions and which typically requires physical proximity. Galbraith (1973) argued that low levels of interdependency can be managed by traditional mechanisms such as rules and programs. However, as the level of interdependency increases additional mechanisms are required such as slack resources and lateral communication (Galbraith, 1973).

Staudenmayer (1997) grouped the contributions of March and Simon, Thompson, and others into the information processing theories of interdependencies. From the perspective of Information Processing Theory (IPT), information processing is the underlying mechanism connecting either organizational structures with task environments. Information processing is the purposeful generation, aggregation, transformation and dissemination of information associated with accomplishing some organizational task (Robey and Sales, 1994). IPT explains that different coordination mechanisms, either formal organizational structure or informal coordination, have different information processing capacity. Furthermore tasks with different levels of interdependencies present different information processing requirements. The degree to which requirements and capacity are appropriately matched determines the quality of task outcomes (Galbraith, 1977; Tushman and Nadler, 1978). When information processing capacity is less than what is necessary to perform the task, performance standards will not be met, the task will not be completed on time, and/or the task will be completed at a higher than desired cost. On the other hand, when the organization employs an approach that provides more information processing capacity than is required, the task will be accomplished in an inefficient manner.

Although IPT is usually used to study coordination problems in an intraorganizational setting, it could be extended to an inter-organizational context. In a recent study adopting an IPT perspective, Stock and Tatikonda (2008) found that the match between task (external technology integration) uncertainty and interorganizational interaction leads to higher technology integration performance. Thus coordination mechanisms used in an inter-organizational context should also provide enough information processing capacity to manage task interdependency across organizational boundaries. In the next section, two types of

coordination: contractual and procedural, used in structuring inter-organizational relationships are discussed. Then based on IPT, the fit between procedural coordination and inter-organizational task interdependency in the context of NPD is proposed to improve project outcomes.

3.1.2 Procedural Coordination and Task Interdependency. According to Sobrero and Schrader (1998), "two fundamental dimensions which characterize the structuring of inter-firm relations: contractual coordination and procedural coordination." (pp. 585). Contractual coordination refers to the mutual exchange of rights between the two firms (Sobrero and Schrader 1998). The contract seeks to align incentives and interests between both firms, and represents ex ante promises or obligations to perform particular actions in the future (Poppo and Zenger 2002). Contractual coordination, however, is not sufficient to achieve coordinated activities among members from the two firms since autonomous parties read and react to signals differently even if their incentives are well aligned (Williamson 1991). Procedural coordination relates to the "mutual exchange of information for the combination of agents or functions towards the production of results" (Sobrero and Schrader 1998, pp. 587).

In our problem context, contractual coordination is done at the top-management of the two firms. It does not tell us how members in the two sub-groups coordinate their engineering activities through exchanging technical information. Procedural coordination in a BG-SG dyad in a NPD project refers to the information exchange norms and processes that promote a shared understanding of the task environment and mutual adjustment in design activities. It is important to solve coordination problems arising due to the cognitive limitations of individuals that prevent them from knowing how others will behave in situations of interdependence, and how they are interdependent with others" (Gulati 2005). Thus in this study, we will only focus on procedural coordination.

Procedural coordination differs on frequency, timing, media and directionality (Sobrero and Schrader 1998, Sobrero and Roberts 2002). Except timing, all the other three dimensions are related with information processing capacity of procedural coordination. When the two groups mutually exchange information more frequently through richer media, on one hand, they are able to process more information in a given amount of time; on the other hand, they need to spend much more resources, such as time, in coordination. Too much coordination, a major type of group process loss, diverts engineers' efforts from core design work, which lowers work productivity and process efficiency (Hackman 1987).

From the IPT perspective, therefore, the level of procedural coordination should fit with the level of task interdependency between the two sub-groups to deliver the best design in a most efficient way. According to the three sources of task interdependency mentioned at the end of section 2.2, the two sub-groups should engage in a higher level of procedural coordination: (1) when a supplier is engaged in developing a component that shares strong interface with other components in the system, and/or (2) when the design task for the focal component is partitioned in a way that tasks of the two sub-group are highly interdependent, and/or (3) when the manufacturing process is sensitive to changes in design and no one sub-group has full access to both design and manufacturing information.

3.1.3 Performance Implications of Under- and Over-coordination. There are two types of misfit between procedural coordination and BG-SG task interdependency: under- and over-

coordination. When procedural coordination provides too much (less) information processing capacity, the group task is over- (under-) coordinated.

The two types of misfits have different effects on component design quality. Only under-coordination (the coordination mechanism is too mechanistic) will be negatively associated with component design quality. Lack of timely information is the cost of under-coordination. When task is under-coordinated, engineers could not obtain design interference information and adapt to interferences by making design changes in a timely fashion. Thus under-coordination increases the chance that the design does not fit with either other components, or with customers' needs, or with the manufacturing process. Under-coordination between the two firms may also reduce design functionality and durability due to a lack of alignment in interdependent design activities within the BG-SG dyad for designing the component. Over-coordination does not affect design quality because the enough information processing capacity is provided to manage task interdependency. Thus we propose that:

Hypothesis 1a: Under-coordination is negatively associated with component design quality.
Hypothesis 1b: Over-coordination is not significantly associated with component design quality.

Both under- and over-coordination are negatively associated with process efficiency. Due to a lack of timely information sharing and effective decision making in early stages of the design process, under-coordination increases the chance that the design has to be modified in later stages, which is more costly and time-consuming. An example of negative effects of under-coordination on development time is the delay of the Airbus 380 project. "The root cause of the issue," said Christian, Airbus President and CEO, "is that there were incompatibilities in the development of the concurrent engineering tools to be used for the design of the electrical harnesses installation." A lack of coordination among design teams causes the mismatch problem to be identified so late (when the electrical harnesses were installed into the fuselage) that a lot of rework has to be done, significantly delaying the project. The cost of over-coordination is a waste of resources on unnecessary coordination, which "takes time and energy away from productive work", resulting in lower productivity (Hackman 1987). Lower productivity implies a lack of efficiency: the design group has to spend more time and incur higher cost in designing the component. Thus choosing the optimum level of coordination always improves process efficiency. Thus We propose that

Hypothesis 1c: Coordination fit leads to higher process efficiency.

3.2. Goal Congruence.

3.2.1 Theoretical Basis. Goals are concerned with desired future states of the world, and represent the underlying motives for intentional behavior (Mintzberg, 1983). Present actions could be characterized and attitudes toward future conduct could be defined by goals, explicitly or implicitly. Goals can be explicitly set by the dominant group or coalition within an organization (Cyert and March, 1992). For instance, cost, duration and quality are goals of a project explicitly set by project managers (e.g., Kerzner, 1997). Goals can also implicitly exist in actors' rational calculation process for maximizing self-interests (Bonner, 1995, Eisenhardt 1989). For instance, subordinates often, ignoring managerially prescribed goals, engage in opportunistic self-serving activities (Ouchi, 1979).

Goal incongruence could be caused by different preferences in ranking multiple goals. Autonomous units often prioritize goals differently, due to their local expertise and social embeddedness in institutional infrastructure of their respective "communities". A typical example is the conflicts between engineers, marketing and procurement people in product design. Engineers usually want to create the most innovative design, while marketing focuses on satisfying customers' requirements at all costs and procurement wants to minimize costs. Such goal incongruence will drive actors to adopt different solutions, which often conflict with each other due to the reciprocal constraining relationships among multiple goals. For example, in a satellite launch vehicle, lightweight structural material provides less radiation shielding. Thus to satisfy the radiation shielding goal, more shielding material around sensitive electronic components are needed, which, in turn, offsets some of the weight advantages of the lightweight material (Thomsen 1998).

Goal incongruence may also be caused by autonomous units' self-serving orientation (Eisenhardt 1989). The classical agency problem is an example of goal incongruence between cooperating parties. One party (the principal) delegates work to another (an agent), who performs that work. The agency problem occurs when (a) the goals of the principal and the agent conflict due to their respective self-serving orientation, and (b) it is difficult for the principal to verify what the agent is actually doing (Jensen and Meckling 1976, Ross 1973). Such goal incongruence could be identified in a lot of relationships, such as employer-employee, lawer-client, buyer-supplier and so on (Harris and Raviv 1978). Agency theorists have focused on how to limit the agent's self-serving behaviors through contract design for a long time (Jensen and Meckling 1976, Fama 1980, Fama and Jensen 1983).

No matter what cause it, goal incongruence is traditionally believed to be negatively associated with organizational performance. Conventional management and economic theories have demonstrated that deviation from managerially prescribed goals by subordinates will necessitate additional coordination and communication efforts to resolve the discrepancies (Eisenhardt, 1985, 1989; Levinthal, 1988; Milgrom and Roberts, 1992). In team management literature, many studies suggest that a shared goal among team members improves with team effectiveness (e.g., Kristof-Brown and Stevens, 2001; Witt et al. 2001). The members who show congruity of peer goals feel better fit with team values (Vancouver and Schmitt, 1991), are more cooperative, and have more constructive interpersonal exchanges (Kristof-Brown and Stevens, 2001). Goal congruence in international product development teams enhances expectation and improves communication (Moenaert et al. 2000). Shared priorities enhance the single-minded direction that the project team is moving toward (Witt et al., 2001). The congruence between an individual's and a team's goals is shown to be crucial for team performance (Kristof-Brown and Stevens, 2001). Gowen (1986) found that such individual-team goal congruence can increase productivity by 31%.

In an inter-organizational setting, goal congruence is defined as "the extent to which firms perceive the possibility of common goal accomplishment" (Eliashberg and Michie, 1984), and is used for estimating the degree of incentive alignment among supply chain entities. Buyer-supplier goal congruence facilitates coordination efforts and idiosyncratic investments by both parties in the dyad (Jap 1999). In a following study, Jap and Anderson (2003) found that, at higher levels of opportunism, buyer-supplier goal congruence acts as a more powerful safeguard, compared with interpersonal trust, in preserving exchange outcomes and expectations of relational continuity. A lack of congruent goals increases inter-organizational

"friction", which lowers effectiveness and efficiency of their interactions. Tabrizi and Walleigh (1997), for instance, argue that buyer-supplier differences in style, priorities, and motivation increase costs of projects with supplier involvement. Buyer-supplier task interdependency further amplifies the negative effects of goal incongruence on inter-organizational coordination costs (Lakemond et al. 2006). In a recent study of buyer-supplier relationships, Rossetti and Choi (2008) shows that inter-firm goal incongruence leads to supply chain disintermediation, the risk of a supplier entering its buyer's aftermarket. In a principal-agent relationship, goal incongruence also increases monitoring costs for the principal. For instance, Sapienza and Gupta (1994) found that goal incongruence between venture capitalist (VC) and CEO of new ventures will lead to higher monitoring cost, in terms of more VC-CEO interactions, for the VC.

However, goal incongruence is not always bad. New data from experiments in social psychology indicate that an intermediate level of goal incongruence may have potentially positive effects on group problem-solving performance (Amason, 1996; Jehn, 1995; Pelled, 1996; Watson et al., 1993). Goal incongurency, on one hand, forces actors to consider a wider range of possible solutions to a problem, which increases the likelihood that a more ideal solution will be found. On the other hand, goal incongruence leads to a better understanding of the trade-offs associated with each solution, which improves solution quality for current problems and decision effectiveness for similar problems arising in the future (Kunda 1992). Similar findings could be identified in organizational demography research. For instance, group heterogeneity could improve solution creativity through increasing diversity and requisite variety (Hoffman and Maier 1961, Morrison 1992, Weick, 1979). Furthermore, groups are more effective at solving complex, non-routine problems when they are composed of individuals with different perspectives (Shaw, 1976; Wanous and Youtz, 1986). In sum, diversity in cognitions and views can prevent "group thinking" and motivate group members to search for better solutions.

3.2.2 Goal Incongruence in a BA-SG Dyad. In a BG-SG dyad, both types of causes could lead to varying goals across the two groups. First, the two groups may prioritize multiple goals differently. We call this Type 1 goal incongruence. For instance, the buyer group may want a design that best satisfies its customers' functional requirements, while the supplier group may just want a design that could be produced in a fast and cheap way. Second, different goals held by the two groups may simply be caused by each firm's opportunistic behaviors driven by self-serving orientation. We call this Type 2 goal incongurency. If the two firms do not expect a long term relationship, agency problems may occur on the group level. For instance, if the supplier firm finds itself too exposed to technology diffusion risk, it may tell the supplier group not to share key technology information with the buyer group. Under this circumstance, although both groups may target improving design functionality, the supplier group has one more goal: preventing key technology information from being disclosed to the buyer, which is not congruent with shared goals of the two groups. A possible outcome of such goal incongruence is double-marginalization, a typical problem in decentralized system where local agents' self-serving behaviors cause the failure to reach global optimum (Spengler 1950).

Based on the literature reviewed in section 3.1.1, the two types of goal incongurency seem to have different effects on performance of a BG-SG dyad. A medium level of Type 1 goal incongurency, an indicator of diversity in opinions, perspectives and knowledge, is beneficial for the BG-SG dyad in terms of forcing both sub-groups to search for a better solution. Type 2 goal incongruence, an indicator of agency problems, is always detrimental to group

performance. Therefore it seems not clear whether the total amount of goal incongruence is good or bad for delivering a good design.

In the detailed design phase of a NPD project, we propose that both types of goal incongruence lower project performance. When two groups of people prioritize goals differently (Type 1), their corresponding actions will be in conflict with each other. For instance, one group focusing on innovation may spend a lot of resources in explorative trials, while the other group targeting efficiency may prefer to spend the same amount of resources in exploiting existing technology and knowledge. With Type 1 goal incongruence, both groups have to spend more time negotiating with each other to reach an agreement, which takes away engineering hours from the core design work. Literature has shown that buyer-supplier agreements on technical and business goals are positively associated with NPD project team performance (Peterson et al. 2005). When the buyer and supplier groups agree on the expected benefits associated with the supplier integration efforts, in terms of quality, cost, scheduling, the outcome is not only a new product, but often lower costs as well (Laseter and Ramdas 2002, Ragatz et al. 2002). Thus Type 1 goal incongruence is unproductive. Because Type 2 goal incongruence is always detrimental for inter-organizational collaboration (Eisenhardt 1989, Jap 1999), the total effect of both types of goal incongruence on project performance should be negative.

Both component design quality and process efficiency are improved by inter-group goal congruence. When the two sub-groups share congruent goals, more efforts will be devoted to achieving the shared goals of the project; the two groups will have more high-quality communication; both groups are more willing to support and adapt to each other. All of these benefits result in higher component design quality. Furthermore, congruent goals held by the two sub-groups minimize inter-group friction, thus increasing process efficiency through improving productivity. Thus we propose that:

Hypothesis 2a: Goal congruence leads to higher component design quality.
Hypothesis 2b: Goal congruence leads to higher process efficiency.

3.3 Collaboration Quality.

3.3.1 Collaboration Quality and Design Performance. Propositions regarding effects of collaboration quality on design performance as well as its mediation roles are built on Hackman's theory of group effectiveness (Hackman 1987). As defined in section 2.2, a work group is a BG-SG dyad who works on the detailed design of one component in the final product. BG-SG collaboration quality measures the extent to which the two sub-groups mutually support each other, engage in high-quality communication and are fully committed to the project, the three dimensions of an effective collaboration process.

Hackman (1987) proposed a normative model of group effectiveness (Figure 3-1) which aims to "identify factors that most powerfully enhance or depress the task effectiveness of a group and to do so in a way that increases the possibility that constructive change can occur". In the group effectiveness model, the design of a group: task structure, group composition, and group norms, and organizational context: the reward, education and information systems, directly affect group process effectiveness. Both group design and organizational context act as initial conditions designed to affect group process effectiveness. Process effectiveness, a state emerging from group interactions, is measured by (1) level of effort brought to bear on the

group task, (2) amount of knowledge and skill applied to task work, (3) appropriateness of the task performance strategies used by the group. Group effectiveness is indicated by (1) performances of group output, (2) group member satisfaction, and (3) group members' capability to work together in the future. Hackman also mentioned two moderators, group synergy and contextual supports, which "tune" main effects in the model.

Hackman's model has been used to descriptively analyze various kinds of teams in different types of organizational settings (see Hackman 1990). Empirical evidence has been found supporting different parts of the model. For instance, effects of group design factors, such as group autonomy (Seers, Petty and Cashman, 1995, etc.), task characteristics (Wageman 1995, etc.), group diversity (Campion et al. 1993, etc.)and size (Steiner, 1972, Vinokur-Kaplan 1995, etc.), on process effectiveness have been widely studied. Organizational context, such as rewards (Campion et al. 1993, etc.) and supervision (Cohen et al. 1996, etc.), are also found to affect process effectiveness in work groups. Among few studies which test Hackman's model in a comprehensive way, Vinokur-Kaplan (1995) found that particular initial and enabling conditions, such as group size, task clarity, environmental supports, group interdependence, etc., significantly affect group process effectiveness, indicated by standards met, team cohesion and individual well being, which ultimately affect team effectiveness.

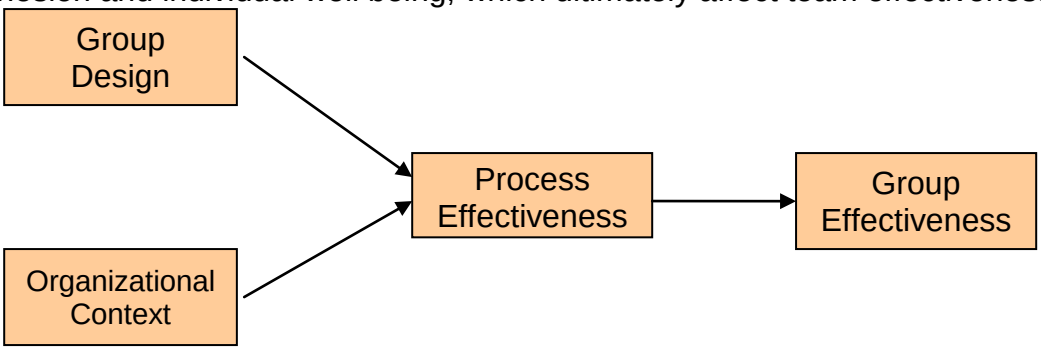

Figure 3-1: Hackman's theory of group effectiveness (adapted from Hackman 1987)

From the perspective of work effectiveness theory, collaboration quality, an indicator of process effectiveness, should improve performance of a BG-SG dyad in terms of delivering a better design. A BG-SG dyad with high inter-group collaboration quality is characterized by high-quality communication, mutual supports and high commitment to the projects (Hoegl and Gemunden 2001, Hoegl and Wagner 2005). These characteristics are all associated with higher design quality and process efficiency. To achieve high component design quality, frequent design changes are necessary to solve interferences. If the buyer and supplier members are not willing to adapt to and fully support such design changes, design quality will be compromised. If important ideas are shared openly, high-quality information is made available in a timely fashion, and all the group members are fully committed to the design task, shorter development time and lower development cost could be achieved.

Building upon the above logic, we propose that:

Hypothesis 3a: Collaboration quality is positively associated with component design quality.
Hypothesis 3b: Collaboration quality is positively associated with process efficiency.

3.3.2 Collaboration Quality as a Mediator. According to Hackman's model, collaboration quality serves as a mediator transferring effects of group design and organizational context on group performance. Group design factors include the structure of the group task, the composition of the group, and group norms that regulate member behavior. Organization context factors include the reward, education, and information systems that influence the group, and the material resources that are put at the group's disposal. The two independent variables: coordination fit and goal congruence, are such organizational context factors, whose effects are mediated through collaboration quality.

Coordination fit functions as an information system in improving process effectiveness. An organizational information system provides information for a group to "plan and execute a task-appropriate performance strategy" (Hackman 1987, pp. 330). According to Hackman, an information system in the organization where the group works could (1) increase clarity about parameters of the performance situation, and (2) provide access to data about likely consequences of alternative strategies. These two outcomes could increase the likelihood that the group selects the right strategy to perform the task, one criteria of process effectiveness (Hackman 1987). Similarly, when a buyer group and a supplier group, working on interdependent tasks, exchange the optimum amount of information to coordinate their activities, their collaboration process becomes more effective.

Both over- and under-coordination reduces collaboration quality in its three dimensions. When over-coordinated, group members' time and energy are diverted to unproductive coordination activities, thus reducing sufficiency of efforts applied to core design activities (commitment). Being tied up with unproductive coordinating activities reduces capability to well adapt and support others' needs (mutual supports). Finally important ideas are more likely to be ignored by receivers due to information overload, leading to lower information timeliness and accuracy (communication quality). When under-coordinated, interferences among interrelated engineering activities cause more re-work, thus reducing sufficiency of effort spent on productive activities (commitment). A lack of information on what the other group is doing reduces the capability of mutually supporting each other (mutual supports).. Finally information timeliness and accuracy are reduced due to a lack of relevant information (communication quality).

Thus we propose that:

Hypothesis 4: Coordination fit is positively associated with collaboration quality.

Goal congruence plays the role of a reward system in improving process effectiveness through aligning incentives of group members. According to Hackman, "A supportive organizational reward system can reinforce the motivational benefits of a well-designed team task". Reward systems that support high effort by work teams tend to have (1) challenging and specific performance objectives, (2) positive consequences for excellent performance, and (3) rewards and objectives that focus on group, not individual behavior. In short, an effective reward system could align incentives of all the group members to work hard on group task, thus increasing sufficiency of efforts applied to the group task, another criterion of process effectiveness.

Similarly, when a buyer group and a supplier group have congruent goals, collaboration process effectiveness is improved in its three dimensions. When the two groups have congruent goals, their efforts are channeled towards the same target, thus increasing the amount of efforts applied on productive design activities (commitment). If the two groups have congruent goals, they are more likely to mutually support each other to adapt to changes (mutual support). Congruent goals held by the two groups also motivate them to share high quality information in a timely fashion (communication quality).

Thus we propose that:

Hypothesis 5: Goal congruence is positively associated with collaboration quality.

Figure 3-2 shows the conceptual model

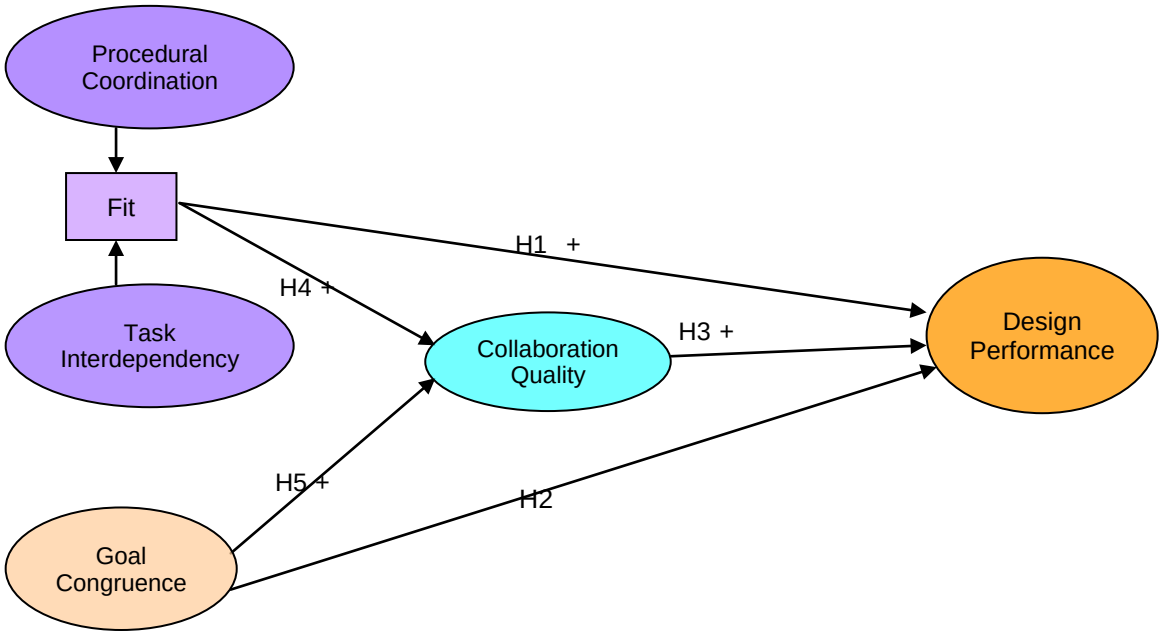

Figure 3-2: the conceptual model

4 Discussions.

4.1 Theoretical Contributions. Theoretically, this study proposed the concept of over-coordination, a situation where the coordination mechanisms provides more than necessary information processing capacity. Specifically, it is proposed that over-coordination lowers project process efficiency without improving design quality. Literature studying supplier involvement in NPD often focuses only on benefits associated with inter-firm procedural coordination. More coordination seems to be always advocated (Takeishi 2001, Jayaram 2008, Ragatz et al. 2002). Some major benefits identified by the literature include higher design manufacturability (Swink 1999), better design quality (Jayaram 2008, Ragatz et al. 2002, Takleishi 2001), higher process efficiency (Ragatz et al. 2002, Sobrero and Roberts 2002, Jayaram 2008). The costs of coordination, however, are largely ignored by the literature. Although insignificant or even negative effects of inter-firm communication on NPD project performances have been identified (Hartley et al. 1997, Hoegl and Wagner 2005), causes of ineffective coordination have not received enough attention. Adopting a contingency perspective, this study proposes that coordination is not always needed. When tasks between

the two firms are decomposed in a way that task interdependency is low, too much coordination just distracts engineers' efforts to unproductive activities.

This study treats a BG-SG dyad as the unit of analysis, emphasizing the match between the two groups, each representing a different firm. The literature often uses characteristics of individual firms or technical/environmental factors to predict performance of NPD with supplier involvement. For instance, Peterson et al. (2003) emphasizes the importance of choosing the right supplier, through assessment, in building an effective project team. Buying firms' internal integration (Takeishi 2001, Koufteros et al., 2005) is also found to be an important success factor for supplier involvement in NPD projects. Technical difficulty (Primo and Amundson, 2002), technical uncertainty (Ragatz et al., 2002) and market stability (Jayaram, 2008) have also been found to affect project performance, when suppliers are involved. The nature of the buyer-supplier dyad, however, is largely ignored. Few studies that did study it focus only on inter-firm trust and commitment (Walter 2003, Barbara Flynn 2000, Song and Benedetto 2008), ignoring the match between the two firms. Thus this study contributes to the literature by proposing that the match between the buyer group and the supplier group in actions and incentives are important success factors for supplier involvement in NPD.

Third, causal relationships between *ex ante* design factors and *ex post* emerging process characteristics are studied for the first time. Ex ante design decisions made before the design process begins, such as timing of involvement, design responsibility, communication frequency, and suppliers' membership on design teams, have been widely studied (Ragatz et al. 1997, Handfield et al. 1999, Monczka et al. 2000, Peterson et al. 2005, Koufteros et al. 2007). What actually happens during the design process, or the emerging ex post nature of the collaboration process, has not received enough attention. This study contributes to the literature by not only examining effects of the emerging process nature, but also proposing a causal relationship between what are designed ex ante and what emerges ex post.

4.2 Practical Implications. Practically, this study suggests that it is not appropriate to coordinate with all the involved suppliers in the same way. Depending on how design task and design/manufacturing information is decomposed between the two firms, different dyads may have different levels of task interdependence. For dyads with higher task interdependence, more frequent information exchange using richer media is necessary.

Then buyers are reminded of costs associated with over-coordination. Instead of trying to communicate with suppliers as intensively as possible, buyers should communicate with suppliers at the right frequency through the right media to avoid either misaligned activities or aligning activities inefficiently. Furthermore, over-coordination is proposed to prevent an effective collaboration process from emerging, which ultimately lowers design performance. Thus it is possible that the more a buyer communicates with a supplier, the less supportive the supplier becomes due to the overwhelming unproductive information sharing activities.

This study identifies three sources of inter-firm task interdependency, which offer a more complete view on inter-firm interdependency in the design process. An important message is, even when the component design task is decomposed into two completely independent modules, each designed by one firm, the two firms may still be highly dependent on each other. For instance, the supplier is always dependent on the buyer for information of either product architecture or customer requirements. The buyer may be dependent on the supplier for

manufacturability constraints and capability. Thus modular task decomposition can not remove all the interdependencies. Recognizing all the three sources could help buyers to purposely reduce interdependency, thus increasing process efficiency (Sobrero and Roberts 2002). For instance, buyers could involve suppliers whom they have worked before to reduce the need for explicit coordination due to existence of shared cognition and values, which is a form of implicit coordination (Espinosa et al. 2002, Espinosa and Pickering 2006).

Aligning goals, i.e. either through contractual coordination (Sobrero and Schrader 1998) or shared education and training (Ragatz et al. 1997), is critical for a successful buyer-supplier collaboration project. This proposition, if empirically verified, could lend supports for Peterson et al. (2003), which found that inter-firm agreements on business and technical targets are positively associated with project team effectiveness. If the two firms do not agree on key targets, friction costs generated by such incongruence will outweigh benefits of diversity in perspectives, thus worsening project performance.

Finally it is important to monitor the on-going collaboration process. Even if the two firms coordinate at the *optimum* level and have *congruent* goals, project performance could still be low due to the emergence of a low quality process. Some indicators are that the two firms do not communicate accurate information timely, or that people from the two firms do not adapt to each other, or that they do not apply enough efforts to the core design task. Monitoring the daily inter-firm interaction may prevent a low quality process from emerging by adapting to early signs of low communication quality, little mutual supports and low commitment.

4.3 Future Directions. Further studies could be done to examine implications of inter-organizational relationships for group-level interactions in collaborative NPD projects. The level of analysis in this study is a BG-SG dyad. Thus characteristics of the buyer-supplier relationships on a firm-firm level are not directly captured in our model. Characteristics of inter-organizational relationships, however, are widely believed to affect how people from the two firms work together (Heide and Miner 1992, Sobrero and Schrader 1998, Heimeriks and Duysters 2007, Manil et al. 2007). For instance, a good buyer-supplier relationship, indicated by rich cooperative experiences, may help cultivating a more productive environment for people from the two firms to work together. However it is also possible that, no matter how good a relationship is on the firm level, operational and relational factors on the project level dominantly determine whether a high quality process emerges. Thus it is important to test links between firm-level relational factors and project-level operational performances, after controlling for project-level operational and relational factors' effects. Significant cross-level effects, if identified, could show the importance of strategically building and maintaining good relationships with suppliers long before they are involved in any projects for successful project-level involvement.

Effects of the two types of inter-organizational goal congruence on project performances could be further studied. In this study, the two types of goal congruence are subsumed under one single construct. However, both types independently exist in reality and may affect project outcomes in different ways. Field or lab-based experiments could be used to help accurately differentiate and measure both types of goal incongruence. Results of such studies have implications on (1) whether a certain level of Type 1 goal incongruence should be maintained, (2) how to contractually coordinate the two parties to minimizes Type 2 goal incongruence, (3) how the two types interact with each other in affecting project outcomes.

In this study, performance of the productive output is the only criterion used to evaluate the effectiveness of a BG-SG group. According to Hackman's model, however, another important criterion for group effectiveness is enhanced capability of group members to work together in the future. Cooperative competency on an inter-organizational level has been shown to be important predictors of firm performance (Dyer and Singh 1998, Sivadas and Dwyer 2000, Blomqvist and Levy 2006, Heimeriks and Duysters 2007). Thus it is important to examine whether an effective collaborative process in one project could benefit the two firms in the future, in terms of improving cooperative competency. However, longitudinal data is needed to do such researches.

Different types of inter-firm task interdependence also deserve more studies in the future. In this study, we identified three sources of task interdependence. However, all the three types are measured under one single construct: task interdependence. And it is assumed that all these interdependencies, either sequential or reciprocal, are coordinated using the same mechanisms. Researches have shown that different types of interdependencies should be coordinated in different ways (Haag, 2006). Thus it is important to examine whether coordination mechanisms should fit not only with the level, but also with the type of task interdependency, in delivering the best outcomes.

Finally effects of action and incentive alignment on innovation performance could be further studied. In this study, we only focus on design quality and process efficiency without considering how innovative the product and the process are. Given the importance of creativity as a criterion for evaluating NPD projects, future studies should be done to see whether the proposed model holds when product and process innovation are outcomes that are evaluated.

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Roles of Purchasing Development and Complexity in Achieving Strategic Supplier Leverage in Small and Medium Enterprises

Jeffery Adams, Ph.D., Assistant Professor
University of Houston-Downtown
713-221-8609; AdamsJeff@uhd.edu

Gary Stading, Ph.D., Associate Professor
University of Houston-Downtown
713-221-2775; StagingG@uhd.edu

***Ralph Kauffman, Ph.D., C.P.M., Associate Professor Emeritus**
University of Houston-Downtown
281-989-2905; KauffmanR@uhd.edu

* Corresponding author

Roles of Purchasing Development and Complexity in Achieving Strategic Supplier Leverage in Small and Medium Enterprises

Abstract. While small and medium enterprises (SMEs) far outnumber large multi-national enterprises (MNEs), relatively little research has been done on their procurement processes and, in particular, on ways in which they may be able to successfully compete with their larger competitors for advantageous supply arrangements. Obviously, except for cooperative arrangements, (SMEs) do not generally have the purchasing power of large companies to leverage lower prices through quantity discounts. Data from a survey of SMEs indicated that there appeared to be a relationship between the degree of complexity of their purchasing situation, the level of development of their purchasing practices, and their ability to effect strategic leverage with suppliers. Using factor analysis and structural equation modeling this study uses survey data to determine factors that contribute to purchasing development, purchasing complexity, and strategic supplier leverage in SMEs and to evaluate relationships between these factors. Purchasing complexity was found to involve technical process complexity and the use of suppliers as a resource. Purchasing development was found to involve development of tactical skills and higher level strategic skills, and supply base development. Strategic supplier leverage was found to involve buyers' ability to influence costs, and to achieve competitive advantage. Significant relationships were found between both purchasing complexity and purchasing development and strategic supplier leveraging.

Introduction. Purchasing leverage is thought of by many buyers as the ability to use large volume purchases to reduce the purchase price or acquire value-added services from suppliers. This is a common practice used by large multi-national enterprises (MNEs) to gain competitive advantage in pricing or other aspects of sourcing. Unfortunately, this is a technique that is not available to many small and medium enterprises (SMEs). Are there other ways that SMEs can make up for this inherent disadvantage in market clout? This study examines how SMEs potentially can use other strategic factors related to purchasing to gain purchasing leverage normally reserved only for large companies.

Studies have shown that an organization's purchasing strategy is a very effective way to gain and sustain competitive advantage, e.g. (Das and Handfield 1997). Also, purchasing power that results in purchase leverage is an important factor in determining the strategic contribution of the purchasing function, and it is considered to be a significant source of competitive advantage for buying organizations (Ramsey 2001). Clearly, many small and medium size organizations lack the purchase volumes necessary to secure significant leverage with suppliers. This of course renders them ineffective at gaining the same degree of competitive advantage as their larger competitors through these practices. This study examines the underlying strategic factors of purchasing development and complexity of purchases and how they may help SME managers to develop strategically sound alternatives that could help them to attain sustainable competitive advantage.

Objectives. Identify factors that contribute to purchasing development and purchasing complexity in small and medium enterprises, and test the hypotheses that higher levels of

these two constructs in SMEs can contribute to their ability to develop strategic leverage options with their suppliers.

THEORETICAL DEVELOPMENT

Small and Medium Enterprises (SMEs). SMEs are a major contributor of new jobs in the American economy. SMEs account for the creation of about two-thirds of the net new jobs in the United States (Birch 1979; Dennis, Phillips, and Starr 1994). It is also likely that jobs being created by SMEs make up for many jobs that are lost when large multi-national enterprises (MNE's) engage in outsourcing as a result of cyclical downsizing, restructuring, or merging activities. SMEs also play a critical role in developing new technologies and identifying and meeting unmet market needs (U. S. Small Business Administration, 1998). Unfortunately, SMEs also have high failure rates due most significantly to their inability to adequately use essential management practices (Monk 2000). Another major factor contributing to the high failure rates of new small or medium sized businesses is the fact that these organizations often lack many resources that are more easily afforded by MNE's. Examples of such resources include management expertise and management systems (Levy, Powell, and Galliers 1999). Also, due to limited resources, many SMEs lag behind their larger counterparts in the implementation of advanced information systems technology (Levy and Powell 2000).

Dollinger and Kolchin (1986) argue that an effective purchasing function is especially critical to the success of small business organizations. In many cases this is because their mere size diminishes their apparent market importance as customers and therefore places them at a disadvantage relative to large organizations in obtaining material and service resources. The subsequent result, they conclude, is that if a small business is unable to obtain necessary resources, it will fail. They also provide evidence that one way to mitigate this disadvantage is through application of the strategy of developing supplier partnerships.

Many SME organizations are driven by niche markets. SMEs use their niches to gain competitive advantage (Chaston and Mangles 1997). These organizations often rely on product innovation, technology, and superior quality to set them apart from the competition. They also tend to have flexible organizations that allow quick response to market situations. Such strategies and abilities gain strength from the complexity that results from development and application of innovations and technology in many niche markets. Development of purchasing practices and expertise by SMEs could contribute to realizing benefits from these types of strategies.

Many businesses use internal operational functions as a source of sustainable strategic competitive advantage. The procurement function is an example of one such functional area that has been growing in importance due to the increased strategic emphasis on outsourcing and supplier partnerships (Monczka, et al 1998). When upgraded from a tactical function to a strategic asset, more companies are finding sourcing and supplier partnering to be a significant contributor to sustaining a competitive advantage (Handfield and Nichols 1999). A major reason for the increased focus on purchasing is due to the continued growth of dollars spent on outsourcing by industrial organizations (Watts, Kim, and Hahn 1995). The trend of outsourcing non-core activities shows a consistent pattern of growth resulting from firms focusing on their core competencies (McCutcheon and Stuart 2000). Thus, as "make" is replaced by "buy," increased proportions of sales revenue are being absorbed by purchases of goods and services. This increase in volume, and the resulting increase in the variety and

scope of goods and services being procured, may contribute to increased purchasing complexity.

The continuous development of managerial skills is virtually a requirement in today's business climate. Hanks and Chandler (1994) argue that functional business managers become more specialized as the firm grows. As firms grow in size and complexity, business managers have to specialize to manage through the dominant problems facing their business. According to Hanks and Chandler, purchasing is one of those areas of specialization in larger MNEs. Due to many SME managers having to wear numerous "hats," functional specialization is not always available to SMEs. This limits the opportunity for SMEs to take advantage of purchasing as a strategic entity through organizational specialization. However, it should not limit their ability to generally improve purchasing strategies and expertise. Development of purchasing skills and abilities often results in such benefits as reduced costs, improved information, and improved competitiveness (Dollinger and Kolchin 1986). Small companies have fewer financial resources, so it is important for them not to waste money through poor purchasing practices (Presutti 1988). Presutti argues that a focused effort in developing purchasing skills and practices within smaller entities should result in significant strategic gains.

The preceding discussion suggests that taking advantage of inherent complexities and applying a developed purchasing skill set can play important roles in strategically meeting customer needs and improving organizational performance. Implementation of such actions would likely require frequent contact with suppliers. Das and Handfield (1997) found a strong positive correlation between contact with suppliers and organizational performance.

This discussion leads us to the proposition that complexity of purchases and purchasing situations, and development of the purchasing function both strategically and operationally are two approaches that can be used by SMEs to potentially gain strategic leverage with suppliers.

Purchasing Complexity. Kralijic (1983) identifies complex supply conditions as those involving supply risk and technical complexity. He also explores more advanced dimensions of complexity including product or service criticality and the management of specialized assets. Transaction cost theory indicates that when asset specificity is important to purchased products, such as specialized products developed to customer specifications, more complex and longer term contracting relationships are more efficient (Williamson 1985). Long-term relationships are based on a philosophy of commitment, trust, and coordination (Liedtka 1996). The interdependence of these factors injects additional complexity into supplier relationships. Ethical elements of commitment and trust are involved in every transaction, and without them, markets would not function. Long-term relationships based on a win-win basis with a small group of critical suppliers can lead to a sustainable competitive advantage (Elram 1996). Collaboration based on trust enables organizations to assimilate suppliers as resources providing information that leads to advantages that are rare and hard to duplicate. This facilitates a sustainable competitive advantage (Mariotti 1999).

The complexity of buyer-supplier relationships continues to evolve and increases in degree as products become more specialized and require more specialized processes to produce (Elram 1992). Traditional models based on market price continue to evolve with the elevation of the role of strategic relationships (Doktor, Tung, and Von Glinow 1991). Theories for managing

these relationships derive various elements from disciplines that include transaction cost analysis, organizational structure theory, and resource-based theory of the firm (Hoyt and Huq 2000). Approaches to managing buyer-seller relationships are based on the level of risk associated with transaction uncertainty, asset specificity, market competition, and the subsequent level of required governance (Dyer and Singh 1998; Chiles and McMackin 1996).

Strategic competitive advantages for SMEs that can emanate from complexity include providing expertise to their customers for the specific technical nature of their niche. Also, on the buying side of the business, complexity-related elements of entrepreneurial strength that SMEs can leverage from suppliers include: involving suppliers in the development of products or processes, leveraging supplier technical or other strengths, developing supplier relationships including an understanding of performance standards, and, ultimately, the potential for suppliers' sharing in the growth of the SME business (Heide and John 1990). To the degree that SMEs can develop and maintain such involvement with their suppliers, particularly if, due to their smaller size and possibly greater flexibility, they can do it to a greater degree than their larger competitors, such involvement represents a form of strategic supplier leverage for the SMEs.

Purchasing Development. Purchasing in some organizations is clerical in nature, but other organizations have a purchasing function that is highly developed and requires technical, managerial, or strategic orientation and skills. Determinants defining the purchasing development construct, and the subsequent contribution to strategically leveraging suppliers, do not appear to be fully explored in the literature.

One way to classify the degree of purchasing development in a company is to examine the skill level required of purchasing personnel. For example, changing procurement activities from transactional duties to strategic initiatives requires a different mix and a higher-level application of skill sets (Giunipero 2000). Various authors have proposed schemes for assessing the degree of development of purchasing or sourcing practices and strategies in a particular company. Several of them include four phases or levels of development. For example: Reck and Long (1988), Freeman and Cavinato (1990), and Monczka, Handfield, Giunipero, and Patterson (2009). Table 1. Summarizes a few of the results of these three studies. In general, these studies indicate that, for purchasing development to proceed to higher stages or levels, it must become more strategically integrated with the firm's overall strategies and the nature of supplier relationships must also change, becoming more strategic and integrative.

Table 1
Examples of Concepts of the Construct: "Purchasing Development"

Study:		Reck & Long (1988)	Freeman & Cavinato (1990)	Monczka, Handfield, Giunipero, & Patterson (2009)
Level				
I.	General Concept	Passive, reactive	Buying, basic financial planning	Basic beginnings, support function
	Supplier Relationships	Adversarial	Price reduction – oriented	Longer-term contracts
II.	General Concept	Independent. Purchasing strategy not linked to firm's	Purchasing, forecast-based planning	Moderate development, establish better supplier relationships
	Supplier Relationships	Variable	Quality, process efficiency	Ad-hoc supplier alliances
III.	General Concept	Supportive. Purchasing strategy supports firm's strategy	Procurement, externally oriented planning	Limited integration of supply management strategies
	Supplier Relationships	Suppliers viewed as firm's resource	Establish and develop relationships	Strategic supplier alliances
IV.	General Concept	Integrative. Purchasing strategy fully integrated with firm's competitive strategy	Supply, strategic management	Fully integrated supply chains, strategic orientation
	Supplier Relationships	Mutual interdependence	Management of commercial relationships	Full-service suppliers, systems approach across the entire supply chain

At its lowest phase, tactical purchasing does not have strategic direction and is often filled by clerical employees. At its highest phase, purchasing is completely integrated into the organization's competitive strategy. The role of the purchasing function is to structure and manage itself in order to support and enhance the firm's desired competitive advantage. An organization's purchasing management system must focus on the elements of competitive strategy that the organization considers essential to its overall success. By focusing on strategic issues, the purchasing function can contribute to the competitive position of organizations utilizing such strategic practices as reducing suppliers and establishing long term partnerships.

Development of the purchasing function to a strategic level includes viewing key suppliers as extensions of the buying organization (Anderson and Katz 1998). Utilizing suppliers as extensions of the company represents an integration that allows for the accurate communication of information between organizations. This cuts down on supply chain

volatility, reduces the bullwhip, and makes suppliers more responsive to changes in demand (Bagchi and Skjoett-Larsen 2002). Integrated supply chains have multiple communication points, shared compatible databases, and transparent information systems.

In summary, some recurring factors that have evolved from the literature in defining purchasing development are included in the list below (Kralijic 1983; Reck and Long 1988; Freeman and Cavinato 1990; Anderson and Katz 1998; Dobler and Burt 1996; Bagchi and Skjoett-Larsen 2002; Monczka, Handfield, Guinipero, and Paterson 2009).

1. The strategic planning horizon (strategic long term vs. short term)
2. Coordination of purchasing decisions with other stakeholders
3. Skills sets needed (including methods of supplier selection and purchasing performance measures)
4. Education levels required
5. Ability to ascertain supplier value add
6. Performance recognition
7. Types of supplier relationships
8. Levels of integration

Each of these factors has been identified to have the potential to individually contribute to and collectively affect the ability of an organization to leverage profitability and to achieve and sustain a competitive advantage through development of the purchasing function.

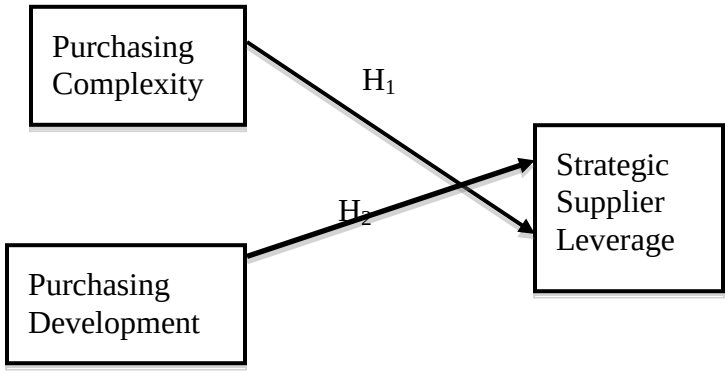
RESEARCH MODEL AND HYPOTHESES

This study investigates attributes affecting purchasing development, purchasing complexity, and the subsequent effect of these factors on the ability of an organization to achieve strategic leverage with its suppliers. Some examples of attributes identified in the literature that could affect purchasing complexity include: the degree of complexity in purchased products and the degree of complexity in the purchase process. Also, the rate of technological change of purchased items, and the degree of risk and uncertainty of supply could impact complexity.

Examples of attributes from the literature which could affect the purchasing development determinant include: types of supplier relationships, skills required by purchasing team members, degree of coordination between purchasing and other departments, and the degree to which purchasing strategy is integrated with overall company strategies. A complete list of attribute items considered and included in this study is in Appendix A.

***Research Model*.** We propose a simple model that relates purchasing complexity, purchasing development, and strategic supplier leverage within organizations. The previously discussed factors affecting the determinants of purchasing complexity and development are examined and are hypothesized to have an effect on the ability of SMEs to leverage suppliers to improve an organization's competitive purchasing position (see Figure 1 below).

Figure 1
Research model for strategic supplier leverage



The main propositions underlying the model are that the more complex the firm's purchasing situation, the more potential for it to leverage supplier value to gain competitive advantage and, that a highly developed purchasing function is better positioned to leverage supplier value to gain competitive advantage. The purchasing function is not able to take advantage of a complex environment when it does not have developed skill sets. A firm would therefore have less capability to leverage suppliers. Abilities of the organization to capitalize on strategic initiatives and to achieve improved financial performance would also be reduced.

***Research Hypotheses*.** This study has identified potential contributing factors to purchasing development and purchasing complexity. These factors will be examined for their affect on purchasing development, purchasing complexity, and strategic supplier leverage.

The first hypothesis proposes a link between purchasing complexity and the strategic supplier leverage of an organization.

> *Hypothesis 1. The purchasing complexity of an organization will have a significant positive effect on the ability of an organization to strategically leverage suppliers. Those attributes that contribute toward the complexity of the purchase function will in turn contribute toward improving the potential for strategic supplier leverage.*

This first hypothesis guides the examination of the effect of those attributes that define an organization's purchasing complexity. Purchasing complexity could consist of a number of potential items including: broad scope of increased numbers of outsourced specialized functions, increasingly complex products, and additional risk factors associated with the management of these functions. This hypothesis is intended to study the effect that purchasing complexity has on achieving strategic supplier leverage.

The second hypothesis proposes a link between purchasing development and the strategic supplier leverage of an organization.

Hypothesis 2. The purchasing development of an organization will have a significant positive effect on the ability of an organization to strategically leverage suppliers. Those attributes that contribute toward defining the development of the purchase function will in turn contribute toward the potential for improving the strategic supplier leverage.

This second hypothesis guides the examination of the effect of managing those attributes that define an organization's purchasing development. These items include developing purchasing managerial skills and developing the supply base. This hypothesis is intended to study the effect that purchasing development has on achieving strategic supplier leverage.

According to Pearson and Ellram (1995) the purchasing function should affect financial performance and profitability for organizations assuming they can utilize the strategic strengths of the supplier. The three main reasons suppliers affect profitability include: a large percentage of an organization's revenue is used to purchase goods and services, supplier selection decisions have a large impact on product quality, and supplier relationships can have a significant impact on total cycle time. In this study we are implying that the more complex the purchasing situation and the more highly developed the purchasing function in a buying company, the greater the likelihood that benefits can be strategically leveraged from suppliers by SMEs.

DATA COLLECTION

A questionnaire that included the items in Appendix A was sent to a mailing list of over 1500 SME businesses. The list was developed through ReferenceUSA for a sampling of SMEs within four North American Industrial Classification System (NAICS) sub-sectors. These subsectors include machinery manufacturing, computer and electronic product manufacturing, electrical equipment manufacturing, and transportation equipment manufacturing. Respondents evaluated the items using a 7-point Likert scale that ranged from "strongly disagree" to strongly agree." Additional mailings and contacts of non-respondents resulted in an overall response rate of 14.4%.

In order to test for non-response bias, the late respondents contacted in the subsequent groups were compared with the earlier respondents of each group to determine if there were significant differences between the three groups (Armstrong and Overton 1977). When data was assimilated and the groups of data were combined and compared, no significant statistical differences were detected. Typical alpha values of data groups were at the 0.70 level. A lack of significant statistical differences indicated that the danger of non-response bias is low.

ANALYSIS AND RESULTS

A factor analysis was used first to identify item grouping and factors that contribute to the three constructs. Structural equation modeling was subsequently used to analyze the data and to test the research model. Support for the hypotheses is indicated by the path coefficients and the statistical significance of the corresponding t value for the path.

***Factor Analysis*.** Thirty-five data items were used for the initial exploratory factor analysis. The factor analysis identified twenty-four items that loaded on the determinants of the constructs. Questions with low loadings (under .55) were eliminated from the factor analysis. Loadings of at least .30 or .40 are considered an indication of some degree of relationship

between the individual question and the component (Portney and Watkins 1993). The variables that load above the level of .50 were included in the component (Bernard 2000).

***Purchasing Complexity and Purchasing Development Results*.** The items that loaded on the Purchasing Complexity and Purchasing Development determinants are listed in Table 2 below. The items that loaded on the Purchasing Complexity determinant generally grouped around two distinct strategic factors. One involved items that had a technical process complexity orientation (these are designated as TPC items in Table 2); the other items grouped around the concept of utilizing suppliers as a resource (these items are marked as SR in Table 2).

The specific items that loaded on the technical process complexity determinant included the following: product complexity, rate of change in product complexity, requirements and costs of switching suppliers, supplier investment in the relationship, and development of supply chain strategies. The items that loaded on the supplier as a resource determinant included the following: supplier selection based on a wide range of criteria, use of quantitative measures to evaluate purchasing performance, importance of purchasing in organization success, long-term supplier partnerships, and integration of key suppliers into company processes.

Table 2
Items loading on the Product Complexity and Purchasing Development Variables after a Varimax rotation

Items	Factor Category[a]	Purchasing Complexity (PC)	Purchasing Development (PD)
Purchases are Technically Complex	TPC	0.820	
There is Rapid Technological Change in Purchases	TPC	0.672	
Major Changes Would be Required to Switch Suppliers	TPC	0.822	
Suppliers have Made Specific Investments to do Business with Us	TPC	0.974	
A Great Deal of Time is Devoted to Developing Supply Chain Strategies	TPC	0.944	
Supplier Selection is Based on A Wide Range of Criteria	SR	0.816	
Quantitative Measures are Used to Evaluate Purchasing Performance	SR	0.984	
Purchasing plays a major role in success of organization	SR	0.616	

Long Term Partnerships with Suppliers are Often Used	SR	0.908	
Key Suppliers are Integrated into Company Processes	SR	0.898	
Little Purchasing Time is Spent on Routine Transactions	DTS		0.896
Purchasing Requires Clerical Skills	DTS		0.812
Purchasing has Little or No Coordination with other Departments	DTS		0.595
Purchased Materials and Services are Readily Available	DSB		0.984
Substitute Sources of Supply are Readily Available	DSB		0.712
Purchases Influence the Quality of Produced Products	DSB		0.720
Purchases Influence Organizational Productivity	DSB		0.787
Purchasing Requires Analytical and Managerial Skills	DHSS		0.881
Planning is an Important Part of Purchasing	DHSS		0.902
Purchasing Strategy is Integrated with Overall Business Strategy	DHSS		0.527

[a] TPC – Technical Process Complexity, SR – Supplier as a Resource, DTS – Developing Tactical Skills, DSB – Developing the Supply Base, DHLSS – Developing Higher Level Strategic Skills

The factors that loaded on the Purchasing Development determinant are grouped generally around the factors of developing tactical skills (DTS in Table 2), developing the supply base (DSS in Table 2), and developing the higher level strategic skills (DHLSS in Table 2).

The items loading specifically on the developing tactical skills determinant included: time spent on routine transactions, clerical skills, and degree of purchasing coordination with other departments. Items loading on the developing the supply base determinant include: Availability of purchased materials and services, availability of substitute sources of supply, influence of purchases on product quality, and influence of purchases on organizational productivity. Items loading on the developing higher-level strategic skills determinant include: analytical and managerial skills, importance of planning, and integration of purchasing strategy with overall business strategy.

***Strategic Supplier Leverage*.** The items that loaded on the Strategic Supplier Leverage determinant generally describe the buyers' ability to influence costs and their company's ability

to achieve and sustain competitive advantage. Regardless of the means of attainment, purchasing leverage is identified with using purchasing to leverage value in the form of lower prices, lower total cost, or other value-adding benefits such as additional services from suppliers. The cost and strategic items loading on the strategic supplier leverage construct can be seen in Table 3 below.

The items that loaded on this determinant included minimizing purchase costs, and minimizing total costs. The ability of a buyer to strategically effect price and availability through supplier selection and the ability of the purchasing function to contribute to an organization's competitive advantage also aligned with this factor.

***Reliability*.** Cronbach's Alpha coefficients are computed for each of the three components to measure the reliability of each component (listed in Table 4).

Coefficients from .50 to .75 represent moderate reliability, and values above .75 indicate good reliability (Portney and Watkins 1993). All three components have good reliability, and as a result, all the components are retained for further analysis. The associated correlation matrix shows moderate correlation between the purchasing complexity and purchasing development determinants and moderate correlation between the purchasing development and strategic supplier leverage determinant. The correlation is not strong enough to indicate significant influence from covariant relationships.

***Structural Equation Model Results*.** The path coefficients for both the purchasing complexity and purchasing development constructs to strategic supplier leverage were found to be significant at the 0.05 alpha level. Thus, both Hypothesis 1 and Hypothesis 2 are supported. The results are provided in Table 5 below.

Table 3
Items Loading on the Strategic Supplier Leverage Variable after a Varimax Rotation

Item	Strategic Supplier Leverage (SSL)
The Goal of Purchasing is to Minimize Purchase Costs	0.985
The Goal of Purchasing is to Minimize Total Costs	0.915
The Goal of Purchasing is to Contribute to Competitive Advantage	0.648
Supplier Selection is Based on Price and Availability	0.770

Table 4
Chronbach's alpha and correlation matrix

	Chronbach's Alpha	PC	PD	SSL
PC	0.928	1.00		
PD	0.863	0.248	1.00	
SSL	0.849	0.139	0.276	1.00

Table 5
Structural model path coefficients and t values for hypothesis testing

Hypothesis	Path Coefficient	t Value
H1:	0.22	2.36 *
H2:	0.37	2.01 *

* $p < 0.05$

DISCUSSION

One goal of the study is to additionally define the attributes that contribute to the purchasing complexity and development constructs. Factors contributing to the purchasing complexity determinant include strategic initiatives associated with building supplier relationships. Important aspects of strategically capitalizing on suppliers include building long-term relationships, considering suppliers important resources, and integrating them into the process. Selecting and providing the proper performance measures for purchasing results are also a part of the construct. The work of purchasing professionals is considered important from the perspective of these respondents in building quality into the final product, in keeping a firm productive, and in contributing to the success of the organization.

The factors linking to purchasing development fell into the general classifications of developing tactical skills and of developing the supply base. The development of tactical skills includes developing daily operational skills of buyers, handling routine transactions, and coordinating with other departments. This factor also includes a buyer's ability to affect and support quality and productivity initiatives through supplier development opportunities. At more strategic levels, professional managerial and analytical skills are required to develop the supply base and identify and develop strategic leverage opportunities. The degree of development of these skills is linked to the ability to achieve strategic supplier leverage.

CONCLUSIONS

The overall research objective of the study proposes evaluating determinants of purchasing complexity and purchasing development and how they affect a company's ability to strategically leverage suppliers. The results of the study provide evidence linking purchasing complexity and purchasing development to strategic leveraging. In addition, this study provides foundations for further defining what is included in the constructs of strategic supplier leverage, purchasing development and purchasing complexity.

Several attributes are identified with strategic supplier leverage. Respondents to the mail survey indicate that strategic supplier leverage is affected when purchase costs are, not only reduced or minimized, but also, when the total cost of the product is reduced or minimized. Respondents also indicate that when lower pricing or other value-adding attributes from the supplier leads to competitive advantage, then strategic supplier leverage is achieved through the purchasing process. This result captures the notion that strategic supplier leverage is not just about reducing prices from suppliers, but leverage can be achieved from other factors, such as enhanced quality, integration of purchasing strategy with overall business strategy, and integration of suppliers into company processes that will drive lower purchase costs or lower total costs, or higher quality. All of these results can contribute to increasing the value proposition that is offered to customers of the company.

The results support the idea that purchasing complexity and the level of purchasing development affect the amount of strategic supplier leverage that can be achieved.

Managerial Implications and Contributions to the Decision Process. This study supports the argument that developing the purchasing function and enhancing supplier integration improves a company's ability to leverage strategic supplier sourcing. This model serves as a starting point for establishing criteria by which purchasing managers of SMEs can prioritize decision criteria. The results of this study can be used by managers to build decision criteria that can allow them to better formulate strategies for using suppliers as a resource.

Managers can leverage suppliers by emphasizing and enhancing the technical complexity of both the product and the process. Governance of suppliers, including establishing long-term relationships and measures by which to gauge supplier performance, also affects leveraging the supply base and improving performance.

Managers can further separate themselves from competition by developing both tactical and managerial skills. The results of this study support the concept that continuous development of the personnel skill base enhances a firm's ability to leverage skills of the supplier. Developing the supply base is an intricate process that includes careful development of substitutes, and complements, including the integration of suppliers in the product development process.

Limitations of the Study. This study is limited to four NAICS sub-sectors (Machinery Manufacturing, Computer and Electronic Manufacturing, Electrical Equipment, Appliance, and Component Manufacturing, and Transportation Equipment Manufacturing). Other industries may have significantly different purchasing requirements. In the future, this research should be extended to other industries testing national and international groups. In order to build on the information learned in this study, additional research should be conducted. This study also

lends itself to a longitudinal perspective. Additional research evaluating a longer term perspective could be useful to substantiate the findings of this study.

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APPENDIX A: POTENTIAL CONSTRUCT FACTORS

All items were rated by the respondents on a 1 to 7 Likert scale with 1 being “strongly disagree” and 7 being “strongly agree.”

Purchases Influence the Quality of Produced Products
Purchased Goods and Services are a High Percentage of Total Costs
Purchases Influence Organizational Productivity
Purchases are Technically Complex

There is Rapid Technological Change in Purchases
Purchased Materials and Services are Readily Available
Substitute Sources of Supply are readily Available
There is Uncertainty in Purchase Market Conditions
Major Changes Would be Required to Switch Suppliers
Suppliers Have Made Specific Investments to do Business With Us
A High Proportion of Purchasing Time is Spent on Crises
Little of Purchasing Time is Spent Planning for the Future
A High Proportion of Purchasing Time is Spent on Routine Transactions
Little Purchasing Time is Spent on Routine Transactions
Planning is an Important Part of Purchasing
A Great Deal of Time is Spent on Developing Supply Strategies
Purchasing has Little or no Coordination With Other Departments
Purchasing is Involved Extensively With Cross Functional teams
Purchasing Strategy is Integrated With Overall Business Strategy
The Goal of Purchasing is to Minimize Purchase Costs
The Goal of Purchasing is to Minimize Total Costs
The Goal of Purchasing is to Contribute to Competitive Advantage
Purchasing Requires Clerical Skills
Purchasing Requires Analytical and Managerial Skills
Supplier Selection is Based On Price and Availability
Suppler Selection is Based on a Wide Range of Criteria
Quantitative Measures are Used to Evaluate Purchasing Performance
Suppliers are of Little Importance and Can Be Replaced
Suppliers are Considered to Be an Important Resource
Purchasing is Not Perceived as an Important Function
Purchasing Plays a Major Role in the Success of the Organization
Supplier Relationships are Mostly Short-Term and Arms-Length
Long Term Partnerships With Suppliers are Ofter Used
Suppliers are Completely Separate From Company Processes
Key Suppliers are Integrated into Company Processes

It Depends on Where You Start: How the Disciplinary Focus of Supply Chain Management Researchers Affects Perceptions of Research Publication Outlets

Michael E. Smith, Ph.D.
Western Carolina University
(828) 227-3697; mesmith@wcu.edu

George A. Zsidisin, Ph.D., C.P.M.
Bowling Green State University
(419) 372-8260; gzsidis@bgsu.edu

Thomas J. Kull, Ph.D.
Arizona State University
(480) 965-6125; Thomas.Kull@asu.edu

Abstract. This paper examines the impact of the academic discipline that a researcher brings to Supply Chain Management (SCM) on the perceptions that the researcher has regarding publication outlets for research in SCM. Findings indicate that researchers coming from the Logistics discipline may evaluate publication outlets differently than do researchers from other disciplines that contribute to SCM. Implications and directions for future research are discussed.

Introduction. Supply chain management (SCM) is a relatively new concept for which the definition is still a matter of substantial disagreement. Further, the variation in definitions tend to depend to a substantial extent on the disciplinary focus of the protagonists among disciplines that contribute to SCM, such as Logistics, Purchasing, Marketing, Operations, etc. as illustrated by Mentzer, Stank and Esper (2008). Further, Larson, Poist and Halldorsson (2007) have observed that supply chain professionals have multiple perspectives on the breadth and depth of SCM. From the perspective of different areas of business study that contribute to SCM, each domain appears to have limits in terms of their consideration of topics within SCM, yielding predispositions toward areas of focus in research and teaching that depend on the disciplinary heritage of the researcher (Mentzer, Stank and Esper 2008). That these differences would appear in the conduct and perceptions of research in SCM is quite natural, and it may also have implications for the perceptions that SCM researchers have regarding publication outlets for SCM research. This paper describes exploratory research aimed at addressing the extent to which SCM researchers that claim an interest in conducting research in Logistics may display perceptions different from those of other SCM researchers.

Differences Have Been Observed Between Logistics and Purchasing Relative to SCM. Larson and Halldorrson (2004, 2002) have examined the perceptions of academics in Purchasing and Logistics regarding the content of SCM. This research has found a range of perceptions about the extent to which the academicians view Purchasing and Logistics as overlapping with SCM, and further, this research has served to highlight differences in perceptions about the appropriate research techniques for scholarship in SCM.

Comparison of the examination of academics in Purchasing (Larson and Halldorrson 2002) with the examination of academics in Logistics (Larson and Halldorrson 2004) shows

considerable differences in how these groups view their respective disciplines in comparison to SCM. For example, while only approximately 2% of purchasing academics saw SCM as subsumed by purchasing, approximately 17% of the logistics academics saw SCM as subsumed by logistics (the "Traditionalists" according to Larson and Halldorrson). If we next consider those individuals who see SCM as being the same as their respective disciplines ("Relabeling"), we find that approximately 69% of the logistics academics saw SCM as either the same as, or subsumed by logistics. This is compared with 28% of the purchasing academics who held such a perspective with respect to purchasing.

Relative to the logistics academics, purchasing academics were considerably more likely to see SCM as containing purchasing or intersecting with the interests than were the logistics academics with respect to the relationship between SCM and logistics (approximately 71% and 30%, respectively). It is particularly striking to note that only 7% of the logistics academics saw an intersection between SCM and logistics (as compared with 41% for purchasing academics). Taken together, these findings clearly suggest that for logistics academics there is considerable confluence between SCM and logistics. Further, it would appear that there is less room in their understanding of SCM for the inclusion of contributions from the other disciplines than is the case for purchasing academics.

Differences also appeared in ratings of preferred research methods. The purchasing group, in the words of Larson and Halldorrson (2002, p. 40) "appear to be biased toward quantitative approaches rather than qualitative approaches." However, for the logistics group "case studies and interviews are rated as highly as surveys" (Larson and Halldorrson 2004, p. 26).

Together, these findings suggest substantial differences in how academics from two different disciplines that contribute to SCM view the content of SCM. Further, there appear to be substantial differences between the two groups in terms of preferred research methods. In the next section, we describe the administration of a survey of SCM academicians regarding evaluation of publication outlets for research in SCM, and then we address results that suggest that differences between logistics academics and others involved in SCM research may include journal evaluation.

Survey Development. A survey was developed to explore both the conceptual bases for journal evaluation and ratings of journals that publish research in SCM. First, the researchers developed a listing of journals that published research in supply management utilizing ABI/INFORM Global and Academic Search Elite inquiries limited to scholarly journals. After eliminating journals that were excessively specialized, such as those limited to specific industries, the list was comprised of 43 journals.

Next, the initial listing of 43 journals was then submitted to a panel of 16 North American and European experts who were selected based upon prolific research contributions in supply management. On a questionnaire initially e-mailed to the experts, they were asked to indicate which journals should be included on a list of influential journals in supply management, including up to five additional journals that they could specify. The experts were also asked to respond to four open-ended items that asked what criteria they used to formulate their selection of leading journals, what the concept of journal quality meant to them, what the concept of journal relevance meant to them, and to provide any additional observations they

might have on the subject. A total of ten questionnaires, five each from North American and European scholars, were completed.

The researchers then conducted a content analysis of the responses to the open-ended items provided by the experts in order to identify themes. These themes were utilized to develop survey items related to how supply management scholars evaluate journals. Feedback from the experts was also utilized to reduce the number of journals to those most consistently seen as influential. A survey was developed that included a section consisting of 25 items related to journal evaluation criteria, a section that asked respondents to rate 26 journals relative to the extent to which they regularly met their criteria as indicated in the first section, a section that collected demographic information, and a section that asked about involvement with each of the journals. A further review by SCM experts who had not previously been involved resulted in additional changes in the survey format and the inclusion of a 27th journal.

The researchers next deployed the survey to academic members of ISM in both a paper form and in electronic form. Of a total of 494 surveys distributed, 111 were completed for a response rate of 22.5%.

Results. Data suggest that the respondents broadly represented the range of personal and institutional characteristics present in the supply management academic community. The majority of respondents were male (65.8%), and between the ages of 35 and 54 (64.8%). With respect to academic rank, 38.7% of the respondents reported the title of associate professor, 24.3% professor, 20.7% assistant professor, and 15.1% reported other titles (1 respondent, or 0.9% did not complete the item). Just over half of the respondents (51.4%) reported having academic tenure. The vast majority of respondents work in the United States (89.2%), although respondents reported working at institutions located in a total of eight different countries. Respondents worked at institutions offering degrees at graduate and undergraduate levels, with 49 respondents coming from institutions that grant doctoral degrees in business. The length of time since the granting of the terminal degree and the amount of time spent as a business practitioner was widely dispersed among the respondents. The mean number of articles in refereed journals for respondents was 15.49, and the percentage of evaluation weight accorded research among the respondents average 44.42%. Finally, in terms of the disciplinary areas within which the respondents reported doing research (note that respondents could report doing research in more than one discipline), 15 reported doing research in Information Technology/Information Systems, 22 reported doing research in Management, 23 reported doing research in Marketing, 60 reported doing research in Operations Management, 45 reported doing research in Logistics, 87 reported doing research in Purchasing and Supply Management, and 20 reported doing research in other areas.

Non-response bias was tested by comparing conference responses and first wave electronic responses (n=75) with the second wave of electronic responses (n=31) using the demographic data of weight percentage of performance evaluations based on research productivity and number of published refereed articles. The second wave responses were deemed representative of academics that did not respond to the survey. T-tests revealed no significant differences, supporting absence of non-response bias (Li and Calantone 1998).

Each subject was asked to rate each of 25 items with respect to the extent that it was important that journals in supply management typically or generally exhibit the stated criterion

from 1—"strongly disagree," to 7—"strongly agree." Based upon the feedback from the expert panel, along with a combined approach utilizing both exploratory factor analysis and confirmatory factor analysis (Anderson and Gerbing 1988; Bentler and Wu 1995; Fan, Thompson and Wang 1999), a four-factor solution was developed to represent the constructs associated with how academics evaluate journals that publish supply management research. Of the 25 items presented to respondents, 23 items specifically loaded on the four factors. A summary is provided in Table 1, which lists the items, parameter estimates, reliability scores, sample sizes, means, and standard deviations for each factor. Sample sizes vary among the factors due to missing responses for some items.

All parameter estimates (loadings) are 0.40 or larger and statistically significant (based upon t values, evaluated for greater than 100 degrees of freedom, $p<0.001$ in all cases), and the construct reliabilities, measured using coefficient omega (Carmines and Zeller 1979), were 0.64 or greater, which exceeds recommendations provided by DeVellis 2003 and Hatcher 1994. Two factors describe characteristics associated with journals (Journal Quality and Journal Reputation), while the other two factors relate to the types of knowledge contribution made by published research (Researcher Relevance and Practitioner Relevance). Greater detail with respect to the derivation, reliability, and validation of the constructs is available in Zsidisin, Smith, McNally and Kull (2007).

Table 1. Summary for four constructs associated with supply management journal evaluation, along with associated parameter estimates and reliability scores.[1]

Factors (with Omega, the composite reliability estimate) and Associated Items	**Parameter Estimates (l_i)**	**n**	**Mean**	**s.d.**
Journal Quality ($\omega = 0.78$)		110	5.71	0.72
The journal has highly qualified reviewers	0.76			
The review process is double-blind	0.69			
The editorial board and board of reviewers are respected	0.64			
The articles are well-written	0.56			
The quality of the articles is consistently high	0.53			
The journal has a diverse readership	0.42			
Journal Reputation ($\omega = 0.64$)		108	4.65	0.82
The journal's overall reputation is good	0.55			
The articles are written by authors with good reputations	0.53			
The institution where I work emphasizes publishing in this journal	0.48			
The journal has a large circulation	0.47			
The journal is sponsored by a respected organization	0.45			
The article acceptance rate is low	0.40			
Practitioner Relevance ($\omega = 0.69$)		110	5.65	0.74

The articles provide information that is useful in teaching purchasing and supply management	0.79			
articles address issues that are of current concern in business practice	0.61			
articles are relevant to managers	0.56			
The articles provide insight into the practice of purchasing and supply management	0.43			
Researcher Relevance (ω = 0.75)		108	5.85	0.65
The journal is useful as a research reference	0.63			
The articles provide insight into the theory of purchasing and supply management.	0.62			
Purchasing and supply management scholars read this journal	0.58			
The research methods are rigorous	0.52			
Purchasing and supply management scholars publish in the journal	0.52			
The articles are relevant to academics	0.51			
The research methods are appropriate for the research objectives	0.40			

[1] Research Question: When I evaluate journals that publish purchasing and supply management research, it is important that the following are typically or generally exhibited. Each Item was then rated from 1 "strongly disagree" to 7 "strongly disagree."

An analysis of Variance was conducted to test the significance of differences in scores for each of the factors between the logistics researchers and other respondents. The logistics researchers rated Journal Quality significantly higher as important in evaluating journals publishing research in SCM than did the other respondents ($F_{(1,108)}$ =5.16, p=0.025). There were not significant differences for the other three factors.

The subjects were also asked to rate the extent of agreement that each of a list of journals generally or consistently displayed the criteria that they had previously rated as important in evaluating journals that publish research and concepts in supply management. The ratings were indicated on a Likert scale from 1 = "strongly disagree" to 7 = "strongly agree." Based upon the classification provided by Charvet, Cooper and Gardner (2008) suggesting that the *Journal of Business Logistics, International Journal of Logistics Management,* and *International Journal of Physical Distribution & Logistics Management* among the journals for which ratings were obtained characterize representative journals for the logistics discipline, ratings were evaluated for differences between the logistics researchers and other respondents. The mean ratings provided by the logistics researchers was found to be significantly higher than those provided by the rest of the respondents for both the *Journal of Business Logistics* and the *International Journal of Logistics Management* ($F_{(1,88)}$ =4.23, p=0.043; and $F_{(1,90)}$ =4.16, p=0.044; respectively). There was not a significant difference in ratings for the *International Journal of Physical Distribution and Logistics Management.* Further, logistics researchers were not found to have ratings significantly different from the rest of the respondents for two

journals with strong ties to the purchasing discipline (*Journal of Supply Chain Management* and *Journal of Purchasing and Supply Management)*.

Implications. As has previously been noted, SCM as a field of interest in research and the practitioner community represents a relatively new emphasis, and one that crosses a number of disciplinary foci. Since each of the contributing disciplines has traditionally had their own approaches to understanding elements of what is today viewed as part of SCM, there exists substantial potential for differences in how the groups approach research. These differences potentially represent challenges for researchers seeking to identify valuable avenues for research, approaches to the research, and publication outlets for completed research projects. This study provides clear evidence those researchers who identify logistics as an area of research interest may evaluate publication outlets differently than do other researchers in SCM. In particular, they appear to place more importance on Journal Quality than do others conducting research related to SCM.

This suggests that journal evaluation in SCM should not be viewed as entirely homogeneous. Further, logistics researchers viewed two out of the three journals evaluated in this study which had previously been identified by Charvet, Cooper and Gardner (2008) as representative of the logistics discipline as better representing their evaluation criteria than did respondents not reporting interest in conducting logistics research. This finding suggests that differences in evaluation criteria between disciplines may also influence journal evaluations in ways that are specific to individual disciplines. To the extent that the disciplines in which we have interest in doing research develop early in our academic careers, there may indeed be merit to the contention that views on research in SCM depend upon where you start.

The findings of the current study indicate that there may be value in applying a multi-group analysis to the criteria associated with journal evaluation, and such a study is currently under way. Further, given the findings derived from studies by Larson and Halldorrson, it would be beneficial to be able to directly compare respondents from the Purchasing discipline with respondents from Logistics. However, given that in the current sample purchasing was reported as a research interest by a substantial portion of the respondents reporting other research interests, it was not possible to conduct such an analysis. Additionally, larger samples explicitly collected from the membership of groups specifically representing the different disciplines would support a more substantial characterization of the differences between the disciplines contributing to SCM in how adherents view publication outlets for research in SCM.

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Is Benchmarking Destined to Fail?

Kimberly A. Bates, Associate Professor of Management
Trent University
705-748-1011 x7934; kimberlybates@trentu.ca

Steven A. Melnyk, Professor of Operations Management
Michigan State University
517/432-6410; melnyk@msu.edu

Sarah Jinhui Wu, Assistant Professor of Management Systems
Fordham University
718-817-4156; jiwu@fordham.edu

Barbara Flynn, Richard M. and Myra Louise Buskirk Professor of Manufacturing Management
Indiana University
317-278-8586; bbflynn@indiana.edu

Dana Johnson, Adjunct Associate Professor, Mechanical Engineering-Engineering Mechanics
Michigan Technological University
906-487-2803; dana@mtu.edu

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Abstract. This paper presents a theoretical framework for studying best practice benchmarking – a framework that was developed to address a critical paradox plaguing research on this topic: *Why is it that best practices benchmarking, which was designed to help individual organizations attain a competitive advantage by introducing best practices, resulted in a convergence of performance within industries, rather than a divergence of performance?* The framework argues that the resolution of this paradox lies in the extent to which an organization incorporates new practices into its core routines, and the extent to which learning about best practices of other organizations supports innovation within core processes.

Introduction. Since its introduction in the 1980s, best practice benchmarking (BPB) has become a staple of business practice intended to help organizations improve performance by adopting and incorporating new practices. Underlying the concept of BPB is a simple but compelling premise: by learning best practices from successful organizations, firms can incorporate these practices into their existing routines without incurring the cost of development. Yet organizations that benchmark best practices appear to seek to duplicate the performance benefits achieved by first-movers in adopting practices; thus, they are unlikely to be market pioneers (Drew, 1997). But, are organizations that engage in benchmarking seeking only to catch up to more successful organizations?

BPB is a form of exploration outside of a firm, where organizations seek to efficiently incorporate new practices; in this sense, it is designed to reduce the classic tradeoff between

exploration and exploitation (March, 1991), where resources expended on one activity cannot be applied to the other. Organizations can seek to compare their processes with competitors within their industry, or with other relevant entities within their organizational field, such as customers, suppliers, regulators, etc. (DiMaggio and Powell, 1983). We retain a broad focus on the organizational field rather than a narrow focus on the organization's industry, because organizations that engage in BPB may be seeking competitive parity, or may be pursing an agenda other than performance improvement. Indeed, if BPB results only in the adoption of existing "best" practices, it should result in a convergence between the organizations that develop best practices and those that learn about them through benchmarking. Do organizations really engage in BPB to seek performance *parity* with other organizations, or the *disparity* of enhanced performance? Do those that learn about new practices through benchmarking successfully incorporating those practices into their existing routines? Does learning through BPB enable them to develop innovative processes internally? Or do organizations simply gain enough knowledge about best practice to create the appearance of being process leaders, while buffering their core routines from outside influences? To address and resolve these questions, this study proposes a comprehensive and integrated framework to explain the benchmarking process and to identify the factors that influence its effectiveness.

We view BPB as a strategic inter-organizational learning process intended to improve efficiency and effectiveness, or to increase the organization's legitimacy (DiMaggio and Powell 1983) with important members of its an organizational field, or to accomplish *both* legitimacy and improved performance. To gain a deeper understanding of BPB, we divide the benchmarking process into six sequential stages; and identify critical questions related to each stage.

Rethinking the Best Practice Benchmarking Process. The overall benchmarking process can be roughly decomposed into six sequential steps: initiation, identification, evaluation, deployment, validation, and routinization.

Initiation. The first phase focuses on understanding why an organization decides to undertake the benchmarking process. Benchmarking may be initiated for a variety of reasons, spanning everything from top management's social ties to executives of successful organizations, to poor performance results, to government regulation. In this stage, we look at factors such as whether the organization is doing BPB as a response to competitive pressures (such as poor performance results or loss of clients), external pressure from related organizations (such as customers that demand the organization adopt certain practices to maintain preferred supplier status), as a response to internal processes or procedures (such as those that identify promising areas for improvement), or top management learning that successful or comparable organizations are engaging in benchmarking. We focus on issues such as the perceived urgency of the need for a best practice benchmark, receptiveness of the organization and its members to the need for a "new" best practice, and the time available for action. In this phase, we are particularly interested in the perceived nature of the need for benchmarking – whether BPB is driven by increasing legitimacy or improving efficiency or effectiveness, or both.

Identification. In this phase, we focus on the various sources of information, particularly the

degree to which BPB provides information new to the organization, and the degree to which it provides information the organization can interpret. There are two dimensions to our discussion of benchmarking sources: the type of organization engaged to conduct BPB studies, and whether the comparison group is composed of intra- or inter-industry organizations. BPB studies can be conducted by a variety of organizations, from in-house studies of published reports of relevant organizations, to participating in processes facilitated by professional societies with an interest in improving standards (e.g. agricultural practices associated with food safety, hospital procedures associated with patient outcomes, or environmental practices associated with "green" products), to engaging consultancies with proprietary databases. The focal organization's practices can be measured for the purpose of the BPB study or can be drawn from its records.

Intra-industry data may be easier to obtain. Repositories for certain data may be available for participation in an industry trade association. There are likely limits to proprietary processes for operational capabilities that could give a firm a competitive advantage. Comparing to peers and competitors, however, may not allow a company to achieve its maximum potential. It allows a firm to "stay in the game" by incremental changes that everyone should be making and not necessarily those that allow them to move into a higher level of performance to excel and be a leader. Only companies with efficient operative processes will remain competitive (Binder and Clegg 2006), and possibly remain as an ongoing entity. In other words, they are preventing failure to remain a player in the industry. Intra-industry benchmarking is a given to remain in the market. Benchmarking is a generally accepted business practice and management tool (Yasin 2002). The superior performer, as recognized in terms of market leadership or achievements, may not be willing to disclose the business practices; thereby, this is a major deterrent in the benchmarking process (Dattakumar and Jagadeesh 2003).

Organizations that use inter-industry comparisons are more likely to gain novel information, but this process is also not without risk. Francis and Holloway (2002) found that inter-industry BPB was more likely to lead to an in-depth understanding of top performers and that these organizations exhibited strong organizational learning and knowledge management, leading to increased customer satisfaction. Garvin (1991) stressed that the core of successful benchmarking lies in regular and documented global scanning for organizations with superior processes, regardless of industry. Inter-industry process benchmarking requires that a organization is able to identify similarities between its processes and those of the organization providing the benchmark, even when they appear to be different (Kyro, 2003).

Evaluation. This phase has been ignored by much of the previous literature, but we see this step as a critical contribution of our research. There are two ways of evaluating benchmarked information: 1) focusing on characteristics of the benchmarked information, which we have discussed above and 2) focusing on characteristics of the organization that is doing the benchmarking. House and Sign (1987) focus on characteristics of the knowledge and practices that are benchmarked, stating that mimicry occurs primarily when technologies are poorly understood and when goals are ambiguous. In contrast, Hayes and Wheelwright (1984) believe that indiscriminate benchmarking is symptomatic of an organization (Stage II) where the operations function isn't believed to be capable of making strategic decisions; because it isn't perceived as capable of evaluating the practices of other organizations, it adopts them all.

Thus, there are some interesting research questions related to the Evaluation step. What information and technology characteristics are more likely to be benchmarked? What organizational characteristics are more likely to be associated with benchmarking? What is the relationship of each of these types of characteristics to ultimate performance? How does benchmarking by Stage II organizations differ from benchmarking by Stage III organizations, both in terms of what is benchmarked and how effective benchmarking is?

Deployment. The deployment stage focuses on the implementation of benchmarked practices. Research questions related to this stage deal with why benchmarking is effective for some organizations, but not for others. The organizational learning literature indicates that learning does not always increase the learner's effectiveness, or even potential effectiveness. Learners can incorrectly learn, and they can correctly learn what is incorrect (Huber 1991). This perspective provides at least two explanations for why companies fail to improve performance from best practice benchmarking.

First, they may imperfectly imitate practices that have been successful for other firms. This is supported by the resource-based view and may also have to do with the capabilities of the firm that is doing the imitating. It may morph the practices that are being imitated so that they are consistent with its capabilities, leading to imperfect imitation. In contrast, however, there is evidence that organizations that put more emphasis on best practice customization, extension, and reconfiguration will develop, through experimentation, the best asset portfolio for their own businesses. For example, Westphal et al. (1997) found that companies that customized TQM practices gained efficiency in performance whereas companies that adopted TQM practices motivated by legitimacy effects gained little. Thus, there are interesting research questions that deal with the extent to which benchmarked practices are adapted and their relationship to the benchmarking organization's capabilities.

Second, organizations may effectively imitate practices and technologies that are inappropriate for their strategic goals and objectives. Thus, this relates back to the evaluation phase. If evaluation is not done effectively, a firm may put a great deal of effort into imitating practices that do not have the potential for improving its performance.

Validation. Although benchmarking starts with borrowing best practices from other organizations, the organizational learning does not end there. Organizations also acquire knowledge through direct experience in the implementation/deployment process, where they evaluate whether they have reached the desired outcomes and determine which elements of the benchmarked practice should be improved or reinforced. Therefore, the validation process provides an opportunity for the firm to refine its knowledge, which serves as a feedback loop to adjust the best practices implementation. This is consistent with the literature on double-loop learning (Argyris 2003; Argyris 2004), as well as the Toyota Production System (Spear and Bowen 1999), which views operations as a series of controlled experiments. Following this perspective, a potential best practice should be viewed as a hypothesis that can be tested through action.

Routinization. This phase happens after a company successfully benchmarks best practices. It prepares employees to draw upon best practices, prevents them from returning to the old

practices (backsliding), and provides a structure for dissemination of the knowledge, experiences, practices, and lessons learned. In this stage, we build on our evaluation of deployment, asking whether the best practice becomes part of the organization's standard operating procedures, becoming part of the core routines and processes of the organization. Is the organization able to incorporate new practices into existing routines? Does learning about the practices of other organizations enable the focal organization to develop its own unique practices (e.g. by combining parts of other organizations routines in novel ways)?

Summary. This study provides a comprehensive conceptual framework to gain a deeper understanding of why BPB may fail to reach the expectations of organizations that engage in it. The overall benchmarking process is divided into six phases and critical questions are raised for each phase, in order to materially improve our understanding of both the outcomes and the process of benchmarking. Our model shows that organizations may fail to improve their performance relative to competitors due to clearly identifiable factors at each stage of the BPB process. Without an awareness of these issues, BPB may lead to competitive parity rather than competitive advantage. We also build on research of other practices, notably TQM, that some firms may engage in BPB in order to gain the appearance of improving their processes, without intending to improve their core routines and processes, in order to improve the opinions of key constituencies, such as consumers, regulators, or even supply chain partners. Other organizations may seek to achieve competitive parity rather than to improve their competitive position. Some may lack the ability to integrate best practices into their existing routines, while others may not realize that achieving competitive parity is unlikely unless they are able to understand how to build on best practices by supporting innovation within.

BPB will only lead to competitive advantage if firms understand the potential issues of each stage of the process. As well, future research into BPB will fail to produce insight unless each of these issues is explored and identified. Given the variety of issues associated with the type of information gained through benchmarking, the divergence of goals for engaging in it, and the issues associated with the firm's ability to integrate new practices into existing routines, more detailed, careful research into BPB is needed. Our research will attempt to validate our model first using detailed case studies to develop our research questions into testable propositions, and subsequently through surveys to establish the relationship between variables at each stage of the model. By asking when and why BPB may lead to competitive parity, rather than competitive advantage, we take a realistic approach to benchmarking that builds on previous studies, while also seeking to make significant improvements.

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Assessing Supplier Default Risk on the Portfolio Level: A Method and Application

Stephan M. Wagner*, Swiss Federal Institute of Technology Zurich, Switzerland
Christoph Bode, Swiss Federal Institute of Technology Zurich, Switzerland

* Corresponding Author (Email: stwagner@ethz.ch)

Abstract

The main purpose of this paper is to quantify the risk in a buying firm's supplier portfolio that stems from the financial default of suppliers. Based on credit risk models we develop a methodology that buying firms can use to determine their exposure to supplier default risk. Empirical data pertaining to supplier portfolios of upper-class car models from three German automotive manufacturers is used to illustrate the application of the methodology. We show that some car models are exposed to higher risk. This places them at a disadvantage, because the higher the supplier default risk, the more likely it is that the supply of components can be disrupted and cars cannot be built and sold. Buying firms can use this methodology for the pro-active assessment of supplier default risk.

Keywords: Supplier default risk; Supplier portfolios; Credit risk models; Automotive industry

Introduction

Automotive manufacturers (original equipment manufacturers – OEMs) have faced a dramatic decline in sales and capacity utilization since the beginning of the economic downturn (Department of Commerce, 2009a). For many automotive OEMs their financial situation deteriorated substantially, while others even had to file for bankruptcy (e.g., Saab in February 2009; Chrysler in April 2009; GM in June 2009). The situation is even worse for automotive suppliers. Automotive manufacturers have been constantly seeking price concessions from their suppliers, while asking them to take on more design and

manufacturing responsibilities and to absorb higher costs for their input materials. It is not surprising that this situation has placed many automotive suppliers under great economic pressure. As a result, the financial situation of many automotive suppliers has deteriorated (Department of Commerce, 2009b), and compared to previous years more and larger automotive suppliers have ended up, or are on the verge of ending up, in bankruptcy (e.g., Contech in February 2009; Visteon in May 2009).

In 2005, the Moody's rating of 54 global auto suppliers (from North America, Europe, and Asia) assigned investment-grade to only 33% of suppliers, but speculative-grade to 67%. The report's outlook was not much more promising: 11% of suppliers had a positive outlook, 59% a stable outlook, and 30% a negative outlook or were on review for possible downgrade (Murphy, Kelly, and Stoll, 2005). The situation has deteriorated since then. In 2009, from a total of 59 global auto suppliers only 24% maintained investment-grade while 76% were rated speculative. The outlook was also much worse: For 1% it was positive, for 34% it was stable, and for 65% it was negative (Harrod, 2009).

Supplier bankruptcies have become a major concern in the automotive industry. For automotive OEMs, the early identification of supplier default risk and the mitigation and management of supplier defaults have risen to the top of the agenda (Wagner, Bode and Koziol, 2009). The measures that OEMs take range from implementing early warning systems to changing sourcing strategies (e.g., from single to multiple sourcing) or financially supporting suppliers in order to keep the supply chain going (Milne, 2009). Such measures, however, can only be pro-actively implemented and effective if the OEM possesses a thorough understanding of the supplier default risk embedded in its supplier portfolios.

So far, the assessment and quantification of supplier default risk that goes beyond the analysis of supplier firm ratings (such as the ratings provided by Standard & Poor's, Moody's, or Fitch) has remained largely unexplored. Reasons are that the prediction of the behavior of firms that are connected in a supply network is complex and that supplier defaults are correlated and not independent events. Furthermore, firms do not have outright access to data for the assessment of supplier default risk. In

consequence, there is a lack of quantitative models for the systematic quantification of supplier default risk.

Therefore, the first goal of this paper is to develop a method based on portfolio credit risk models that can be used to assess supplier default risk. Consistent with the extant literature that buying firms need to manage the risk in their supplier portfolio (as opposed to managing the risk of individual suppliers) (e.g., Choi and Krause, 2006; Wagner, 2004), the proposed method can be applied on the portfolio level. The second goal is to exemplify the application of the method by analyzing real-life supplier portfolios and assessing and comparing the default risk inherent in these portfolios.

The outline of the paper is as follows. Section 2 provides some background information on supplier portfolios and credit risk models. In section 3, we transfer the credit risk modeling approach to the purchasing context and provide a theoretical background on credit risk and supplier risk modeling. Next, we explain the methodology and how empirical data was obtained. In section 5, the results of the empirical analysis are presented. The paper provides discusses implications and concludes in section 6.

Background

Supplier portfolios

Markowitz (1952) proposed the portfolio concept for selection of investment opportunities. He argued that, due to a diversification effect, a collection of investment assets may have collectively lower risk than the sum of the individual asset. Since then, portfolio approaches have been used to represent risk and return trade-offs in making investment decisions. The portfolio approach has also been widely used in purchasing practice for classifying suppliers and materials based on various dimensions, such as purchasing volume, power-dependence relationships, or risk considerations (e.g., Bensaou, 1999; Gelderman and Semeijn, 2006; Kraljic, 1983). Wagner and Johnson (2004, p. 719) define a firm's supplier portfolio as "the set of supplier relationships assembled by the firm with the intent of managing

risks and optimizing returns where management activities involve not just individual supplier relationships but the entire supplier portfolio as a group," pointing out that firms need to deal with risk in supplier portfolios beyond individual buyer-supplier relationships, that interdependencies among suppliers exist and that risk-return trade-offs need to be considered.

In the context of supplier defaults, a supplier portfolio perspective can also help firms in classifying suppliers and deriving groups of suppliers with low or high impacts in case of supplier default. In the following sections this portfolio perspective will be further used in the discussion of exposure, an important input variable of the credit risk models.

Credit risk models

In finance, various models for investment risk quantification and management have been developed. For example a bank determines the price of a loan mainly based on expected loss. The unexpected loss in a loan portfolio should be captured by economic capital, as Basel II regulation requires (Bluhm, Overbeck, and Wagner, 2003).

Figure 1 provides an overview of prominent credit risk models. For the purpose of this study, we adopt the CreditRisk+ model, which was initially developed by CreditSuisse First Boston in 1997, to model supplier default risk. First, it is a widely used and well accepted method for risk quantification. Second, in CreditRisk+ the risk driver is the default risk of the counterparties (obligors in banking) which suits well with the modeling of supplier defaults. Third, all the mathematical formulas in the model are documented and the technicalities are freely available (Wilde, 1997).

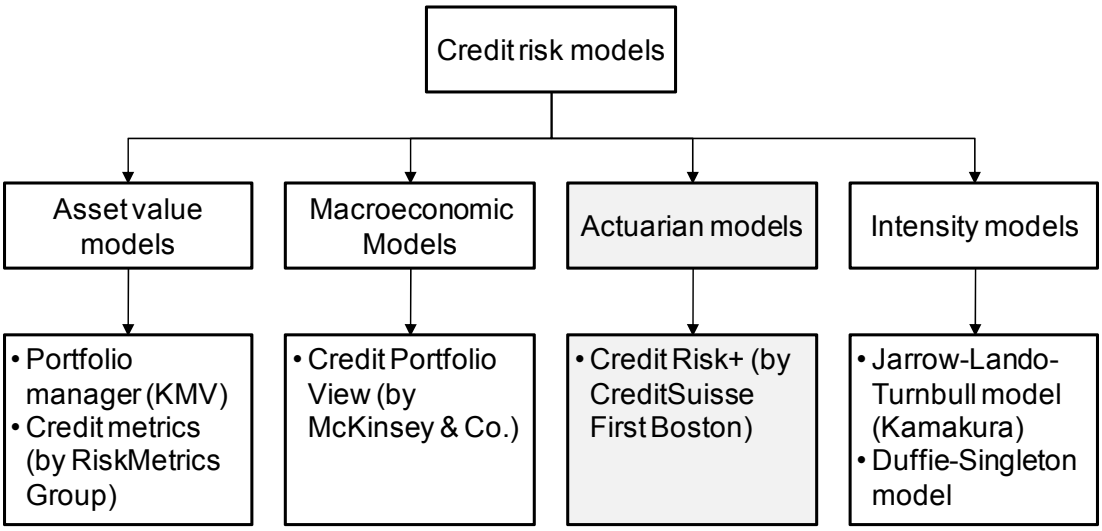

Figure 1. Overview of industry credit risk models (Bluhm et al., 2003)

Transferring Credit Risk Models to Supplier Portfolios

This section aims to provide an introduction to credit risk frameworks and to examine the applicability of these frameworks to the purchasing context. We first discuss the basic risk attributes of a counterparty (i.e., a supplier), including the default probability, the exposure, and the default correlation between counterparties. Second, we explain the Bernoulli model (Bluhm et al., 2003) as a basic approach of modeling defaults. Third, we introduce the CreditRisk+ model as an example of the industry credit risk model (Wilde, 1997).

Essential risk attributes of counterparties

Default probability. The default probability (DP) of a firm represents the probability that the firm goes into bankruptcy in a certain time period, typically one year (Bluhm et al., 2003).

Two approaches can typically be used to assign the DP to a firm. The first approach is *using market data of the firm to calculate the DP*. This approach is supported by previous research and finds its applications in various industry models. Altman (1968) shows the efficiency of predicting firm's

bankruptcy by multiple discriminate models using financial ratios, for example liquidity ratio and leverage ratio. Jarrow and Turnbull (1995) propose a method of estimating default risk using the price of corporate bonds. In the well-known KMV credit risk model, the DP is defined in the content of an asset value process. The DP is the likelihood that the assets value of the firm becomes lower than the critical threshold in a certain period of time, usually one year (Bluhm et al., 2003).

The second approach is to *calculate the DP with ratings from rating agencies* like Moody's, Standard & Poor's, or Fitch. The rating agency measures the credit worthiness of a firm and assigns a rating to the firm which is expressed in a letter system. The transformation from the letter system of the rating to the DP can be done using historic default frequencies, for instance the Moody's historic bond default frequencies for Moody's ratings. Bluhm et al. (2003) suggest a three-step calibration method. The default volatility is also computed with this method.

1. For each letter rating class, compute the over-year mean value of the default frequencies and the standard deviation based on the yearly bond default data, such as the corporate default data from 1920 to 2006 by letter rating of Moody's (Hamilton, 2007).
2. Plot the mean value of the default frequencies of each class against the numbered rating classes for instance 1 (Aaa) to 7 (Caa-C). On a logarithmic scale the mean default frequencies can be fitted by a regression line. There is empirical evidence that default frequencies grow exponentially with decreasing creditworthiness. Hence an exponential fit is chosen to estimate the regression function.
3. Assign a DP using the regression equation from step 2.

In the first approach for obtaining DPs, collecting market data of the firm and modeling the DP has to be done by the researcher. In the second approach, the analysis of the firm is done by rating agencies. The advantage of the second approach is that it requires apparently less effort for data collection and analysis. One disadvantage of ratings is that rating agencies only rate a limited number of firms. For

example worldwide only 59 automotive suppliers were rated by Moody's in the year 2009 (Harrod, 2009). For firms that are not rated, other methods such as peer-group analyses are required. Another disadvantage of ratings is that they are not transparent and may lead to misunderstanding. The ratings may not be reliable. For the purpose of this study we opted to use the second approach, by using the individual DPs of automotive suppliers from a rating evaluation.

Exposure at default. In banking the exposure at default (EAD) of an obligor contains two parts: drawn (OUTST) and undrawn loan (COMM) at the time before default (Bluhm et al., 2003), where

$$\mathrm{EAD} = \mathrm{OUTST} + \gamma * \mathrm{COMM} \quad (1)$$

and γ is the expected portion of the commitments likely to be drawn prior to default. An approach to determine "exposure at supplier default" would be to measure exposure as a dollar value. There are situations in purchasing where a dollar value of an exposure can be estimated. For example, in the raw material spot market the buyer can switch from a contracted supplier to a spot market to satisfy its demand. Haksöz and Kadam (2009) argue that in the setting above, the exposure at contract breach by a supplier is the difference between the spot market unit price and the contract unit price multiplied by the volume of the contract. However automotive parts, components, modules or systems are regularly customer-specific or even car model-specific, so that spot markets with price information do not exist. In case of a supplier default, the OEM cannot turn to the spot market and maybe just pay a higher price. The exposure at supplier default is an ex post measurement which is difficult to forecast accurately. However, OEMs might financially assess exposure (e.g., a simple way would be to use purchasing volumes for the components) and estimate and assign a dollar value for exposure to each supplier.

Besides the availability of such information, another difficulty is that supplier defaults are rare events and empirical reports of the loss from defaults are often not available. Nevertheless, one can identify determinants for defaults (e.g., complexity of the components, availability of suppliers, ease of

switching suppliers) and derive a quantitative measure for exposure (on a scale other than dollar value), and use this information in the credit risk model.

Expected loss of single default. In the banking industry the expected loss of an obligor is measured in the following way: the bank assigns to a obligor denoted as i a default probability (DP), a exposure at default (EAD) and a loss fraction called the loss given default (LGD), describing the fraction of the exposure subject to be lost in the considered time period (Bluhm et al., 2003). The loss $\tilde{L}$ of the obligor is defined by:

$$\tilde{L}_i = EAD_i * LGD_i * L_i \text{ with } L_i = 1_D, P(D) = DP_i \quad (2)$$

where D denotes the event that the obligor defaults in a certain period of time (most often one year). L_i is a Bernoulli random variable and $P(D)$ denotes the probability of D. The expectation of any Bernoulli random variable 1_D is its event probability.

The expected loss (EL) of the obligor as the expectation of its corresponding loss variable $\tilde{L}$ is determined by:

$$EL_i = E[\tilde{L}_i] = EAD_i * LGD_i * P(D) = EAD_i * LGD_i * DP_i \quad (3)$$

In this study the loss due to a supplier default for one OEM is similar to the obligor default in banking. The methods to calculate the loss in a credit risk model are already well established. The expected loss is also calculated according to equation (3).

Default correlation. Similar to the correlation between obligors in a loan portfolio, recent studies have shown that the defaults of suppliers in a portfolio can also be correlated (Babich, Burnetas, and Ritchken, 2007; Swinney and Netessine, 2009; Wagner, Bode and Koziol, 2009). Default correlation between firms in credit risk modeling should be the same from a bank and from an automotive OEM point of view. There are well established explanations about correlation in the credit risk modeling research, for instance the state of the overall economy or the situation in the particular industry.

Correlation modeling is an important and challenging part of credit risk modeling. One basic idea is to treat default probabilities as random variables (Bluhm et al., 2003). The default frequency of companies in the same rating class can vary from year to year. In the Bernoulli model the default correlations are fully captured by the covariance structure of the stochastic default probabilities. In the CreditRisk+ model the correlation is introduced by randomization of default intensity and sector analysis (Wilde, 1997).

Modeling of defaults: The Bernoulli model

The Bernoulli model is a basic model for modeling two state events. A supplier portfolio is a collection of a number of suppliers. The number of suppliers is denoted as m. In a two-state model, each supplier has two future scenarios: either the supplier defaults or the supplier survives. A variable L_i can be used to indicate these two states. In case that supplier i defaults, L_i equals to 1; when the supplier survives, L_i equals to 0. The default probability of supplier with indicator i is denoted as p_i. A vector of random variables $L = (L_1, \dots L_m)$ is called a Bernoulli loss statistics, if all marginal distributions of L are Bernoulli distributions:

$$L_i \sim B(1; p_i), \text{ i.e. } L_i = \begin{cases} 1 \text{ with probability } p_i \\ 0 \text{ with probability of } 1\text{-}p_i \end{cases} \quad (4)$$

The number of defaults in one portfolio is defined as

$$L = \sum_{i=1}^{m} L_i \,. \quad (5)$$

The easiest type of loss statistic can be obtained by assuming a uniform default probability p and independence between the suppliers. The mathematic form of this assumption is

$$L_i \sim B(1; p), \text{ and } (L_i)_{i=1,\dots,m} \text{ independent.} \quad (6)$$

In this case, the portfolio number of defaults L is a convolution of independent and identically distributed Bernoulli variables and therefore follows a binominal distribution with parameter m and p,

$L \sim B(m; p)$. The expected number of supplier defaults and the variance in one year are calculated with the following formulas:

$$E[L] = mp \text{ , and } V[L] = mp(1-p). \tag{7}$$

Keeping the assumption of independent suppliers, but allowing each supplier to have different default probabilities, the following expression is obtained:

$$L_i \sim B(1; p_i), \text{ and } (L_i)_{i=1,\dots,m} \text{ independent.} \tag{8}$$

The portfolio loss is still a convolution of the single loss variables. The first moment (the expected value) and the second moment (the variance) of the loss distribution L are:

$$E[L] = \sum_{i=1}^{m} p_i \text{ , and } V[L] = \sum_{i=1}^{m} p_i\,(1-p_i). \tag{9}$$

The assumption that the suppliers are independent in the default events is rather unrealistic. A basic idea for modeling correlated defaults is the randomization of the involved default probabilities in a correlated manner. This leads to so-called mixture models. In the *Bernoulli mixture model,* fixed default probabilities $p = (p_1, \dots, p_m)$ are considered as a realization of random default probabilities $P = (P_1, \dots, P_m)$. P follows some distribution function F with support in $[0,1]^m$. $L = (L_1, \dots, L_m)$ is a loss statistics vector with Bernoulli variables $L_i \sim B(1; P_i)$. The Bernoulli mixture model assumes that, conditional on a realization $p = (p_1, \dots, p_m)$ of P, the variables $L_1, \dots, L_m$ are independent:

$$L_i|_{P_i=p_i} \sim B(1; p_i),\ (L_i|_{P=p})_{i=1,\dots m} \text{ independent.} \tag{10}$$

The joint distribution of $L = (L_1, \dots, L_m)$ is determined by the following probability function:

$$P[L_1 = l_1, \dots, L_m = l_m] = \int_{[0;1]^m} \prod_{i=1}^{m} p_i^{l_i}(1-p_i)^{1-l_i} dF(p_{1,\dots,}p_m), \tag{11}$$

where $l_i \in \{0,1\}$. The expected value and variance of the single losses L_i are given by:

$$E[L_i] = E[P_i], V[L_i] = E[P_i](1-E[P_i]) \text{ where } i = 1, \dots, m. \tag{12}$$

The default correlation in a Bernoulli mixture model is given by:

$$\mathrm{Corr}[L_i, L_j] = \frac{\mathrm{Cov}[P_i,P_j]}{\sqrt{E[P_i](1-E[P_i])}\sqrt{E[P_j](1-E[P_j])}} \tag{13}$$

For portfolios with a uniform default probability and a uniform correlation, equation (13) can be transferred to a default model with a Poisson distribution. P denotes the uniform random default probability. V[P] denotes the variance of P. $\overline{p}$ denotes the mean value of the random default probability P.

$$\mathrm{Corr}\left[L_i, L_j\right] = \frac{V[P]}{\overline{p}(1-\overline{p})}. \quad (14)$$

For example, assume a portfolio has a uniform default probability of $\overline{p}$=3.558% and V[P] =0.002 (level of Moody's rating class B). Then, the correlation between any two counterparties is 0.064.

Modeling the portfolio loss distribution

Portfolio loss distribution. Portfolio loss distribution modeling is one step further than the modeling of portfolio default distribution. The severity of defaults, which are measured by exposures, may vary largely between suppliers. This is not captured in a portfolio default distribution. Thus, the portfolio loss distribution provides richer insights for credit risk management because all risk quantities, for instance the expected loss and the economic capital (Bluhm et al., 2003), are derived from this distribution. See Figure 2 for an illustration of a portfolio loss distribution. The control mechanisms of the losses at different levels are listed in Table 1. For a more detailed discussion of this topic we refer the interested reader to the technical documentation of CreditRisk+ (Wilde, 1997).

There are essentially two ways to generate a loss distribution: the Monte Carlo simulation and the analytical approximation. The main characteristics of these two methods, as well as the pros and cons are summarized in Table 2.

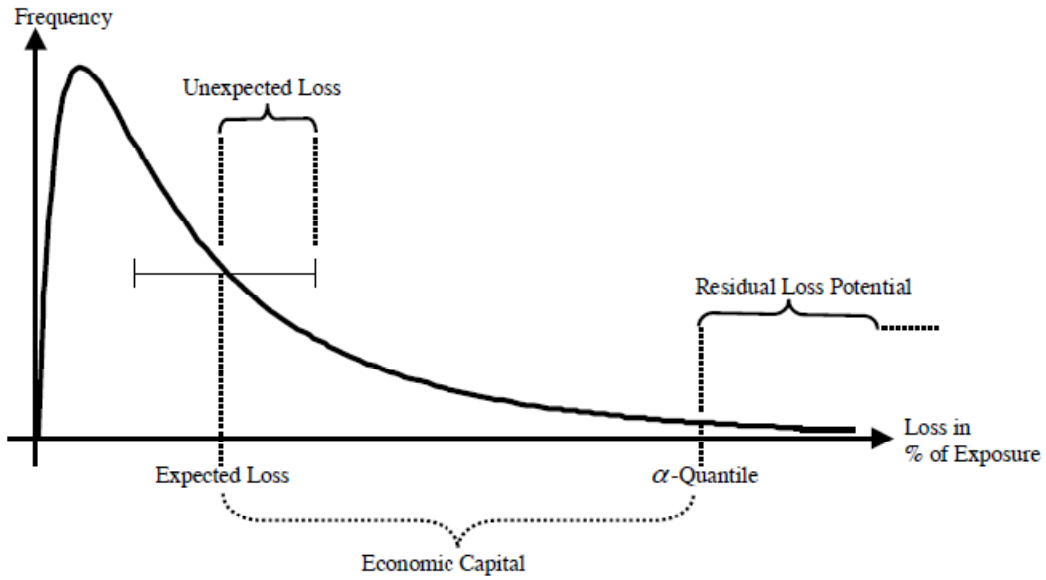

Figure 2. The portfolio loss distribution (Bluhm et al., 2003)

Table 1. Mechanisms for controlling the risk of credit default losses (Wilde, 1997)

Part of loss distribution	Control mechanism
Up to expected loss	Adequate pricing and provisioning
From expected loss to α-Quantile (for instance 99th percentile loss)	Economic capital and/or provisioning
Greater than the α-Quantile	Quantified using scenario analysis and controlled with concentration limits.

Table 2. Comparison of Monte Carlo simulation and analytical approximation method

	Monte Carlo Simulation	Analytical approximation
Generation of distri-bution of portfolio loss	N potential portfolio losses are simulated and tabulated in a histogram	Approximation by some closed form distribution, for example beta distribution using moment matching
Base of asset correlation modeling	Factor models, for example the Global Correlation Model from KMV	Practical experience with portfolios with known average asset correlation,
Default correlation form	Asset correlations between every two counterparties	An average correlation for all counterparties, for instance 20% for all corporate loans
Advantages	Accurately capturing the correlations inherent in the portfolio	Very little computation efforts
Disadvantages	Takes long time when the numbers of counterparties and the number of scenarios are large	Significant model risk from assumption of average asset correlation and approximation with known distributions

CreditRisk+ model follows a Poisson mixture approach. The concentration risk stemming from correlation between counterparties is measured using a sector analysis by introducing default rate volatilities. Sector analysis underlies the correlation structure between counterparties, which are influenced by the same underlying factor for instance the U.S. economy and the automotive industry. If two counterparties have no sector in common, there is no correlation between them. For the level of the correlation please refer to equation (138) of the technical documentation of CreditRisk+ (Wilde, 1997, p. 57).

Instead of modeling directly the portfolio loss distribution, CreditRisk+ model firstly derives the probability generation function of the portfolio loss (see equation (78) of the technical documentation of CreditRisk+ (Wilde, 1997, p. 48)). The loss probability is then solved by a recurrence function (see equation (77) and equation (80) of the technical documentation of CreditRisk+ (Wilde, 1997, p. 48-49)).

Risk contributions and pairwise correlations. Risk contributions and pairwise correlation are two measures connected with default loss distribution. Risk contribution measures the contribution of the counterparty to the unexpected loss of the portfolio, measured by a certain percentile level or the standard deviation. The sum of the risk contributions of all the suppliers in the portfolio should equal to the loss of chosen percentile (e.g., 99th percentile). Risk contributions of the suppliers have important implication in portfolio management. By removing counterparties with high risk contributions, the risk level can be decreased. See the technical document (Wilde, 1997) for an illustrative example.

The pairwise correlation function of two suppliers A and B are calculated with the following equation:

$$\rho_{AB} = (\mu_A \mu_B)^{1/2} \sum_{k=1}^{n} \theta_{Ak} \theta_{Bk} \left[\frac{\sigma_k}{\mu_k}\right]^2 \quad (15)$$

where k denotes the sectors with index k and n is the number of sectors. $\theta_{Ak}$and θ_{Bk} denote the sector decomposition of supplier A and B. μ_k denotes the long-term annual average number of defaults of sector k and σ_k denotes the standard deviation of number of defaults of sector k. μ_A and μ_B denotes the

expected number of defaults of supplier A and B in a certain time period. When the considered time period is one year, μ_A and μ_B are equal to the default probability. If all the suppliers are allocated to a single sector, so $k = 1$, $\theta_{Ak} = \theta_{Bk} = 1$, the equation can be rewritten as:

$$\rho_{AB} = (\mu_A \mu_B)^{1/2} \left[\frac{\sigma_1}{\mu_1}\right]^2, \tag{16}$$

$$\sigma_1 = \sum_A \sigma_A \, , \mu_1 = \sum_A p_A \tag{17}$$

where p_A denotes the mean default probability of supplier A; μ_1 denotes the long-term annual average number of defaults of the single sector 1 and it equals to the portfolio sum of default probabilities; σ_A denotes the standard deviation of default probability of supplier A; σ_1 denotes the standard deviation of default probability. Because the fraction $\frac{\sigma_1}{\mu_1}$ is usually close to 1, the pairwise correlation has the same order as the term $(\mu_A \mu_B)^{1/2}$.

Method and Empirical Data

Empirical setting

We have chosen the German automotive industry for our empirical analysis for various reasons. It is a well known and important industry in many countries, particularly in Germany. Also, automotive OEMs are highly dependent on their suppliers. On the one hand, automotive OEMs are large and powerful customers, on the other hand, suppliers are critical for automotive OEMs to achieve and sustain competitive advantage due to the high degree of outsourcing and the innovation that comes from the suppliers. The high criticality of suppliers for the OEM's success coupled with frequent supplier defaults observed in the industry warrants an investigation of supplier default risks which can inform industry practice and research.

Supplier portfolios from "Who Supplies Whom" database

The database "Who Supplies Whom" published by SupplierBusiness, a research company focusing on automotive supply base issues, is the starting point for our data collection. The data base contains comprehensive information about current car models, components, and modules as well as suppliers and covers around 80% of the volume in Europe and North America. Europe has been covered on this level of detail since 2002 and North America since January 2004. SupplierBusiness gathers the data through surveys of approximately 800 suppliers globally.

Based on this database, we constructed and analyzed supplier portfolios for three upper-class car models which have similar target customers and belong to a similar price range: the BMW 5-series (platform: E60; launch: 2003), the Audi A6 (platform: C6; launch: 2004), and the Mercedes E-class (platform: W211; launch: 2002).

Amadeus database for company ratings and default probability

Company ratings and default probabilities were obtained from the AMADEUS (Analyse MAjor Databases from EUropean Sources) data base provided by Bureau van Dijk-Electronic Publishing. AMADEUS focuses on European companies and provides standardized annual reports (for up to 10 years), and financial ratios as well as information on business activities and ownership structures on approximately 11 million companies throughout Europe. AMADEUS also offers a rating – the MORE (Multi Objective Rating Evaluation) rating, a credit risk product from ModeFinance[1]. The MORE rating is used for obtaining default probabilities. The MORE rating is based on the financial situation of the company and uses five categories of information as input (1: Solvency ratios; 2: Liquidity ratios; 3: Profitability ratios; 4: Interest coverage ratios; 5: Constraints on efficiency). The MORE rating methodology is very similar to Moody's methodology; an important difference between the two rating

[1] See www.modefinance.com for details.

systems is that Moody's takes both quantitative and qualitative information of a firm into account. The latter considers, for example, the financial policy, market share, competitive position and geographic/business diversification. In case that a uniform probability is assumed for all the suppliers in one portfolio, Moody's default probability is used.

Supplier switching cost estimation

As discussed earlier, exposure is difficult to measure in the automotive industry. Therefore, we have chosen switching costs as a proxy for exposure. While exposure measures the value subject to loss at default, switching costs measure the cost of switching away from a supplier after a default. Both concepts are part, component, module, system, and supplier market specific.

Estimating a dollar value of switching cost of a certain component is almost impossible for a broad range of components. Therefore, we aimed at assessing how difficult it is to switch away from a supplier of a certain component. Based on a standardized questionnaire, multiple experts were asked to estimate the switching cost for each component on a five-point rating scale (1: very low, 2: low, 3: medium, 3: high, 5: very high), which we denoted as switching cost rating (SCR).[2] Thus, it is important to note that these "switching costs" are measured on an arbitrary unit. It is not a monetary value as in the common credit risk distributions. And an assumption made is that the switching cost ratings of suppliers are linear; hence it is allowed to add the switching cost of suppliers together. This assumption is necessary to justify the use of switching cost ratings as exposures.

A key criterion for selecting the informants – who assess the supplier switching costs – is the knowledge and familiarity of the informants with the topic under investigation (Wagner, Rau, and Lindemann, 2010). Therefore, we selected two informants that were familiar with the supply markets and the components provided to automotive OEMs. We calculated interrater agreement on the rating of

[2] The complete questionnaire and the coded answers can be obtained from the corresponding author.

the 132 components in the questionnaire. 90% of the differences of the ratings were within one rating class. This shows that there is a relatively high level of interrater agreement.

The switching cost rating of the individual components received were transferred to a switching cost rating. Since the unit of analysis in the CreditRisk+ model is the individual supplier, not a component, it was necessary to aggregate the SCRs of the components to that of the supplier. For suppliers supplying multiple components there are three different possibilities to calculate the SCRs of suppliers from the SCRs of the components:

- SCR of supplier = Sum of SCRs of all components in the supply scope (*scenario I*)
- SCR of supplier = Mean of SCRs of all components in the supply scope (*scenario II*)
- SCR of supplier = Max of SCRs of all components in the supply scope (*scenario III*)

Scenario I assumes that the SCRs of components are linear and can be added together. On the one hand, this assumption seems to be reasonable, as the more components the supplier delivers, the higher the switching cost. But on the other hand, the assumption has a disadvantage. If one supplier delivers five very simple components, all with SCR of 1, the supplier has finally a SCR of 5, which is equal to a supplier which delivers a very difficult component with SCR of 5. This may not be the case in reality. Following scenario I the supplier can receive a SCR bigger than 5.

Scenario II takes the average value of SCRs of all the components in the supply scope as the rating of supplier. In this case, the disadvantage of adding up the ratings in scenario I is avoided. If a supplier supplies 5 components with SCR of 1, the supplier receives a SCR of 1. Following scenario II the supplier SCR ranges from 1 to 5.

Scenario III assumes that the most difficult component to replace in the supply scope is decisive for the SCR of a supplier. For instance, if one supplier delivers two components, one with SCR of 4 and the other with 3, the supplier receives a SCR of 4. Similar to scenario II, the supplier SCR is also between 1 and 5 under scenario III.

Depending on the method of aggregation, the SCRs of the suppliers have different values. In the results section, all three scenarios are examined in the CreditRisk+ model.

Supplier default correlation

Wagner, Bode, and Koziol (2009) find that in the German automotive industry default dependency among suppliers often exists and can have significant consequences. They identify several sources of default dependency between suppliers that can also be found in the German automotive industry. First, cooperative relationship between automotive suppliers, for example, exchanging explicit and tacit information, or engaging in joint venture projects can have the consequence that strategic decisions of suppliers are similar. Second, raw material price increases may have high impact on the profitability of all suppliers with the same factor input. Third, automotive suppliers face similar challenges because of the characteristics of the industry. Due to the highly concentrated market, there are only a few large and powerful automotive OEMs that can exert power over suppliers. Automotive suppliers are under constant pressure of cutting prices annually and providing innovations to OEMs. Fourth, the defaults of automotive suppliers are correlated because their financial health is all depending on the state of the economy and the automotive industry. In the current economic crisis there is drastic drop in the demand for cars, resulting in lower volumes at all automotive suppliers.

Results

Supply market and overlapping of supplier portfolios

In this section we analyze the supplier portfolios for the three car models BMW 5-series, Audi A6, and Mercedes E-class. Excerpts of the data are included in Appendix B.[3] Automotive suppliers usually supply to several automotive OEMs. Hence, the supplier portfolios for the three car models investigated

[3] The complete data sets pertaining to the three car models can be obtained from the corresponding author.

in this study also overlap (Figure 3). As such, we investigate the dynamics in triadic supply network relationships where a supplier works with two or three customers, and where the customers are direct competitors (Choi and Wu, InPress).[4]

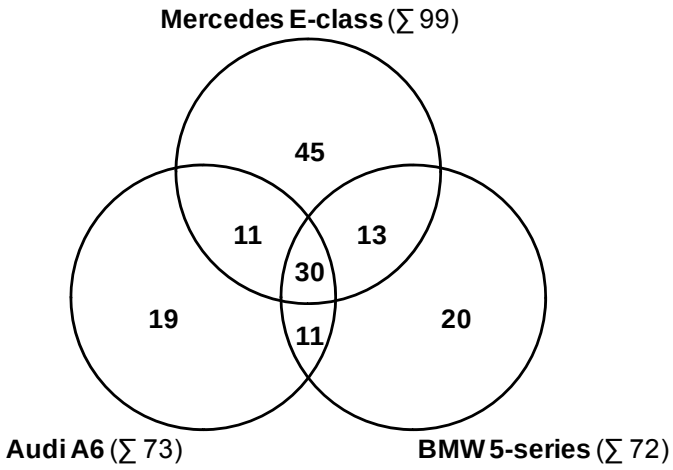

Figure 3. Overlap of the three car models' supplier portfolios

The supplier portfolio we were able to compile from our data sources contains 72 suppliers for the BMW 5-series, 73 for the Audi A6, and 99 for the Mercedes E-class. The total number of suppliers amounts to 149, of which 30 suppliers supply to all these three models. Mercedes E-class has 43 suppliers in common with the BMW 5-series and 41 suppliers with Audi A6. Therefore, the financial health of these common automotive suppliers is important to all three OEMs, and OEMs may have to cooperate in dealing with supplier defaults. For instance ZF delivers transmission system for all the three OEMs. If such a supplier goes bankrupt, it may receive support from its different customers. Hence choosing a supplier with broad customer base is better in terms of risk sharing once the supplier defaults.

[4] When supplier default correlation is considered – as we do in our model – the perspective on the supply network is extended even further to at least two customers and two suppliers. This reflects even better "the real and complex relationship that supply chain managers encounter every day."(Choi and Wu, InPress, p. 3).

Portfolio default distribution: The Bernoulli model

Portfolio of uniform DP and independent suppliers. As discussed in the Section "Modeling of defaults: The Bernoulli model" when the suppliers are independent and have a uniform default probability of p , the number of defaults in a portfolio L follows a Binomial distribution. Figure 4 shows the Binomial density distributions of three portfolios with different number of suppliers under the same uniform DPs. Table 3 shows the first moment E(L) and second moment V(L) of portfolio number of default L under different number of suppliers m and default probability p. E[L]and V[L] are computed according to equation (7). One can see that the more suppliers the portfolio contains and the bigger the uniform DP, the higher the expected number and the variance of default events. This can also be observed from equation (7). Following this model if two portfolios have the same uniform default probability and independent suppliers, the bigger portfolio has higher risk regarding number of defaults.

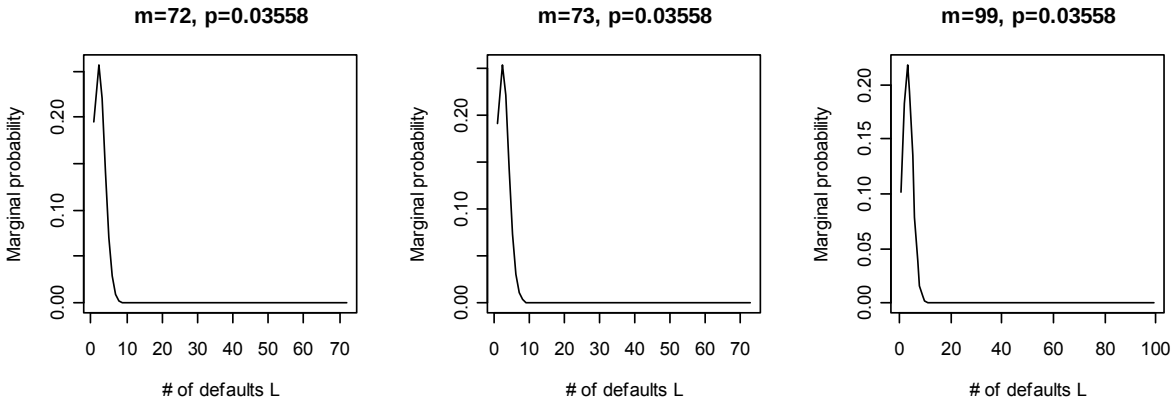

Figure 4. Binomial density distributions of loss statistics L under uniform DP 3.558%

Table 3. Default events modeling using Bernoulli model under assumptions of uniform DP and independence between suppliers

Moody's Letter rating		m=72		m=73		m=99	
	DP=p	E (L)	V (L)	E (L)	V (L)	E (L)	V (L)
Aaa	0.012%	0.009	0.009	0.009	0.009	0.012	0.012
Aa	0.038%	0.027	0.027	0.027	0.027	0.037	0.037
A	0.117%	0.085	0.084	0.086	0.086	0.116	0.116
Baa	0.366%	0.264	0.263	0.267	0.266	0.362	0.361
Ba	1.141%	0.822	0.812	0.833	0.824	1.130	1.117
B	3.558%	2.562	2.471	2.598	2.505	3.523	3.397
Caa-C	11.095%	7.988	7.102	8.099	7.201	10.984	9.765

Portfolio of different DPs and independent suppliers. Under the assumption of independent suppliers the distribution of **L** depends on the number of suppliers and the default probability of each supplier. The more suppliers the portfolio contains and the higher the default probability of each supplier is, the higher are the expected number of defaults **E**[**L**] and variance **V**[**L**]. Applying equation (5), **E**[**L**] and **V**[**L**] are calculated for the three automotive supplier portfolios. Excerpts of the three datasets are included in Appendix B. Table 4 shows that the **E**[**L**] and **V**[**L**] of the Mercedes E-class are higher than the other two portfolios.

Table 4. Default events modeling with Bernoulli model with empirical DPs and independent suppliers

Supplier portfolios	Number of suppliers	E (L)	V (L)
BMW 5-series	72	2.17	1.72
Audi A6	73	3.25	2.25
Mercedes E-class	99	4.73	3.39

Bernoulli mixture model. Using a Bernoulli mixture model, the distribution of defaults can include the effect of the correlation between the supplier defaults. According to equation (11), the joint distribution function of the loss statistics depends on the distribution of the default probability **F**, which is assumed to be a multivariate normal distribution in the KMV model. Equation (6) can be rewritten as

$$P[L_1 = l_1, \dots, L_m = l_m] = \int_{[0;1]^m} \prod_{i=1}^{m} {p_i}^{l_i}(1-p_i)^{1-l_i}\, d\boldsymbol{F}(p_{1,\dots,}p_m)$$
$$= E\left[\prod_{i=1}^{m} {p_i}^{l_i}(1-p_i)^{1-l_i}\right] \cong Mean[\left[\prod_{i=1}^{m} {p_i}^{l_i}(1-p_i)^{1-l_i}\right] \quad (15)$$

Equation (15) shows that it is possible to simulate the value of $P[L_1 = l_1, \dots, L_m = l_m]$ using a random number generator for the multivariate normal distribution. The function "rmvnorm" of software R (R Development Core Team, 2008) offers such a solution.

Computation using CreditRisk+ model

In the Bernoulli model, the exposure is not included in the analysis – in the CreditRisk+ model it is. The model computes the portfolio loss distribution, the expected loss of each supplier, and the risk contribution at the given percentile level. The input information is the suppliers names, their exposure, mean default probabilities and the default rate volatility, and the sector split.[5]

Portfolio loss distributions. This section contains the portfolio loss distribution of the three supplier portfolios which are generated by the CreditRisk+ model. Because there are three scenarios of supplier switching cost ratings, which is discussed in the section "Supplier switching cost estimation", there are accordingly three different scenarios of exposures. So finally there are nine different cases (3

[5] The data can be obtained from the corresponding author.

portfolios times 3 exposure scenarios). Table 5 summarizes the risk percentiles of these cases. The loss distributions of the three car supplier portfolios are compared under each scenario.

Summary of risk percentiles. The risk percentiles are derived from the portfolio loss distributions. By comparing the default level of risk percentiles, a buying firm can determine the risk of the portfolios.

Under the same scenario, for instance scenario I, the 99 percentile loss level of the BMW 5-series portfolio is 69, the Audi A6 is 94, and the Mercedes E-class is 96. That is, the Mercedes E-class portfolio has also the highest expected loss value, which is denoted as mean value in the table.

Across the three scenarios, the default loss under scenario I is significantly higher than under scenario II and III. The difference between scenario II and III is rather small. This is because in scenario I the SCRs of suppliers, which are used as exposures in the modeling, are systematically higher than that of scenario I and II.

Table 5. Risk Percentiles of the three portfolios under three different scenarios

Percentile	**Loss amount**								
	BMW 5-series Scenario I	BMW 5-series Scenario II	BMW 5-series Scenario III	Audi A6 Scenario I	Audi A6 Scenario II	Audi A6 Scenario III	Mercedes E-class Scenario I	Mercedes E-class Scenario II	Mercedes E-class Scenario III
Mean	13	7	7	22	10	11	25	15	16
50	7	4	4	15	8	9	19	12	13
75	19	10	11	32	14	16	35	21	22
95	45	22	23	65	26	29	67	37	39
97.5	56	27	28	77	31	34	80	44	46
99	69	33	35	94	37	40	96	52	55
99.5	80	38	40	106	41	45	108	59	61
99.75	90	42	45	118	46	50	120	65	68
99.9	104	48	51	133	51	56	135	72	76

Portfolio loss distributions. In the following Figures, the loss distributions for the supplier portfolios of the three investigated car models are depicted. We applied the Creditrisk+ framework to the three scenarios. Figure 5 summarizes the portfolio loss distributions under scenario I (i.e., sum of SCRs of all components in the supply scope).

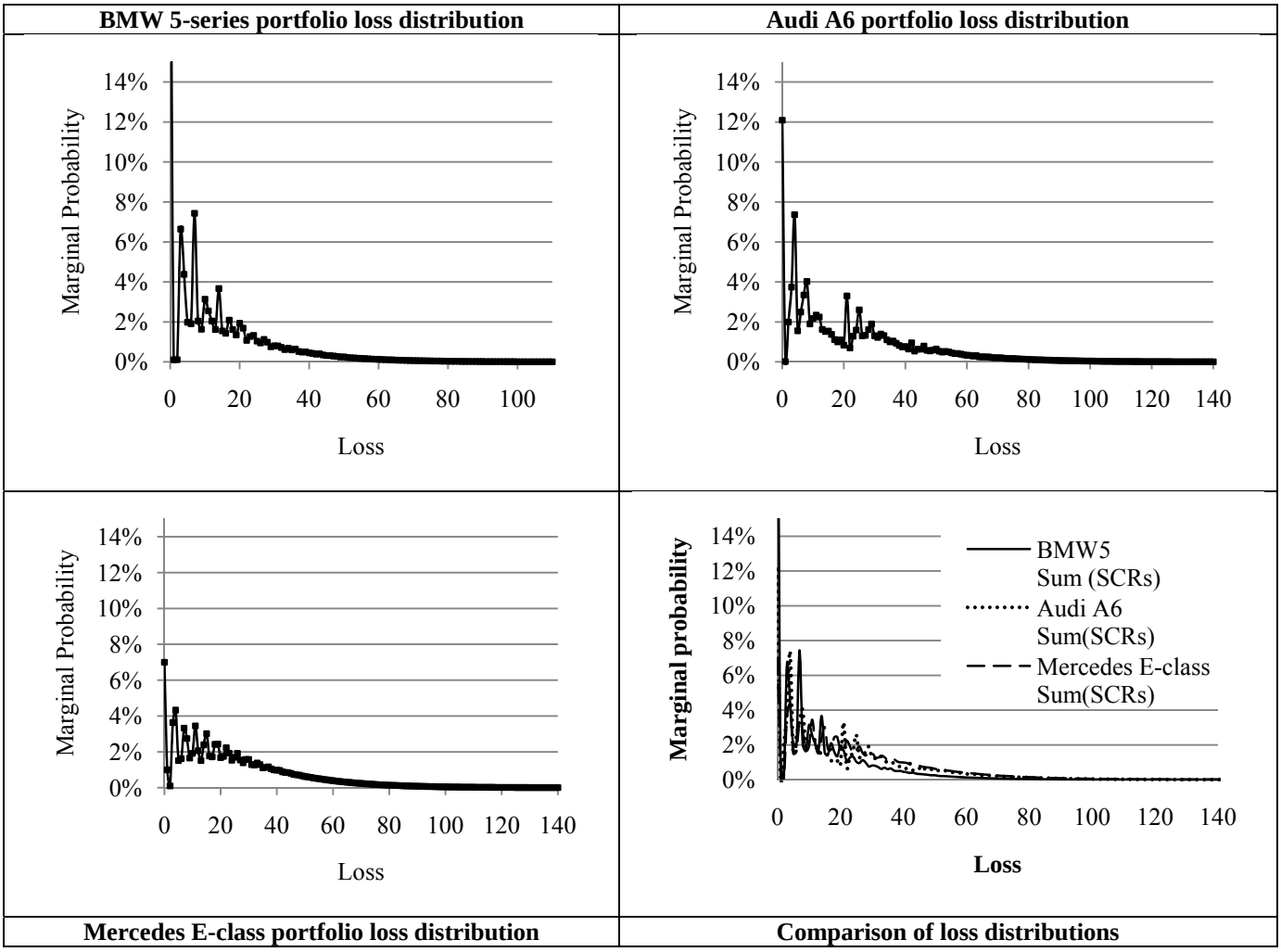

Figure 5. Portfolio loss distributions under scenario I

Figure 6 summarizes the portfolio loss distributions under scenario II.

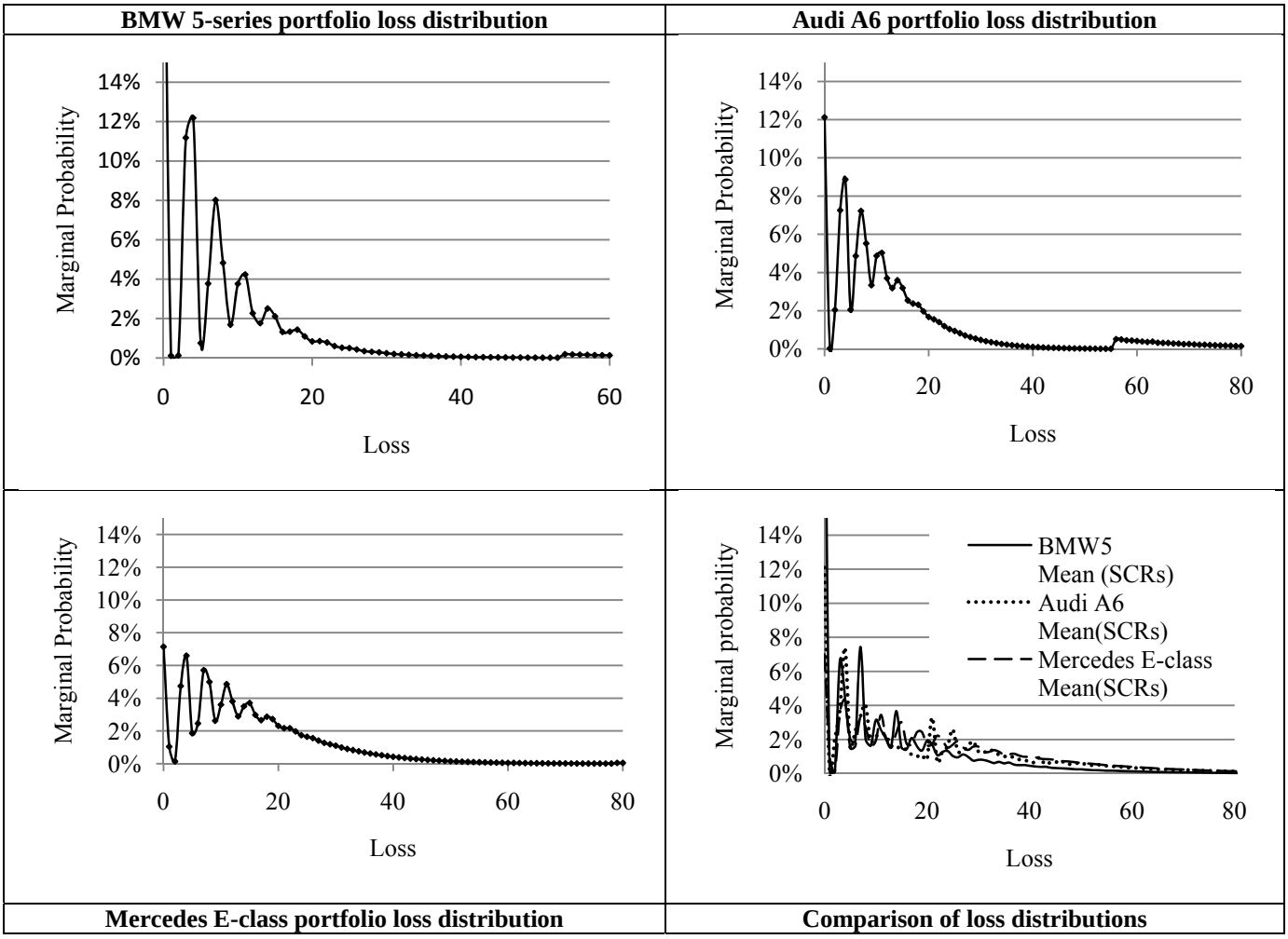

Figure 6. Portfolio loss distributions under scenario II

Figure 7 summarizes the portfolio loss distributions under scenario III.

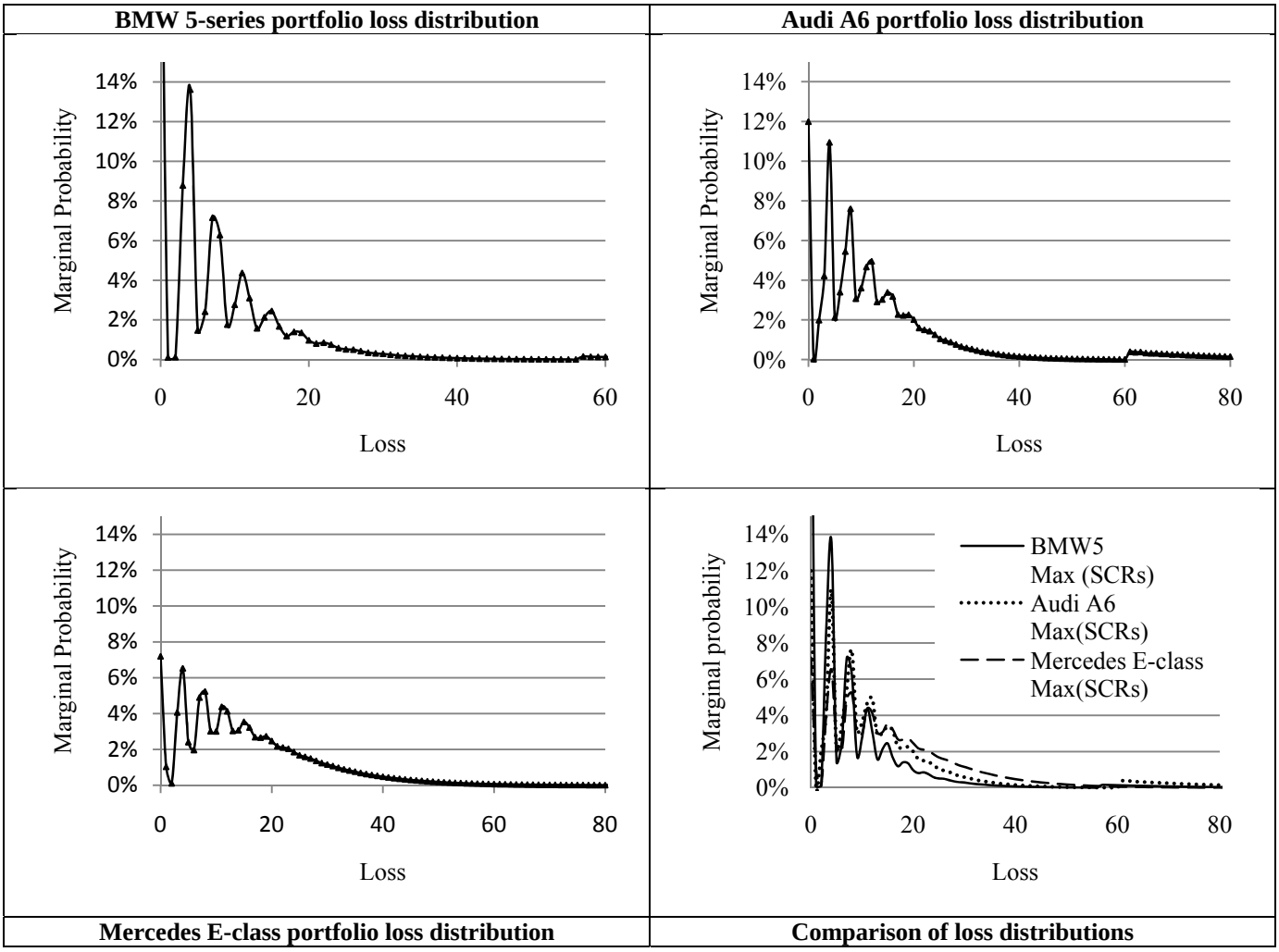

Figure 7. Portfolio loss distributions under scenario III

Recall that the scenarios were constructed to capture the OEMs' exposure to supplier default risk. The absolute values on the x-axis are only limited meaningful. Figure 5, for example, shows that, in the Audi A6-portfolio, the probability of incurring a loss of 20 (e.g., defaulting of 4 suppliers with a SCR rating of 5) during the next year is about 2%.

Risk contributions and pairwise correlations. To measure risk contribution – the contribution of the supplier to the unexpected loss of the supplier portfolio – we set the percentile level to 99th percentile. The sum of the risk contributions of all the suppliers in the portfolio should be equal to the

loss of 99th percentile. Table 6 summarizes the sum of risk contributions and the 99th risk percentile. They are slightly different. This could be due to the accuracy limit of the model used.

μ_A and μ_B denote the expected number of defaults of supplier A and B in a certain time period, and σ_A and σ_B denote the standard deviation of default probabilities of supplier A and B. For instance, in the supplier portfolio of the BMW 5-series, $\mu_1 = \sum_A p_A = 2.17$, $\sigma_1 = \sum_A \sigma_A = 1.79$. The default probability of supplier ZF is 0.4% and that of supplier Webasto is 1.2% (see Appendix B). The default correlation between these two suppliers is $(0.4\% * 1.2\%)^{1/2} \times (1.79/2.17)^2 = 0.47\%$.

Table 6. Sum of risk contributions at 99th risk percentile

	BMW 5-series			**Audi A6**			**Mercedes E-class**		
	Scenario I	Scenario II	Scenario III	Scenario I	Scenario II	Scenario III	Scenario I	Scenario II	Scenario III
99th risk percentile	69	35	35	94	37	40	96	52	55
Sum of risk contributions	65	25	27	87	28	32	86	45	48

Implications and Conclusion

In this paper, credit risk models are introduced to the supply chain context to quantify supplier default risk. The Bernoulli model and the CreditRisk+ model are examined for their applicability. The models are applied to three automotive supplier portfolios: BMW 5-series, Audi A6, and Mercedes E-class. The portfolio default distributions and the portfolio loss distribution are derived for the three supplier portfolios. The results provide various information which support the automotive OEMs in supply chain risk quantifications and management from various aspects.

First of all, the credit risk models provide the buying firm a new perspective and an integral framework for analyzing the different risk aspects of the supplier portfolio, mainly the default probabilities and exposure of suppliers and the default correlation structure among suppliers. Hence the first important message from the models is that knowing the suppliers is important. OEMs should pay

attention to the risk attributes of the suppliers, for instance the financial health of the supplier, the availability of alternative suppliers and so on. The data collection process itself enables the OEM to know its own supplier portfolio better in a systematic way. Based on the collected data, the OEM may keep a watch list of suppliers which have high default probability in the next year. The OEM may also analyze the suppliers with very high exposure and identify them as strategic partner or consider the development of alternative suppliers.

Second, the outputs of the models may support various decision making processes in supply chain risk management. With the default event distribution and the loss distribution of the supplier portfolio, the OEMs can plan its human and capital resources more efficiently. For instance, if the analysis shows that the default risk of the portfolio is high in the next year, it is perhaps advocated to invest more resources in managing the supplier base, enhancing supplier development or switching away from a supplier with high default probability. The portfolio loss distribution supports buying firms in creating risk mitigation strategies, for example buying insurance. The risk contribution of each supplier from the CreditRisk+ model advocates risk-benefit balance thinking in supplier evaluation processes and assists the portfolio management, for instance reducing the portfolio extreme loss by removing suppliers with high risk contributions.

However it is also important to be aware of the limitations of our approach. Before implementing the models, the OEMs need to identify and understand the inaccuracy in the input dataset and the assumptions made in the models itself and finally consider these aspects for the interpretation of the model output.

To sum it up, credit risk models can be adapted to assess supplier default risk. As the application of credit risk models requires a large amount of information on the suppliers, the buying firms (including OEMs) are in the best position to do the analysis. The analysis process may become a tool for OEMs to

quantify and manage supplier default risk. The models can also be applied to other industries where the buying firm is concerned about risk of supplier defaults.

Several areas of further research can be highlighted. First, the study can be extended to examine the applicability of other industrial credit risk models, for instance the KMV model. Second, in this paper, only the first-tier suppliers were considered. It would be interesting to examine the applicability of the credit risk models to multi-stage supply chains, taking into consideration various design and structural characteristics (e.g., a multiple sourcing vs. a single sourcing strategy) and the second-tier suppliers and suppliers further upstream in the supply chain into account. Third, researchers may try to apply credit risk models to model a broader spectrum of supply chain risk, for instance delivery delays.

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Appendix

Appendix A. List of notations and abbreviations

Notation	Meaning
L	It denotes the total number of defaults in a portfolio in the Bernoulli model.
L_i	The Bernoulli variable denoting default of counterparty i.
$\boldsymbol{L}$	A Bernoulli loss statistics. It is a vector of random variables $\boldsymbol{L} = (L_1, \dots L_m)$
$\tilde{L}$	The loss of an individual obligor
i	Index of a counterparty (a supplier or an obligor), $i = 1, \dots, m$
m	The number of counterparties (suppliers or obligors)
p	A assumed uniform default probability for a portfolio
p_i	The observed default probability of counterparty i. In Bernoulli mixture model it means one realization of random number P_i.
D	The event that the obligor defaults in a certain period of time (most often one year).
$P(D)$	the probability of D
1_D	A Bernoulli variable
$E[L]$	The expected value of default distribution L
$V[L]$	The variance of default distribution L
P_i	The randomized default probability of counterparty i
$\boldsymbol{P}$	The vector of the randomized default probabilities of all the counterparties $\boldsymbol{P} = (P_1, \dots, P_m)$
P	The uniform random default probability in the Bernoulli mixture model
$\overline{p}$	The mean value of the uniform random default probability P in the Bernoulli mixture model.
$\boldsymbol{p}$	The vector of the mean default probabilities $\boldsymbol{p} = (p_1, \dots, p_m)$. In Bernoulli mixture model it means one realization of $\boldsymbol{P}$.
λ_i	The observed default intensity of counterparty i. In Poisson mixture model it means a realization of random number Λ_i.
$\boldsymbol{\lambda}$	The vector of realization of random default intensities $\boldsymbol{\lambda} = (\lambda_1, \dots, \lambda_m)$.
L'	The portfolio number of default from Poisson model both in case of independent counterparties and in the Poisson mixture model.
Λ_i	The randomized default intensity
$\boldsymbol{\Lambda}$	The vector of randomized default intensities, $\boldsymbol{\Lambda} = (\Lambda_1, \dots, \Lambda_m)$.
$\boldsymbol{F}$	A multivariate distribution. In Bernoulli model it represents the distribution of $\boldsymbol{P}$ with support in $[0, 1]^m$. In Poisson model it represents the distribution of $\boldsymbol{\Lambda}$ with support in $[0, \infty)^m$.
A, B	Denote two suppliers in CreditRisk+ model
ρ_{AB}	Default correlation of two suppliers A and B
μ_A, μ_B	The expected number of default in a certain time period.
k	Index of sectors in CreditRisk+ model
n	The number of sectors
θ_{Ak}, θ_{Bk}	Sector decomposition of supplier A and B
μ_k	The long-term annual average number of defaults of sector k
σ_k	Standard deviation of number of defaults of sector k
σ_1	Standard deviation of number of defaults of the single sector if all the suppliers are allocated to the same sector
μ_1	The long-term annual average number of defaults of the single sector 1.
p_A	Default probability of supplier A
σ_A	The standard deviation of default probability of supplier A

Appendix B. Excerpts of supplier portfolio data

BMW 5-series Supplier name	Exposure Scenario I	Exposure Scenario II	Exposure Scenario III	Mean Default Rate	Default Rate Standard Deviation	Sector split Automotive Industry
A. Raymond	10	3.3	4.5	0.25%	0.29%	100%
AGC Automotive	3	3.0	3.0	43.00%	11.86%	100%
Alcoa	9.5	4.8	5.0	0.01%	0.05%	100%
Allevard Rejna	4.5	4.5	4.5	0.40%	0.74%	100%
Alpine	5	2.5	2.5	3.70%	4.71%	100%
Alu-Guss	1	1.0	1.0	0.25%	0.29%	100%
Arques	2.5	2.5	2.5	1.20%	1.87%	100%
ArvinMeritor	7.5	3.8	4.0	3.70%	4.71%	100%
Behr	3.5	3.5	3.5	1.20%	1.87%	100%
Benteler	9	4.5	5.0	1.20%	1.87%	100%
Beru	6.5	3.3	3.5	0.20%	0.29%	100%
BorgWarner	3.5	3.5	3.5	1.20%	1.87%	100%
Bosch	19.5	3.9	5.0	0.40%	0.74%	100%
Boysen	3.5	3.5	3.5	1.12%	1.87%	100%
...	...	...	...	...	...	...
Visteon	4	4.0	4.0	3.70%	4.71%	100%
WABCO	4.5	4.5	4.5	2.00%	1.87%	100%
Webasto	4	4.0	4.0	1.20%	1.87%	100%
ZF	32	4.0	5.0	0.40%	0.74%	100%
Mean	7.0	3.3	3.6	0.03	0.02	1
Max	36.0	5.0	5.0	0.45	0.12	1
Min	1.0	1.0	1.0	0.00	0.00	1
Median	5.0	3.3	3.5	0.01	0.02	1
Standard Deviation	6.2	0.8	0.9	0.07	0.03	0
Sum	502.5	234.3	256	2.17	1.79	72

Audi A6 Supplier name	Exposure Scenario I	Exposure Scenario II	Exposure Scenario III	Mean Default Rate	Default Rate Standard Deviation	Sector split Automotive Industry
AGC Automotive	3	3.0	3	43.00%	11.86%	100%
ArvinMeritor	8	4.0	4.5	3.70%	4.71%	100%
Autoliv	3	3.0	3	0.35%	0.74%	100%
Avon	4	4.0	4	48.00%	11.86%	100%
Benteler	19	3.8	4.5	1.20%	1.87%	100%
BorgWarner	8	4.0	4.5	1.20%	1.87%	100%
Bosch	11	3.7	4.5	0.40%	0.74%	100%
Brembo	2.5	2.5	2.5	0.35%	0.74%	100%
Brose	6.5	3.3	3.5	0.07%	0.12%	100%
Calearo	2	2.0	2	0.35%	0.74%	100%
Catem	4	4.0	4	1.33%	1.87%	100%
CML Innovative Technologies	3	3.0	3	0.40%	0.74%	100%
Continental	31.5	3.2	4.5	1.20%	1.87%	100%
Denso	3.5	3.5	3.5	5.70%	4.71%	100%
...	...	...	...	...	...	...
Voestalpine	5	5.0	5	1.20%	1.87%	100%
Volkswagen Braunschweig	7.5	3.8	5	1.20%	1.87%	100%
Webasto	4	4.0	4	1.20%	1.87%	100%
ZF	22.5	4.5	5	0.40%	0.74%	100%
Mean	6.4	3.2	3.5	0.04	0.03	1
Max	31.5	5.0	5.0	0.48	0.12	1
Min	1.0	1.0	1.0	0.00	0.00	1
Median	4.0	3.2	3.5	0.01	0.02	1
Standard Deviation	5.9	0.8	0.9	0.11	0.03	0
Sum	468.5	235.1	256.0	3.25	1.91	73

Mercedes E-class Supplier Name	Exposure Scenario I	Exposure Scenario II	Exposure Scenario III	Mean Default Rate	Default Rate Standard Deviation	Sector split Automotive Industry
A. Raymond	6.5	3.3	3.5	0.25%	0.29%	100%
AGC Automotive	3	3.0	3	43.00%	11.86%	100%
ArvinMeritor	3.5	3.5	3.5	3.70%	4.71%	100%
Autoliv	7	3.5	4	0.35%	0.74%	100%
BASF	1	1.0	1	0.40%	0.74%	100%
Behr	7	3.5	3.5	1.20%	1.87%	100%
Beru	13.5	3.4	4	0.20%	0.29%	100%
Bleistahl	4	4.0	4	3.70%	4.71%	100%
Borgers	8.5	2.8	3.5	1.20%	1.87%	100%
BorgWarner	3.5	3.5	3.5	1.20%	1.87%	100%
Bosch	36	3.3	5	0.40%	0.74%	100%
Brembo	2.5	2.5	2.5	0.35%	0.74%	100%
Brose	9	3.0	3.5	0.07%	0.12%	100%
Continental	39	3.0	5	1.20%	1.87%	100%
...	...	...	...	...	...	...
Wagon	4	4.0	4	7.10%	4.71%	100%
Webasto	8	4.0	4	1.20%	1.87%	100%
Witzenmann	4.5	2.3	3.5	0.40%	0.74%	100%
ZF	20.5	4.1	5	0.40%	0.74%	100%
Mean	6.7	3.2	3.5	0.05	0.03	1
Max	39.0	5.0	5.0	0.48	0.12	1
Min	1.0	1.0	1.0	0.00	0.00	1
Median	4.0	3.3	3.5	0.01	0.02	1
Standard Deviation	6.6	0.9	1.0	0.11	0.04	0
Sum	667.0	319.8	346.5	4.73	2.92	99

MAKING AN END RUN:
WHEN DO FIRMS BUILD RELATIONSHIPS WITH DISTANT SUPPLY CHAIN PARTNERS?

Anne Parmigiani
Lundquist College of Business
University of Oregon
Eugene, OR 97403
Tel: (541) 346-3497
Fax: (541) 346-3341
e-mail: annepa@uoregon.edu

Jennifer Irwin
Lundquist College of Business
University of Oregon
Eugene, OR 97403
Tel: (541) 346-3378
Fax: (541) 346-3341
e-mail: jirwin3@uoregon.edu

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MAKING AN END RUN:

WHEN DO FIRMS BUILD RELATIONSHIPS WITH DISTANT SUPPLY CHAIN PARTNERS?

Abstract: Firms are vertically interconnected through supply chains to obtain materials, exchange information, and provide products to customers. Members in a supply chain include raw material producers, component suppliers, manufacturers, distributors, and end users. Although acknowledging several firms are involved, received literature focuses on dyadic relationships between buyers and suppliers. But, firms sometimes go around their closest supply chain partner and deal directly with a more distant firm, such as a component supplier working directly with a distributor. Motivations include leveraging market power, reducing information asymmetry, and mitigating environmental uncertainty. This paper explores when and why firms go around proximate partners to work with more distant firms, discusses implications of this behavior, and provides illustrations from the motorhome industry.

Firms do not conduct business in isolation, but rather work with other firms to procure materials and provide products to customers. Groups of firms which provide raw materials, produce intermediate components, distribute products, and provide service activities are collectively termed supply chains (Cohen and Lee, 1988). Goods and information are exchanged within the supply chain, typically between the proximate members such as between component suppliers and manufacturers. In this way, volume requirements, product specifications, and pricing data are conveyed upstream while physical products and services flow downstream. Proximate members are the direct customers and suppliers for a focal firm; maintaining robust relationships with them are critical for firm performance (Dyer and Singh, 1998; Porter, 1980). However, in some cases, firms may also choose to build relationships with more distant upstream or downstream members within their supply chain, bypassing a direct and proximate partner. These indirect relationships must benefit up and downstream parties who are both going around a proximate middle partner in the chain. We term these "end runs" and suggest firms do this to leverage market power, reduce information asymmetries, and mitigate environmental uncertainty.

Received theories in industrial organizational economics describe the dyadic relationship between buyers and suppliers by focusing on market power. Firms that are larger or in more concentrated industry sectors will have more market power over their proximate supply chain partners, being able to dictate price and other terms to their advantage (Bain, 1962). Firms that can credibly threaten to vertically integrate will also be more powerful and able to demand concessions from partners (Blois, 1972; Scherer and Ross, 1990). Powerful firms may be more likely to skip over close partners and build distant relationships because they are less dependent upon them and do not fear retaliation (Pfeffer and Salancik, 1978).

Arguments grounded in other organizational theories, particularly those based in sociology, propose that power is based upon social capital and exchange, which originates from the firm's position among other firms. Therefore, firms will strive to create links to more distant partners to improve information flows (Burt, 1992; Uzzi, 1997). This may be particularly relevant for firms that produce technically complex goods, since they will need to educate customers and obtain feedback on how their products interrelate with others. Firms will be cognizant of their relationships with close partners (Dyer and Singh, 1998). If these relationships are adversarial, firms may not want to increase conflict further by contacting distant firms. If these relationships are very strong and robust, firms may have little need to contact distant firms as they can obtain required information through their close partners. Therefore, firms with moderate

relationships with close partners may be more likely to work with distant firms.

Both economic and sociological branches of organization theory consider the impact of environmental uncertainty upon vertical relationships. This includes both the need to be responsive to changes in volume and design as well as the need to adapt to broader changes in technology or the economic landscape. Volatile demand will exacerbate the bullwhip effect as order variance increases upstream, making forecasting more difficult and less accurate (Forrester, 1961; Lee and Padmanabhan, 1997). Obtaining demand information directly from customers mitigates this effect, which could motivate firms to build relationships with more distant supply chain members. Likewise, having direct relationships with end users improves responsiveness to design requirements (Von Hippel, 1988). Changes in the broader environment require firms to gather more information from a variety of sources to understand how their business will be affected (Arrow, 1974). Supply chains can behave like complex adaptive systems, organically changing with the environment (Choi, Dooley, and Rungtusanatham, 2001; Holweg and Pil, 2008); but for this to occur, firms may need relationships with distant supply chain members.

To illustrate cases in which firms go around their proximate partners and build relationships with more distant supply chain members, we turn to the motorhome industry. Motorhomes are self-contained units with their own engines and drive trains, incorporating kitchens, bathrooms, sleeping quarters, and general living space. These highly complex products contain over 3,000 sub-components, miles of wiring, and sophisticated electrical, plumbing, and other systems. We focus on Type A motorhomes, the most common category, which are typically 40 feet long with an average retail price of $179,000. This is a sizable sector of the recreational vehicle (RV) industry; in 2007, 32,900 units were shipped with a total value of $5.84 billion, representing 9% of unit shipments 40% of dollar sales (RVIA, 2008).

The supply chain in this context, shown in Figure 1, consists of five entities. Raw materials producers provide the basic materials, such as metals, wood, and fiberglass. Engine producers are included in this group since their product is a sub-component for chassis producers. Component suppliers provide chassis (the steel sub-structure, which also includes the engine, transmission, and axles), electronics, exterior parts (wall panels, roofs, windows, etc.), and interior goods such as appliances, furniture, and cabinetry. Manufacturers assemble the motorhomes and often also produce some components. Dealers provide distribution and service, typically for multiple manufacturers and brands. End users are consumers.

We next connect theoretical perspectives with our motorhome context, proposing that firms within this supply chain will go around proximate partners to leverage market power, reduce information asymmetry, and mitigate environmental uncertainty. See Table 1 and Figure 2 for previews of our propositions.

Leveraging Market Power. Firms may bypass their proximate supply chain partners and build relationships with distant members to leverage their market power provided by size and potential for vertical integration. Larger firms need not fear retaliation by close partners as their size typically means that they control large portion of the industry demand or supply with multiple close partners, such that these partners are dependent upon them (Pfeffer and Salancik, 1978; Porter, 1980). By going around their closest partners, they can learn more about the industry cost structure and appropriate more of the overall margin (Pindyck and Rubenfeld, 1995). Distant members may desire to form a relationship with this larger member of the chain to take advantage of branding or reputational opportunities (Dyer and Nobeoka, 2000). Thus, we propose:

P1: The larger the relative size of the focal firm, the more likely it will build a relationship with a distant member of the supply chain.

Firms may also bypass close supply chain partners if their partners can credibly threaten to vertically integrate. This threat is more likely if close partners have excess capacity, if the focal firm's business is less technologically sophisticated, or if it does not require considerable scale or scope economies (Perry,

1989). If partners integrate into the focal firm's business, they become competitors and therefore the focal firm will need new customers or suppliers. This threat is more credible if partners already internally produce or distribute some of their requirements (Dutta, Bergen, Hieide, and John, 1995; Harrigan, 1986; Parmigiani, 2007). It may also be more likely if the focal firm's product represents a significant expense, such that the partner is motivated to integrate due to perceived cost savings. This logic leads to:
P2: The greater the potential for vertical integration by a proximate partner, the more likely a firm will build a relationship with a distant member of the supply chain.

Reducing Information Asymmetry. Another motivation for firms to connect with distant supply chain partners is to reduce information asymmetry. Gaps in information can arise from the technical nature of the products or from the nature of the firm's relationships with proximate partners. Firms whose products are technically complex, meaning that they involve multiple, interrelated components with different underlying technologies, will want to build more ties because it gives them greater information about how their goods are used and how they might be improved (Ahuja, 2000; Franke, Keinz, and Schreier, 2008). Having both strong, direct ties with close partners in addition to weaker ties with more distant supply chain members will improve the amount and diversity of information gathered by the firm (Granovetter, 1973; Uzzi, 1997). These firms will also want to educate downstream users about how best to use their products. Because of the task uncertainty created in using highly technical goods, distal members of the supply chain will be willing to develop relationships with these firms (Casciaro, 2003). Thus, we propose:
P3: The greater the technical complexity of the good provided by the focal firm, the more likely a firm will build a relationship with a distant member of the supply chain.

Firms with strong and intimate relationships with their closest supply chain partners may not benefit from contacting more distant members. Their collaborative partnerships may provide them with sufficient information about their products and markets (Dyer and Singh, 1998). In contrast, firms with adversarial relationships with close partners may be unlikely to build ties with more distant members as they risk retaliation of these proximate members, upon whom they depend for supply or distribution (Pfeffer and Salancik, 1978). Therefore, we may observe an inverted-U relationship such that firms with neither very strong nor very adversarial ties to close partners will be more likely to build relationships with more distant members. We term these types of relationships "cordial" and propose the following:
P4: Firms with a cordial relationship with the proximate supply chain member will be more likely to build a relationship with a distant member of the supply chain.

Mitigating Environmental Uncertainty. Environmental uncertainty may also motivate firms to build relationships with distant supply chain members. We focus on two types of environmental uncertainty: short term, which dictates the degree of responsiveness required; and long term, the degree of dynamism in the broader environment. Firms whose environments involve uncertain and volatile volumes benefit by gaining direct demand data from farther down the supply chain (Forrester, 1961; Lee and Padmanabhan, 1997). Likewise, firms with products that are influenced by design will benefit from contact with downstream users to customize offerings and improve time to market (Cousins and Menguc, 2006; Lee, 2002; Wathne and Heide, 2004). Thus:
P5: The greater the need for responsiveness, the more likely a firm will build a relationship with a distant member of the supply chain.

Finally, firms that operate in dynamic environments will benefit by having relationships that are more distant. They will gain a broader understanding of technological changes that may impact their product which will enable them to proactively make changes (Brusoni, Prencipe, and Pavitt, 2001; Helfat and Raubitschek, 2000). In industries beset by economic and political uncertainty, firms may strive to form distant relationships to form coalitions to gain political strength and promote the overall industry (Savage, Nix, Whitehead, and Blair, 1991). This type of uncertainty may also promote imitation among supply

chain members in how they treat partners, all using the same simple rules to promote adaptation (Choi et al., 2001; Holweg, Disneym, Hines, and Naim, 2005; McFarland, Bloodgood, and Payan, 2008). This may make it more likely and easier for indirect contact between members since they will understand each other's approach. This leads to our final proposition:

P6: The greater the environmental dynamism, the more likely a firm will build a relationship with a distant member of the supply chain.

End Runs in the Motorhome Supply Chain. Within the motorhome supply chain, we observe three sets of distant relationships: between engine producers and manufacturers, between chassis suppliers and dealers, and between manufacturers and end users. Engine producers, such as Ford or Cummins, are some of the largest firms in the supply chain, giving them the power to contact motorhome firms directly. Many motorhome firms, such as Monaco and Tiffin, have vertically integrated backward to produce their own chassis such that they require closer contact with engine firms. Engines are technically complex, thus direct communication with manufacturers improves their use and integration with other components. Both engine and motorhome firms have cordial relationships with chassis suppliers, with few, if any, exclusive or unfriendly ties. Environmental dynamism in the form of changes in technology, such as hybrid fuels, and political uncertainty regarding emissions and CAFÉ standards, also motivate formation of these ties.

Likewise, chassis suppliers and motorhome dealers tend to build relationships, bypassing manufacturers. Chassis suppliers, such as Freightliner or Spartan, are typically Fortune 500 firms or divisions thereof with motorhomes being a sideline product. Chassis represent about 40% of the total cost of a motorhome and are the highest value component, giving suppliers considerable market power. This has motivated motorhome firms to internally produce some chassis, but they generally still purchase a majority of their required volumes. Chassis are the most technically complex component, involving the steel structure upon which the motorhome is built, the drive train, and the rolling gear (axles and wheels). As such, chassis suppliers need to educate dealers on features as well as obtain feedback for improvements. Since both chassis suppliers and motorhome dealers maintain relationships with multiple manufacturers, these exchanges are cordial. Responsiveness arises from aftermarket parts sales and service requirements for the chassis that are generally provided by dealers. According to one chassis maker, dealers are less guarded, provide more candid feedback about the industry, and know more about what customers really want as compared to manufacturers.

Manufacturers maintain direct relationships with end users primarily to improve information flows and mitigate uncertainty. Manufacturers are larger than dealers, so have the market power to promote direct customer relationships. Technical complexity also motivates them to educate consumers and differentiate their offerings. Most manufacturers have user groups to connect them directly with consumers, promote brand loyalty, provide a means of obtaining direct customer feedback about new features, and allow publicizing of new models. Techniques include customer rallies, dedicated publications, and company-owned campgrounds and real estate. Relationships with dealers are cordial, but not intimate, since dealers sell multiple manufacturers' brands. Responsiveness is vital in this industry, as manufacturers produce one or more new models each year, including new features and design elements to maintain their competitive position. Demand is seasonal, with greater volumes in the spring and summer months. Customers tend to trade up from older motorhomes or towable units, typically every three years, but because this purchase can be postponed, demand can be difficult to predict. Thus, dynamism in the broader environment is also evident as demand is highly cyclical. Shipments in 2008 were only 14,900 units, less than half the 2007 volume, due to higher fuel prices, tightening consumer credit, and declines in the stock market and home equity values. Manufacturers are thus motivated to maintain direct contact with consumers since it is unclear when their next purchase will occur. Demographic and cultural changes, such as greater environmental awareness, also promote these end-run relationships.

Conclusion. This paper explores when firms will build relationships with more distant supply chain partners, providing illustrations from the motorhome industry. We suggest that market power, information asymmetry, and environmental uncertainty all promote these auxiliary relationships. Understanding these relationships provides a more holistic view of supply chains, which some now view as the appropriate unit of analysis to study competition (Ketchen and Hult, 2007). These relationships provide insight into how firms coordinate activities and manage uncertainty, and raise interesting issues regarding governance between proximate members. They also suggest that our current theories of firm boundaries may need to be expanded beyond how firms deal with proximate partners since they can gain knowledge and power through these more distant contacts (Santos and Eisenhardt, 2005).

This research provokes several additional questions. To what degree are these distant relationships reciprocal? How do firms simultaneously manage both proximate and distant relationships? Are some types of supply chains or products more likely to encourage formation of distant relationships? While there has been some nascent work on supply chain triads (Choi and Zhaohui, 2009; McFarland et al., 2008), much remains to be investigated. As Choi and Liker (2002: 202) suggest, "'It is certainly easier to get data on dyadic relationships, but the more challenging and perhaps more interesting questions involve longer supply chains." We hope our insights promote further work toward answering these questions.

Figure 1: Type A Motorhome Supply Chain

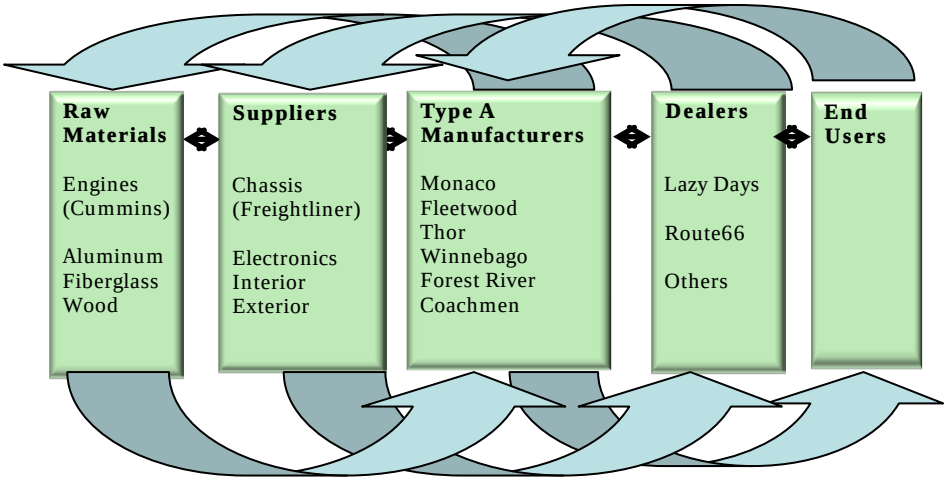

Figure 2: A Model for Building Distant Supply Chain Relationships

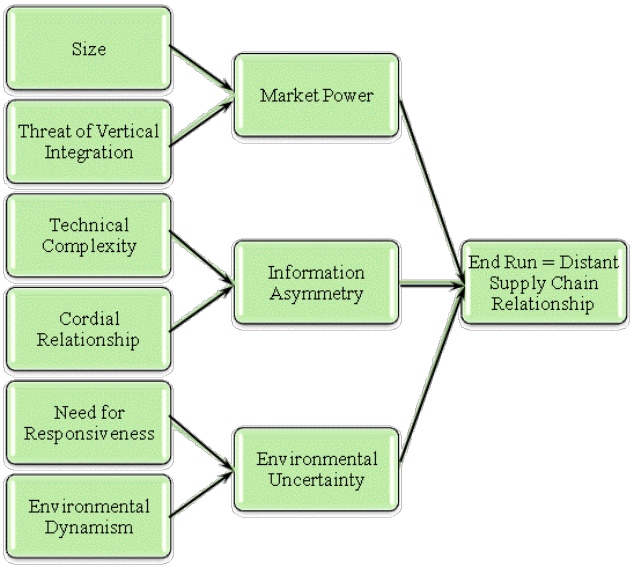

Table 1: Motivations for Building Distant Supply Chain Relationships in Motorhomes

Proposition = Motivation	Raw Material Producers & Manufacturers	Component Suppliers & Dealers	Manufacturers & End Users
P1: Relative Size	X	X	X
P2: Vertical Integration	X	X	
P3: Technical Complexity	X	X	X
P4: Cordial Proximate Relationships		X	
P5: Responsiveness		X	X
P6: Dynamism	X		X

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The Moderating Role of Absorptive Capacity and Collaborative Communication in a Buyer-Supplier Learning Collaboration

Zach G. Zacharia
Assistant Professor of Supply Chain Management
College of Business and Economics
Lehigh University
(610/758-4433); zacharia@lehigh.edu

Nancy W. Nix
Associate Professor of Supply Chain Practice
M. J. Neeley School of Business
Texas Christian University
(817/257-7463); n.nix@tcu.edu

Robert F. Lusch
Professor of Marketing
Eller College of Management
University of Arizona
(520/621-7480); rlusch@eller.arizona.edu

Abstract. Buyers and Suppliers collaborate for many reasons such as to pool skills and knowledge, to take advantage of a unique opportunity, to solve a complex problem or to access and deploy resources and capabilities not found in their own firm. However one ancillary benefit of collaboration is the learning that takes place between the firms throughout the collaboration. Two factors that specifically moderate the learning or knowledge gained in a collaboration are the absorptive capacity of the firm, and the collaborative communication between the firms. A research study of 285 collaborations between buyers and their suppliers found the relationship between high levels of collaboration and knowledge gained was moderated by the absorptive capacity of the buying firm and collaborative communication between the firms.

(Keywords – Learning Collaboration, Collaborative Communication, Absorptive Capacity)

Introduction. Collaboration, defined here as the degree to which two or more firms work jointly and share complementary knowledge or skills to solve a problem or explore an opportunity (Mattessich, and Monsey 1992), has become more important in the competitive environment as knowledge and capabilities become dispersed in the supply chain. Knowledge becomes a key strategic resource especially in a turbulent environment (Hult, Cavusgil and Calontone 2003). The resource based view of the firm (Barney 1991, Wernerfelt 1984) views every firm as a bundle of knowledge. Of all the resources a firm may

possess its knowledge base can be a significant source of competitive advantage (Gupta and Govindarajan 2000). A particular benefit of interfirm collaborations is the knowledge sharing and learning that takes place between the collaborating firms (Lane and Lubatkin 1998). Therefore this research examines the relationship between knowledge gained by buyers from suppliers who are in a collaboration and factors that moderate the relationship between the level of collaboration and the knowledge gained.

Collaborations occur between competitor firms to buyer-supplier firms to solve a particular problem or take advantage of a special opportunity. It is interesting to note that buyers that are already involved in a collaboration with a supplier would have very little reason to want to learn from the supplier. Buyers have already outsourced that capability to their supplier, what is the benefit of learning or gaining knowledge back from the supplier? Our goal was to explore the factors that affect the knowledge specifically tacit knowledge that can be used in future collaborations gained by the buyer from the supplier.

To be successful, collaborating firms must be willing to engage intensely in sharing information, generating ideas, and learning from each other to achieve a successful outcome. Firms with the ability to absorb and take advantage of new knowledge (absorptive capacity) and have a collaborative communication process in place are more likely to gain new knowledge and skills as a result of the collaboration. Among the most common form of collaborations are those collaborations that take place between a buyer and a supplier. Suppliers want to understand what the buyers need and seek to learn from their collaboration partner. Buyers are willing to provide knowledge to the buyer to ensure their requirements are met. Interestingly as buyers outsource capabilities and tasks to suppliers, buyers must still be willing to learn from their suppliers, especially the knowledge and skills associated with the outsourced task to manage future relationships. Tacit knowledge exchanged in the collaboration would likely be more important especially in future collaborations with other suppliers. Communication between buyers and suppliers would likely affect both this collaboration and future collaborations.

H1: The higher the level of collaboration between the buyer and the supplier the greater the knowledge gained by the buyer.

H2: The higher the ability of the buyer firm to acquire, assimilate, transform and exploit new knowledge (absorptive capacity) the stronger is the positive relationship between collaboration level and knowledge gained.

H3: The greater the collaborative communication (frequency, bidirectionality, formality and non-coercive content) the stronger is the positive relationship between collaboration level and knowledge gained.

A survey research design following the total design method (Dillman 1978) was used to collect the data and test the three hypotheses. Respondents were pre-

qualified to ensure they had experience with collaboration projects and were asked to focus on a completed collaboration project to ensure responses reflected actual outcomes and not an estimate of the potential outcome of the collaboration. Our primary sources of information about collaborations between buyers and suppliers were supply chain professionals from the Institute of Supply Management.

The hypotheses were tested using hierarchical moderator regression analysis (Cohen and Cohen 1983). Summated scales for the constructs were used for the regression tests based on the strong correlations among the subscales (Carver 1989). The continuous independent variables in the hierarchical moderator regression models were mean centered to reduce multicollinearity between the main and interaction terms (Aiken and West 1991). The interaction variables were entered in the regression model after the main variables to separate the main effect from the interaction terms (Cohen and Cohen 1983).

Hypothesis 1 posited that a higher level of collaboration leads to a higher level of knowledge gained. The standardized coefficient of 0.49 as a main effect in the regression indicates a very strong relationship between intense collaboration and acquiring knowledge. The higher the level of collaboration the greater the levels of commitment between the firms, more decisions are made jointly, more information is shared, there is a freer flow of knowledge and an openness to discover new knowledge and improve joint performance. Knowledge gained as an outcome suggests buyers acquire tacit and explicit knowledge, learn better ways to conduct business, and gain new insights about your supplier.

Hypothesis 2 posits there is a stronger relationship between collaboration level and knowledge gained in the presence of absorptive capacity. The interaction effect of absorptive capacity on collaboration level and knowledge gained was significant. However it has a negative coefficient of - 0.119 which would suggests as collaboration level increases the amount of absorptive capacity in the firm has a lower effect on the knowledge gained. This would suggest at high levels of collaboration knowledge will be gained regardless of the absorptive capacity of the buyer firm.

Hypothesis 3 posits there is a stronger relationship between collaboration level and knowledge gained in the presence of collaborative communication. The interaction effect of collaborative communication on collaboration level and knowledge gained was significant with a positive coefficient of 0.136. At low levels of collaboration, high collaborative communication led to lower knowledge gained which suggests at lower levels of collaboration it might be better to not use collaborative communication. However as collaboration level increases greater knowledge is gained, and the presence of collaborative communication clearly has a greater impact. Therefore the greater the collaborative

communication between the firms, in the presence of a high levels of collaboration the more knowledge the buyer will gain from the supplier.

This research serves to fill a gap in the literature with respect to understanding the role of absorptive capacity, collaborative communication and a high level of collaboration on organizational learning. Firms constantly face a complex problem or opportunity that is beyond their own capabilities to address. In such instances buyers can become dependent on developing a high level of collaboration with their suppliers to complete the project. Firms with the ability to acquire, assimilate, transform and exploit new knowledge and ideas gained through the collaboration (absorptive capacity) are much more likely to learn from the collaboration. Similarly, firms already involved in an intense collaboration that develop a collaborative communication process would likely achieve greater organizational learning. This research provides valuable insights to help practitioners and researchers gain a better understanding of the factors that can enhance the knowledge gained as an outcome of collaboration efforts between buyers and suppliers.

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The Architecture of Relational Capabilities: Building and Managing Strategic Supplier Relationships

Gregory M. Magnan
Associate Professor, Seattle University, Albers School of Business & Economics, 901 12th Avenue, Seattle, WA, 98122, USA,
Tel. +001 2062966466, *Email* gmagnan@seattleu.edu

Marc Day
Associate Professor, School of Management, Henley Business School, University of Reading, Greenlands, Henley-on-Thames, UK, RG9 3AU
Tel. +44(0)1491414559, Email marc.day@henley.com

Carola Hillenbrand
Research Fellow, School of Management, Henley Business School, University of Reading, Greenlands, Henley-on-Thames, UK, RG9 3AU
Tel. +44(0)1491418800, Email carola.hillenbrand@henley.com

Stanley E. Fawcett
Donald L. Staheli Professor of Management
Marriott School, Brigham Young University
668 TNRB, Provo, UT 84602

The Architecture of Relational Capabilities: Building and Managing Strategic Supplier Relationships

Abstract

1. Introduction

The resource-based view (RBV) holds that, within the firm, unique combinations of inimitable and immobile resources and capabilities form the basis of competitive advantage (Wernerfelt, 1984; Barney, 1991). Others have extended the RBV to include resources that lie outside firm boundaries, noting that inter-organizational relationships provide conduits to knowledge, information, ideas, products, technologies and innovation residing in a firm's network (Gulati, 1998; Madhok, 2002; Lavie, 2006). Working in relationship with other firms can increase strategic flexibility (Sanchez, 1995), provide access to new knowledge (Grant, 1996b), and allow organizations to accomplish goals together which they could not achieve on their own (Dyer and Singh, 1998; Madhok and Tallman, 1998). Actively cultivating a cooperative network of suppliers and partners effectively increases the pool of available resources that, when combined with the firm's own resources, will collectively meet organizational and customer needs (Dyer, 1996; Gulati et al., 2000; Narasimhan and Das, 2001).

To access the complementary resources residing in networks and trading partners, firms and their sourcing organizations should actively develop the governance skills and *relational capabilities* necessary to create an exchange environment that engenders trust, enables information flow, and facilitates knowledge creation or transfer (Lorenzoni and Lipparini, 1999; Madhok, 2002; Lavie, 2006). Collis (1994, p. 145) define organizational capabilities as, "the socially complex routines that determine the efficiency with which firms physically transform inputs into outputs." Capabilities are tangible or intangible processes, specific to the firm, and over time are created through complex interactions among the firm's resources and human capital (Amit and Schoemaker, 1993). Amit and Schoemaker (1993) also note that capabilities can be considered intermediate goods, developed to enhance the productivity of organizational resources. In the context of relationships, a firm's *relational capability* (RC) involves the inter-organizational routines and human capital that combine to transform the inputs of each party into outputs. Notably, the inputs include the complementary resources residing within and in-between firm boundaries, and RC is an intermediate good directed at improving the productivity of the combination of complementary and firm-owned resources.

Jacobides (2006) calls for more research in the area of capabilities, especially regarding the effects of *organizational architecture* on knowledge creation and capability development. Acknowledging that organizational architecture lacks a robust definition, he identifies the organizational structure, division of labour, resource allocation mechanisms, and interdepartmental coordination as key elements of the construct. Others have included strategy, structure, processes, culture, people, and evaluation/rewards in the set of architectural elements (Howard,

1992; Nadler et al., 1992; Smith and Tushman, 2005). Building on this foundation, we can apply the notion of architecture to inter-organizational relationships, creating a *relational architecture* (RA). A subset of organizational architecture, decisions regarding resource allocation, the structure of a firm's boundary spanning resources, the division of labour between firms, and processes and mechanisms of inter-organizational coordination are foundational to RA. The manner in which these elements are structured will affect a firm's RC, or its ability to access and leverage the resources in its network.

The primary outputs of the relationship process are jointly produced resources (Madhok, 2002), which can be leveraged to create relational rents, the supernormal profits only available through inter-firm efforts (Dyer and Singh, 1998). Another, less tangible output of organizational relationships is *social capital*, which generally refers to the accumulated goodwill (Adler and Kwon, 2002) and overall asset created by gaining access to actual and potential resources embedded in networks (Granovetter, 1992; Nahapiet and Ghoshal, 1998). A similar construct, *relational capital*, "refers to the level of mutual trust, respect and friendship that arises out of close interaction at the individual level between alliance partners" (Kale et al., 2000, p. 218). These perspectives present social and relational capital as resource stocks (Dierickx and Cool, 1989), to be nurtured and developed for the purpose of leveraging the value residing in network resources (Amit and Schoemaker, 1993; Lorenzoni and Lipparini, 1999). Recently, (Gulati and Kletter, 2005) suggested that a firm's ability to develop positive relationships (i.e., its relational capability) and the subsequently enhanced value of the relationships (i.e., relational capital) are critical to long-term success in today's complex world. Others have linked relational capital to performance improvements for buyers and customers (Collins and Hitt, 2006; Krause et al., 2007; Lawson et al., 2008) and stated that differentials in relational capabilities can be a source of competitive advantage (Peteraf, 1993; Madhok, 2002).

Extant research, however, indicates that the processes of developing stronger relationships and building relational capital are not easily mastered, as the success rates of inter-firm collaboration efforts (Madhok and Tallman, 1998; Fawcett and Magnan, 2002; Cousins and Spekman, 2003; Poirier and Quinn, 2006) and firms' perceived satisfaction with alliances (Khanna et al., 1994; Day, 1995; Dyer et al., 2001) are quite low. While our knowledge of buyer-supplier relationships still needs further development (Goffin et al., 2006), we do know that the inherent challenges in developing closer relationships manifest in both intra- and inter-organizational dynamics (McIvor and McHugh, 2000; Dyer et al., 2001; Stank et al., 2001; Cousins and Spekman, 2003; Golicic et al., 2003; Myhr and Spekman, 2005; Emberson and Storey, 2006; Spekman and Carraway, 2006; Swink, 2006; Fawcett et al., 2008).

Despite the volume of work supporting the relational approach, there are relatively few studies that have examined the relational architecture necessary to support and develop relationships with *strategic suppliers*. In particular there is little research to date that assess those elements that address challenges internal to the buying firm, and how these interact with those factors external to the firm. Given the necessary investments and inherent risks, most firms develop close buyer-supplier relationships with a selective subset of their supply base—their strategic suppliers. By expanding on the concept of relational architecture (Gulati and Kletter, 2005; Jacobides, 2006)

we seek to identify empirically the intra- and inter-organizational activities and underlying organizational elements that enhance relationships with strategic suppliers. Put another way, we seek to better understand the relational architecture which supports the development of relational capital. Using cluster analysis, a typology of maturity regarding strategic supplier relationship management (SSRM) is developed. Intra- and inter-organizational activities promoting relationship development—elements of relational architecture—are analysed across the clusters to identify linkages to enhanced relationship quality and relational capital, strengthening our understanding of SSRM. The remaining sections of the paper will discuss the theoretical underpinnings of relational architecture, the associated relational capabilities, and relationship quality as a measure of the maturity of strategic supplier management. We then develop relevant hypotheses, present the methodology, and end with a discussion of the results and implications.

2. Theoretical background

There has been a growing interest in the way that inter-organizational relationships can be used to grow competitive advantage between firms. This topic sits at the nexus of the fields of economics/theory of the firm (Williamson, 1985; Barney, 1991), strategy (Dyer, 1996; Lorenzoni and Lipparini, 1999; Takeishi, 2001), firm boundaries (Santos and Eisenhardt, 2005; Jacobides and Billinger, 2006), marketing (Dwyer et al., 1987; Heide, 1994; Narayandas and Rangan, 2004; Fink et al., 2006), supply management (Landeros and Reck, 1995; Chen et al., 2004; Das et al., 2006; Saccani and Perona, 2007), operations management (Narasimhan and Das, 2001; Swink et al., 2005), and supply chain management (Paulraj and Chen, 2007). Collaborative relationships effectively blur the boundaries of production and exchange between firms, allowing access to network resources, capabilities and knowledge without the full costs and risks of ownership (Sanchez, 1995; Grant, 1996a).

Empirical research across multiple disciplines supports the position that closer, more collaborative inter-organizational relationships drive improved financial and operational performance for buying firms (Dyer, 1997; Lorenzoni and Lipparini, 1999; Carr and Pearson, 2002; Ulaga, 2003; Corsten and Felde, 2005; Terpend et al., 2008), particularly in uncertain and dynamic environments (Noordewier et al., 1990; Jap, 1999; Fink et al., 2006). Recent empirical research in purchasing and supply management adds to the literature confirming the link between strong buyer-supplier relationships and improved performance (Kannan and Tan, 2006; Cousins and Lawson, 2007; Fink et al., 2007; Krause et al., 2007; Chin-Chun et al., 2008; Lado et al., 2008).

The relevant theoretical foundations of inter-organizational relationships derive from the transaction cost economics (TCE) and resource-based view (RBV) theories of the firm, and the contributions of social exchange and social capital theory. Broadly, relationships and governance structures range from markets (arms-length) on one end and hierarchies (vertical integration) on the other, with the middle ground occupied by various hybrid forms, including joint ventures, equity and non-equity alliances, and contractual relationships (Duffy, 2008). Generally, TCE theory suggests that as asset specificity and dependency increase, firms will move away

from markets and towards vertical integration to reduce the transaction costs related to opportunism and its safeguarding (Williamson, 2002; Williamson, 2005). Critiques of TCE centre on the omission of two themes, differential advantage (Ghoshal and Moran, 1996; Madhok, 1996) and social relations (Morgan and Hunt, 1994; Gulati, 1995). Alternatively described as the capability-based (Kogut and Zander, 1992), knowledge-based (Grant, 1996b) or the resource-based view (RBV), this perspective suggests the unique and inimitable combination of resources, capabilities and knowledge that is the firm can be exploited to create competitive advantage (Barney, 1991; Lavie, 2006). The frame of RBV, focused on growth and advantage, is different from the efficiency and cost minimisation perspective of TCE. The social factors that characterise relationships (e.g., trust, obligation, and relational norms) are critical as they can affect partners' willingness to be opportunistic (and the associated safeguarding costs).

Social exchange theory (SET) rests on the basic assumption that parties enter into and maintain relationships—in which resources are exchanged—for the expected benefits received (Blau, 1964). In their review of SET, Lambe et al. (2001) identify four basic premises, stating a) exchanges result in economic or social outcomes, which are b) compared over time to other exchange alternatives (to determine dependence), c) that positive exchange outcomes, over time, build trust and commitment, as well as d) develop relational norms. Applying SET to a network of organizations elucidates the benefits of relational exchange, expanding the domain of RBV to include the resources present in the network (Gulati, 1998). The capabilities-based or knowledge-based view combines the RBV and SET to consider the broad array of economic and social outcomes, such as the creation of knowledge, resources, and social capital inherent a firm's network. Social capital theory (Nahapiet and Ghoshal, 1998) suggests a firm's ability to access network resources and motivate trading partners to collaborate is a function of its social and relational capital, and when combined with a firm's absorptive capacity, results in sustained advantage (Kogut and Zander, 1992; Dyer and Singh, 1998; Gulati and Kletter, 2005).

2.1 Relational capability, architecture, and capital

2.1.1 Relational capabilities

Organizational capabilities, necessary to convert resources into products and services, are comprised of routines (Collis, 1994). Teece et al. (1997, p.510) updated the concept of capabilities by extending the RBV to high-velocity environments, stating that *dynamic capabilities* comprise the "difficult-to-imitate organizational, functional, and technological skills" that engender the development of new competencies. Eisenhardt and Martin (2000, p. 1107) defined a dynamic capability as the firm's "processes to integrate, reconfigure, gain and release resources—to match and even create market change." Zollo and Winter (2002, p. 310) essentially combined these views, suggesting that a dynamic capability is a "learned and stable pattern of collective activity through which the organization systematically generates and modifies its operating routines in pursuit of improved effectiveness." Routines, too, are predicated on those working within them to learn from and respond to internal or external stimuli (Zollo and Winter, 2002). Repeated exposure to stimuli provides the feedback and experience necessary for learning and improving

routines. (Gavetti and Levinthal, 2000, p. 113) suggest “routines reflect experiential wisdom in that they are the outcome of trial and error learning and the selection and retention of past behaviors.”

Through the lens of the relational view, a firm’s relational capability can be leveraged to access resources and capabilities present in a firm’s network, which are not retained by the focal firm (Dyer and Singh, 1998; Lorenzoni and Lipparini, 1999). Lorenzoni and Lipparini (1999, p. 320) define relational capability as “the ability to develop, integrate, and transfer knowledge across different actors in a network”, and observed that relational capability is supported by the firm’s ability to learn from others (Cohen and Levinthal, 1990) and to develop new knowledge and combine it with existing capabilities (Kogut and Zander, 1992). In doing so, firms must create an exchange environment that facilitates the willingness of trading partners to contribute relational resources and participate in creating new knowledge (Lavie, 2006). Building on the work outlined above, we offer the following definition of relational capability:

> *Relational capability is the collection of resources and processes to access, integrate, develop, and reconfigure network resources and capabilities, and is developed over time through the systematic improvement of intra-and inter-organizational routines.*

Borrowing from Nelson and Winter's (1982) hierarchy of routines, Grant's (1996a) “architecture of capabilities” is built on the idea that higher-order capabilities are developed only through integrating knowledge at lower levels of the hierarchy, making them difficult to imitate and therefore, a source of advantage. Examples of higher-order capabilities include faster time-to-market (Lorenzoni and Lipparini, 1999) and the ability to effectively execute post-acquisition integration processes (Zollo and Winter, 2002). Similarly, we consider a firm’s relational capability as a higher-order capability, as it demands the structure necessary to access resources, the social skills necessary to develop trust, and the technical skills to integrate knowledge across multiple organizations and functions. In the knowledge-based view of the firm, the “know-how” (Kogut and Zander, 1992) of managing relationships takes on greater significance as explicit knowledge not embodied in products cannot be easily transferred through market contracts, nor can firms maintain all of the knowledge required for future products in-house (Grant and Baden-Fuller, 1995; Grant, 1996b; Lorenzoni and Lipparini, 1999). The “know-how” of relationships can be learned, as the development and management of inter-organizational relationships is considered a process (Dwyer et al., 1987), reflected in the routines and sub-processes involved in creating and improving relational capability (Ring and Van De Ven, 1994; Cousins, 2002; Leiblein and Miller, 2003). In the realm of alliances, a similar thread of research promotes alliance capability—the ability to learn from alliance experience and develop repeatable routines for alliance management—as a driver of enhanced alliance performance and firm success (Kale et al., 2002; Heimeriks and Duysters, 2007; Kale and Singh, 2007).

Relational capability’s importance in the relational view (Dyer and Singh, 1998) and the development of sustained advantage (Lado et al., 1997; Madhok and Tallman, 1998; Nahapiet and Ghoshal, 1998) positions it for studies addressing how different facets of it become manifest. Paulraj et al. (2008) demonstrate the importance of

inter-organizational communication, describing it as a relational competency and establishing links to buyer and supplier performance improvement. Cousins et al. (2006) observed that informal socialisation mechanisms such as supplier visits and communication guidelines contribute to improved relationships. Cousins and Spekman (2003) also highlight the role of performance measures in supporting continuous improvement and learning in relationships. Whilst Pfohl and Buse (2000), in their study of the development of relational capability in the context of an auto assembler and its logistics partners, note that the overall collection of routines and collaboration practices were integrated into a relational capability. They also observed that structural elements, such as joint team structures and executive roles, and "infrastructural" elements, such as communication and learning, were buttressed by joint problem solving and subsequent task assignment. They noted specific activities such as devoting meeting time to the rules and norms of collaborative behavior, and the systematic use of previous experience (e.g., improved documentation) were observable facets of these infrastructural elements.

2.1.2 Relational architecture

Gulati and Kletter (2005, p.78) describe relationship-centred organizations as firms that are "shrinking their core and expanding their periphery", in that they are increasing focus on fewer activities and sourcing the rest from "strategic partners." Their model of relationship-centric organizations is very similar to Morgan and Hunt's (1994) relationship marketing model which identified supplier, internal, lateral, and customer partnerships as four primary stakeholder groups requiring behaviors and interactions that tend toward relational exchange (Dwyer et al., 1987). Gulati and Kletter (2005, p.81) identify four stakeholders—suppliers, customers, organizational sub-units, and alliances—to which relational capital is leveraged for the purpose of "extracting full value from their various partners." They depict the relationship-centred organization in the context of its *relational architecture* (RA), presented as a continuum (or "ladder") of four relational levels for each stakeholder group. Rungs of the ladder are ascended as the firm develops its relational capability, enabling it to leverage its relational capital.

Teece (1997) has further linked the ideas of architecture and capabilities, stating the "microfoundations" of dynamic capabilities include distinct skills, processes, procedures, organizational structures, and decision rules. Nadler et al. (1992) ascribe the principles of architecture (i.e., purpose, fit, materials, and collateral technologies) to organizations, and suggest organizational architecture (OA) is "the art of shaping organizational space to meet human needs and aspirations" (Gerstein, 1992, p. 15). They further delineate organizational space to include behavioral space, information space, and cultural space, each of which is affected by structure, processes, information flow, and values. Other characterisations of OA often overlap, and include structure, processes, reward systems, people, and culture (Howard, 1992); decision rights, task bundling, organizational structure, performance evaluation, and allocation of rewards (Brickley et al., 1995); strategy, structure, people, processes, and culture (Nadler and Tushman, 1997); structures, processes, capabilities, and technologies (Sauer and Willcocks, 2002); tasks, formal organization, and culture (Smith and Tushman, 2005); and organizational structure, division of labour, resource allocation mechanisms, and interdepartmental coordination (Jacobides, 2006). In her study of internal collaboration, (Liedtka, 1996,

p. 31) refined (Nadler et al., 1992) definition of OA to include “all of the elements of design of the social and work systems, including formal structure, the design of work practices, operating styles, and processes for selection, socialization, development and reward,” and found that, across all of these areas, high-performance firms exhibited a special emphasis on nurturing collaboration.

Analysing the elements of OA that are applicable to inter-organizational relationships suggests that the formal structure of a firm’s boundary spanning resources, the division of labour within and between firms, resource allocation mechanisms, inter-organizational coordination practices, people, information and communication processes, metrics and rewards, and culture combine to create a firm’s relational architecture (RA). Borrowing from Teece (2007), the elements of RA together provide the foundation on which a firm’s relational capability is developed and nurtured. Several of the studies previously cited have in common the notion that competitive advantage is increasingly reliant on a firm’s ability to interact with other organizations in ways that combine access to knowledge and resources with the capability to jointly reconfigure them into products and services (e.g. Dierickx and Cool, 1989; Amit and Schoemaker, 1993; Morgan and Hunt, 1994; Sanchez, 1995; Dyer et al., 1998; Lorenzoni and Lipparini, 1999; Madhok, 2002; Gulati and Kletter, 2005; Lavie, 2006). Fundamental to the relational view is the design and implementation of relational architectures that facilitate the development and continuous improvement of firms’ relational capability.

2.1.3 Social capital, relational capital, and relational architecture

In addition to economic benefits arising from exchange, success in developing a relational capability will generate social capital for firms, previously described as an accumulated asset or stock resulting from relational encounters and valued for its access to actual and potential resources (Nahapiet and Ghoshal, 1998; Adler and Kwon, 2002). As part of the process of ascribing social theories and constructs to organizations, a multitude of definitions of social capital exist. In their presentation of social capital theory and its link to the creation of intellectual capital and knowledge, Nahapiet and Ghoshal (1998) incorporate two general themes from the literature in their definition of social capital: a) the network and overall structure in which relationships reside, and b) the assets in the network made available through those relationships. They outlined three dimensions of social capital that affect conditions necessary for parties to exchange intellectual capital: structural, cognitive, and relational. The structural dimension refers to the overall pattern of connections and linkages (i.e., how you reach people). The cognitive dimension refers to the shared language, vocabulary, and stories that together enable knowledge exchange and combination. The relational dimension refers to the characteristics of relationships (e.g., trust, norms, and obligations) that engender the anticipation of value and motivation for parties to engage in the exchange of knowledge and intellectual capital.

Acknowledging the difficulty in operationalising and separating these dimensions, Nahapiet and Ghoshal (1998) suggest the use of Granovetter's (1992) distinction between structural and relational embeddedness, in which structural embeddedness refers to interactions generated by an actor’s location in a network, and relational embeddedness refers to the assets created by a history of interaction. However, it

has been found that it is ambiguous to conceptualise social capital as both the structure in which relationships occur *and* the characteristics or outcomes of relationships (Rowley et al., 2000; Moran, 2005). In order to avoid this Adler and Kwon differentiate their importance, arguing that the real "substance" of social capital is the goodwill generated by a relationship's history of interactions, and in their definition of social capital notes that its "source lies in the structure and content of the actor's social relations." (Adler and Kwon, 2002, p. 23) They further distinguish goodwill from its possible effects, which include the value associated with information, influence, and solidarity made available by social capital. Using a river as a metaphor, we might consider its source (i.e., structure) to be the watershed and headwaters, but the river's ultimate carrying capacity (i.e., its goodwill) is affected by the relationship with its environment over time, and its potential to irrigate or flood (i.e., its effects) are determined far downstream from the source. Adler and Kwon's (2002) characterisation is similar to Nahapiet and Ghoshal's (1998) social capital theory, in which the relational and cognitive dimensions of social capital generate the motivation for partners to share intellectual capital and create knowledge, while the structural dimension provides a conduit to sources.

Kale et al. (2000) also separated the goodwill element of social capital from its structural sources, identifying commitment, trust, respect and friendship as primary factors in *relational capital*. The approach used by Cousins et al. (2006), closer to earlier definitions of social capital, defined relational capital in terms of social structure, but assessed it using behavioral elements such as trust and respect. Lawson et al. (2008) separated the constructs of relational capital and structural embeddedness, but did not link them sequentially as intimated by Adler and Kwon (2002). They did find direct effects for relational capital, and the structural elements of managerial communication and technical exchange, on buyer performance, measured by improved product design, process design, lead time, and quality. Krause et al. (2007) separated social capital into its structural, cognitive and relational elements, finding different effects across a range of operational performance metrics. Collins and Hitt (2006) observed a positive relationship between relational capital and successfully transferring tacit knowledge.

Separating relational capital from social capital leaves the structural element of social capital isolated. Nahapiet and Ghoshal (1998, p. 244) described structural embeddedness as the "overall pattern" of connections and linkages, which they restated as "who you reach and how you reach them." Adler and Kwon (2002) described the structural component as the source of social capital, derived from the access and opportunity created. Granovetter's (1992) conception of structural embeddedness has largely been viewed through the lens of networks and the structural configurations of relationships (Moran, 2005). Network concepts such as holes, density, and distance, however, do not adequately capture the complexity and milieu of behavioral, informational, and cultural factors that shape the conditions, or "inter-organizational space", necessary for successful exchange (Nadler et al., 1992; Adler and Kwon, 2002; Lavie, 2006). Further, structural embeddedness and network configurations do not address the organizational routines and processes that combine to form capabilities. In their structural capital construct, Krause et al. (2007) seem to recognise this limitation by including information sharing, supplier evaluation, and supplier development elements, which incorporate a routines-capabilities logic similar to that of Leiblein and Miller (2003).

Nadler et al. (1992) suggest that a firm's organizational space, including its behavioral, informational, and cultural factors, is shaped by architectural decisions regarding structure, processes, information flow, and values. Inter-organizational space, and its behavioral, informational, and cultural factors, is likewise shaped by the decisions regarding relational architecture (Gulati and Kletter, 2005). Earlier we identified several characteristics of relational architecture, including structure, resource allocation mechanisms, inter-organizational coordination practices, people, information and communication processes, and metrics. We propose that the relational architecture concept, due to its holistic nature and connectivity to routines (and therefore to capabilities), is a more appropriate frame for evaluating the "source" of relational capital than the concept of structural embeddedness. Like other capabilities, relational capability, necessary for the development of relational capital (Collins and Hitt, 2006), is created by applying learning to the underlying routines and processes. Relational architecture shapes the behavioral, informational, and cultural factors that configure inter-organizational space. Experience and learning continue to refine RA decisions to support the continuous improvement and development of relational capability and relational capital.

2.2 Strategic supplier relationship management

Two inter-related areas of supply management (make/buy decisions and strategic supply) suggest that inter-organizational relationships are strategically important, so developing the architecture underpinning buyer-supplier relationships is a necessary capability. A third, supplier portfolio analysis, is emerging as a tool to classify an organization's suppliers and/or supplier relationships, providing a starting point for deploying aspects of relational architecture. A brief discussion of each follows, with a view to understanding the strategic parameters within which resources can be allocated to those suppliers with whom relational capital can be built.

Make/buy models acknowledge that companies do not have the resources to be world-class across all the elements of their value chain, and recommend that even strategic inputs should be sourced from firms maintaining a comparative advantage ((Venkatesan, 1992; Maltz and Ellram, 1997; Jennings, 2002; Gottfredson et al., 2005). These decisions are critical as they indirectly shape the capabilities and resources the firm develops internally (Jacobides, 2005). Strategic supply has evolved as a response to outsourcing and changes in the quantity, value and nature of what firms buy. As the practice of outsourcing has grown, so has the overall spend and the reliance on the supply base for innovation, prompting many authors to suggest that firms should elevate the profile of supply management to better align the function with its growing involvement in strategic matters (Kraljic, 1983; Cousins and Spekman, 2003; Day and Lichtenstein, 2006).

As the nature of sourcing has changed, supplier segmentation and portfolio models have developed to provide frameworks by which buyers can organise and classify existing suppliers, to inform supplier selection decisions. They usually contain two multi-dimensional constructs developed from product (e.g., criticality, volume), supply market (e.g., concentration), and supplier and buying firm characteristics (e.g., relational investments, assets, skills), and serve to guide managers in

determining the appropriate supplier relationships and governance structures, given various product and market conditions (Kraljic, 1983; Bensaou, 1999; Wagner and Johnson, 2004)). Each model is different in that researchers have used a multitude of drivers to create portfolios, including relationship intensity and supplier management capabilities (Wagner and Boutellier, 2002), technology and collaboration (Kaufman et al., 2000), dependency risk (Hallikas et al., 2005), asset specificity (Bensaou and Anderson, 1999), complexity and strategic importance (Myhr and Spekman, 2005), certainty and dependency (Cousins, 2002), purchase importance and situation (Olsen and Ellram, 1997), and company and supply market strength (Kraljic, 1983). Generally, portfolio models divide the two dominant constructs into two categories, resulting in a 2x2 matrix, and often the labelling of the quadrant reflecting the most challenging or critical scenario identifies the supplier as "strategic" and/or the relationship should be managed as a "partnership" (Bensaou, 1999; Hallikas et al., 2005; Caniëls and Gelderman, 2007; Saccani and Perona, 2007).

Suppliers are deemed strategic because they possess resources or knowledge desired by the buying firm (Bensaou, 1999), because of the amount of spend with them (Olsen and Ellram, 1997), or the nature of the product purchased (Kraljic, 1983). Developing and maintaining relationships is expensive and risky, so close relationships should not be developed for every supplier in a portfolio. Risks include getting too close to suppliers and losing objectivity (Jap and Anderson, 2007), the potential for a firm to lose its core competence (Parry et al., 2006), opportunity costs (Swink and Zsidisin, 2006) not realising an acceptable return on the significant investment required to nurture relationships (Adler and Kwon, 2002), and diminishing returns associated with committing too much to an individual relationship (Swink and Zsidisin, 2006). Despite these risks, several studies indicate they are outweighed by the benefits generated through strategic supplier relationships, including operational improvements (Hojung Shin et al., 2000), enhanced business performance such as market share, ROI, and profit growth (Li et al., 2006), and overall competitive advantage (Chen et al., 2004).

Portfolio models suggest that the characteristics of the outsourced activity or item, the nature of the supply market, and attributes of particular suppliers and the buying firm inform decisions regarding supplier selection and governance structure (Olsen and Ellram, 1997). As sourcing decision environments vary in complexity, a range of suppliers and relationship types is best for buyers, rather than striving for close, collaborative relationships in all dyads (Bensaou, 1999; Cox, 2004; Myhr and Spekman, 2005). Governance structures range from the use of open markets to hierarchies and ownership, with relational governance models falling in the middle (Heide, 1994). Within this spectrum, supplier relationships span from adversarial/arms-length to collaborative/partnership approaches (Hallikas et al., 2005; Swink and Zsidisin, 2006; Duffy, 2008). Aligning the relationship and governance structure with the hazards and characteristics of the buy can reduce transaction costs (Williamson, 2005), maximize value appropriation (Cox, 2004), and improve the overall performance of the exchange (Poppo and Zenger, 2002; Lawson et al., 2008).

Taken together, make/buy, strategic supply, portfolio and relationship models clearly suggest that as buying firms source goods and services of increasing strategic

importance, the relationships with the suppliers of those strategic items should move to the collaboration end of the relationship continuum. The fields of marketing and strategy have identified this "relational view", noting that the strength and quality of a firm's relationships with trading partners can indeed be a source of value generation (Morgan and Hunt, 1994; Dyer and Singh, 1998; Madhok and Tallman, 1998; Lorenzoni and Lipparini, 1999) and are fundamental to the financial and performance success of alliances and cooperative networks (Anderson and Narus, 1984; Dwyer et al., 1987; Lavie, 2006). Due to the variety of transactions (and their inherent complexity) facing firms, (Williamson, 2002) observed that the "problem of economic organization" is, rather than the oft-used markets *or* hierarchies, is actually one of markets *and* hierarchies. At any point in time, an organization will have relationships across the continuum, and may even have multiple relationships and governance modes with the same supplier (Gulati and Kletter, 2005). Studying the effects of and ways in which firms manage their strategic suppliers, however, can shed light on the most important elements of relational architecture.

2.3 Linking relational maturity to relational capital and relationship quality

The experience generated through repeated interactions with trading partners leads to increased understanding of their partner's capabilities and weaknesses, supporting the development of trust (Gulati, 1995; Gulati and Singh, 1998). In social exchange theory (SET), the outcomes of trust and relational norms only accrue over time (Lambe et al., 2001), highlighting the importance of frequency and repeat exchange. Noting the temporal nature of experience, Lorenzoni and Lipparini (1999, p. 332) write, "Interfirm ties are enhanced over time by the creation of a sense of community and trust, daily activity in knowledge access, and co-design practices. Familiarity between organizations through prior alliances convinces firms to progressively use less hierarchical structures in organizing new alliances." Similarly, Leiblein and Miller (2003) suggest greater experience generates learning that allows firms to better gauge the hazards of cooperative behavior, enabling closer fit between relationships and governance modes.

Experience is fundamental to organizational learning (Grant, 1996b), and is a necessary element for capabilities formed and developed by continuously improving their underlying routines and processes (Collis, 1994; Zollo and Winter, 2002; Jacobides, 2006; Teece, 2007). Gavetti and Levinthal (2000, p. 113) suggest "routines reflect experiential wisdom in that they are the outcome of trial and error learning and the selection and retention of past behaviors." Leiblein and Miller (2003, p. 846) apply this thinking to routines in sourcing and the development of relational capabilities:

> "Greater sourcing experience is likely to aid in the development of organizational routines that allow firms to efficiently collaborate with a broad array of partners. These routine-based capabilities may include general capabilities such as standard contractual safeguards or mechanisms to enhance interfunctional coordination across partners as well as firm-specific relational capabilities. Experienced firms may select better suppliers, understand how to organize relationships more effectively, and better anticipate and respond to technological or market contingencies over time."

Viewing maturity as an outcome of experience, Sawhney and Zabin (2002) present a model of relational maturity, based on the five-level Capability Maturity Model of software development (Bemberger, 1997). Their four-dimensional model of relationships includes customers, channel partners, employees, and suppliers (Morgan and Hunt, 1994; Gulati and Kletter, 2005), and Sawhney and Zabin (2002) suggest that "relational equity" is the wealth-creating potential that resides in relationships with stakeholders, and conclude that relational equity is best managed by making decisions across five "pillars" that include strategy, process, technology, organization, and metrics. Similarly, Gulati and Kletter's (2005) relationship-centric model is built on "relationship ladders", connoting a maturity of relationships and a firm's ability to leverage its relational capital. Whilst Sawhney and Zabin (2002) do not test their five-level model of relational maturity, they do depict more relationally-mature firms as having support from top leadership, high satisfaction levels across relationships, an optimised infrastructure for relationship management, integrated and coordinated processes, and strong performance measurement programs.

When studying organizational phenomenon, it is necessary to keep the level of analysis at the appropriate level. As a firm maintains multiple inter-organizational relationships, the level of the firm would be too coarse for the analysis of relationships which are idiosyncratic in nature at the aggregated relational level. Within a dyad, a buyer and supplier may be simultaneously engaged in multiple exchanges, ranging from simple to complex (Gulati and Kletter, 2005), therefore judging the performance and operational benefits owing to relational changes across the entire range of goods and services provided by a supplier would be very difficult. To overcome these challenges, researchers have examined *relationship quality* (RQ) as an outcome variable, as it is broad enough to capture the social outcomes across the range of exchanges within a dyad. The breadth leads to the treatment of RQ as a multi-dimensional construct with several elements considered, including customer orientation and ethical profile (Dorsch et al., 1998), willingness to invest and expectations of continuity (Kumar et al., 1995; Jap et al., 1999), information sharing and communication (Lages et al., 2005), and understanding (Leonidou et al., 2006). Despite the variety of terms and lack of clarity (Naude and Buttle, 2000), the majority of recent work identifies trust, commitment, and satisfaction as the three primary contributors to RQ (Crosby et al., 1990; Dorsch et al., 1998; Hennig-Thurau et al., 2002; Walter and Ritter, 2003; Farrelly and Quester, 2005; Ulaga and Eggert, 2006; Skarmeas et al., 2008).

3. Model and Hypotheses

We have so far have noted that inter-organizational relationships provide access to knowledge and resources that lie outside of firm boundaries, which may be combined with a firm's own resources to create advantage and rents (Dyer and Singh, 1998; Lavie, 2006). Gaining access to the complementary resources embedded in a network is a function of a firm's relational capability (Lorenzoni and Lipparini, 1999; Gulati and Kletter, 2005; Collins and Hitt, 2006). Capabilities are comprised of routines (Collis, 1994; Zollo and Winter, 2002), which can be improved and refined with experience. In addition to direct economic benefits, positive inter-organizational exchange produces relational capital, a social benefit that enhances future access to network resources (Nahapiet and Ghoshal, 1998; Cousins et al.,

2006). A firm's relational architecture provides the foundation on which relational capabilities are developed, and includes formal structure, processes, people, division of labour, resource allocation mechanisms, metrics and rewards, and inter-departmental coordination (Sawhney and Zabin, 2002; Jacobides, 2006; Teece, 2007). These constructs and relationships are depicted in Figure 1.

<<Insert Figure 1 about here>>

Building on Gavetti and Levinthal's (2000) idea that experiential wisdom leads to the selection and retention of past behaviors and decisions, Leiblein and Miller's (2003) observations that sourcing experience leads to enhanced relational capabilities, and the maturity framework introduced by Sawhney and Zabin (2002), we posit that firms that are more experienced and mature in managing strategic suppliers (i.e., capable) will likely have created the relational architectures that lead to better outcomes. Through learning, they will have altered the elements of their architectures—structure, processes, people, technology, resource allocation, and metrics—to enhance their capability to manage relationships. That is to say, the experience allows them to become more mature in their relational abilities. Finally, the capability (i.e., maturity) manifests in enhanced relational capital (i.e., improved relationship quality).

Figure 2 portrays the theoretical model we are using to study the architecture/capability/capital sequence. We have identified internal and boundary spanning elements that comprise relational architecture and use maturity to account for capability. Relationship quality serves to capture relational capital, that "stock" that motivates partners to invest time, energy, and creativity in a relationship.

<<Insert Figure 2 about here>>

The elements of organizational architecture most frequently mentioned in the literature include structure, processes, culture, people, decision rules and resource allocation, tasks and division of labour, performance evaluation and rewards, information and communication, and strategy (Nadler et al., 1992; Brickley et al., 1995; Nadler and Tushman, 1997; Jacobides, 2006). Relational architecture decisions involve these same levers, combining the behavioral, informational, and cultural factors to form the inter-organizational space necessary for creating new knowledge (Madhok, 2002; Lavie, 2006). By leveraging the accumulated experience of interorganizational relationships, RA decisions and upgrades also affect the development of a firm's relational capability, or its ability to access and integrate network resources (Amit and Shoemaker, 1993; Lorenzoni and Lipparini, 1999; Teece, 2007).

Commitment to relationships has long been associated with improved performance and satisfaction (Dyer, 1997; Morgan and Hunt, 1994; Mohr and Spekman, 1994; Wu et al., 2006). One way in which organizations demonstrate commitment to partners is by allocating and dedicating assets to the relationship. Internally, dedicating human assets or adjusting the organizational structure by creating organizational units focused on relationships can signal management's commitment to the rest of the organization, providing legitimacy and reducing barriers (Dyer et

al., 1997; Fawcett et al., 2006). Due to the benefits associated with dedicated assets and commitment, we posit:

> H1: Organizations that allocate and arrange internal resources (e.g., structure, people) for relationships will better manage their strategic suppliers.

Maturity in relationship management may also be reflected in the tools and decision frameworks a firm develops and maintains. Financial-oriented frameworks have addresses the return on investment analysis regarding close ties with strategic suppliers (Emberson and Story, 2006; Swink and Zsidisin, 2006) and guidelines for sharing benefits with suppliers (Cousins, 2002). Tools directed at relationships include documenting relationship strategies (Olsen and Ellram, 1997; Wagner and Boutellier, 2002) and providing training for employees (Kale, Dyer, and Singh, 2002). Therefore:

> H2: Organizations that develop and use frameworks to guide resource allocation and governance will better manage their strategic suppliers.

Experience and learning associated with strategic suppliers may also manifest in increased information sharing and the overall structure that engenders information exchange (Carr and Pearson, 2002). Several studies have noted the importance and benefits of communication and sharing of information performance (Lawson, et al., 2008; Fawcett, et al., 2006; Lusch and Brown, 1996). Sharing evaluation criteria and results, and strategic information is associated with improved relationships and performance (Cousins and Lawson, 2007; Lorenzoni and Lipparini, 1999; Mohr and Spekman, 1994). Given the multitude of evidence that information sharing improves performance, we posit:

> H3: Organizations that openly exchange strategic and performance information will better manage their strategic suppliers.

Close ties and relations allow for firms to work together to improve processes and drive value. Several authors have noted that, at their most basic level, relationships between buyers and supplier or alliance partners creates an environment in which both parties are willing to contribute energy and creativity to improvement and joint problem solving (e.g., Gulati and Sytch, 2007; Saccani and Perona, 2007; Swink and Zsidisin, 2006; Mohr and Spekman, 1994). Close relationships provide the time and space necessary for learning how to work together. Therefore:

> H4: Organizations that engage in more joint work with suppliers that drives value for both firms will better manage their strategic suppliers.

Lorenzoni and Lipparini (1999) observed firms' willingness to learn and adapt their governance styles by investing in relational activities, writing, "When the 'learning by interacting' mechanisms started to show their usefulness, the lead firms abandoned the 'hierarchy' option of manufacturing, adding the relational dimension to the efficiency-based consideration traditionally driven by make-or-buy alternatives." An organization's overall commitment to collaboration, manifest in investments in relational architecture, leads to performance improvements and higher value relationships (Liedtka, 1996; Wu et al., 2006). Therefore:

H5: Organizations that are more mature regarding their management of strategic suppliers will have higher quality relationships.

4. Methodology

Moran's (2005, p. 1132) discussion of social capital touches on the structural and relational elements, and he asks the question, "That is, in comparison with the network structure, to what extent does the quality of one's relationships matter?" Nahapiet and Ghoshal (1998) provide insight, observing that while structural elements may provide access to other organizations and their resources, it is the relational and cognitive factors which provide the motivation for partners to exchange and share. Studies of relationship quality suggest it is driven by activities that increase trust, signify commitment, and result in customer satisfaction (Skarmeas et al., 2008). In Sawhney and Zabin's (2002) maturity model, the highest levels are associated with satisfaction. Johnsen, et al., (2008) recommend, in the case of strategic partnerships, that evaluation focus on the relationship, not solely on the standard set of performance metrics used to evaluate suppliers.

Our methodology is modeled after Cannon and Perreault's (1999) study of relationship types, in which they collected survey data, created supply market-related factors (antecedents), employed cluster analysis using factors describing buyer-supplier relationship linkages, and then used discriminant analysis to investigate the relationship between the antecedents and the clusters (relationship types). Finally, they used ANOVA to investigate the relationship between the clusters and selected outcome variables.

Our study is arranged similarly. We first developed an online questionnaire survey methodology sent to a randomly selected group of organizations across a broad range of service and manufacturing sectors. Data was collected in relation to the research questions and hypotheses described in the previous sections. The unit of analysis in this study is at the business-unit level in respect of the approach adopted to supply relationship management. The terms "company" or "organization" are used in a broad sense, and relate to the business unit level of the firm. The data set of 657 responses was used to conduct statistical analysis and test the hypothesised relationships in the model (see Figure 2).

4.1 Survey and data collection

The questionnaire survey was designed with respect to the guidelines and recommendations presented in (Dillman, 2007) for maximising the response rate to the survey and adhering to the conventions of sound questionnaire research design. Respondents were contacted by email on three separate occasions. The first email (including a link to the questionnaire) was followed up with two reminders (each sent two weeks apart representing a total data collection period of seven weeks in duration). Due to time constraints only three emails were sent.

The survey questionnaire used constructs from previous literature, with a modified scale. The type of scale employed was chosen depending on the ease with which

the respondents can answer and on the type of analysis performed, in accordance with (Forza, 2002). In questions concerning supply relationship strategy, perceptual Likert scales with verbal frequency measures and statements to which the respondents gave their approval rate were used instead of metric measurements. By using perceptual Likert scales, response rates can be improved since the respondents can more easily give estimations and do not need to verify the exact value.

A total of 5298 questionnaire completion requests were sent via email. 852 questionnaires were returned, of which 659 responses were usable. This represents a usable combined response rate of 12.4 percent which is reasonable, in comparison to other studies (Fawcett and Scully, 1995; Narasimhan and Das, 2001) and survey research analysis in operations management (Frohlich, 2002). Non-response bias is estimated by comparing the responses from the first round with those received after the final reminder as suggested by (Lambert and Harrington, 1990). Univariate *t*-tests were performed on randomly selected survey items. The univariate *t*-tests yielded no statistically significant difference among early and late respondents, with no significant differences (at the 0.05 level) between these groups of respondents.

4.2 Sample

The sample frame consisted of organizations included in the membership databases of the International Procurement Leadership Foundation (IPLF) and the Council of Supply Chain Management Professionals (CSCMP). These combined memberships made up of over 12,000 supply management professionals with over 6,000 at the Manager, Vice President and Director level. Both the CSCMP and IPLF are professional development organizations for supply management professionals. This approach to identifying a sample frame has been used previously, and has been found to be robust (Narasimhan and Das, 2001; Carr and Pearson, 2002). All respondents belonged to the membership of the IPLF or CSCMP and worked with supply management issues on a day-to-day basis. The study includes small, medium-sized as well as large companies. A wide range of industries participated in the survey participated in the study. We eliminated those respondents that indicated their job role as ‘consultant’, as this group of individuals could have been answering on behalf of a client rather than on their own organization’s supply relationship management practices. They constituted respondent to some of the 195 questionnaires, and were eliminated before the analysis commenced, as we considered their responses to be a potential source of bias. This was because they may be responding to questions about their own organization, or a client’s business and as such we considered their responses to be a potentially poor in terms of respondent-related reliability.

The sample for this study reflected the whole database of members from the IPLF and a randomly selected group of 2,000 members from the CSCMP. Each of the professionals served as a key informant. These respondents were chosen as they were informed about the subject matter having been involved in purchasing and had supplier management responsibilities which gave them the insight necessary about supplier relationships. The profile of respondent accorded with the need to investigate the relationships that organizations (through their staff) have with suppliers.

The main reason for the elimination of questionnaire responses was a failure to complete the survey in its entirety, due partly to its lengthy nature. However, extra questions were necessary as they formed a key part of a self-assessment benchmarking profile that was returned to each participant once the survey had been completed. This aided in increasing the response rate, but did have the negative effect of making the survey longer to complete, thus resulting in 195 surveys being discarded as they were incomplete. Table xx presents the characteristics of the respondents.

The respondents to the survey consisted primarily of executives at the Director and Vice President level. About 50% of the respondents are in procurement, supply chain, or logistics roles. The respondents worked for a variety of industries, ranging from fast moving consumer goods, oil & gas, and pharmaceuticals. Firm size was measured in terms of gross dollar/euro/UK pound sales (currency conversions were correct at the time of the survey). On average, firms in the sample had $1B in sales revenue.

5. Results & Discussion

The data analysis begins with the results of structured equation modelling to establish convergent and discriminant validity for the underlying variables and their respective factors in the model. Next, cluster analysis, discriminant analysis, and ANOVA were used to test the hypothesised relationships in the model.

Confirmatory factor analysis was used to develop the factors that measure relational architecture. From a list of about 20 items, the CFA process reduced those to 16 items. Table 1 lists the items (and Cronbach's alpha scores) that comprise the factors used to measure the sub-elements of relational architecture, as well as the items comprising the relationship quality (RQ) scale. Table 2 contains the latent variable correlation matrix, demonstrating discriminant validity for the factors.

The items in Table 1 broadly represent the elements of organizational architecture—particularly in terms of shaping the behavioral, informational and cultural space (Nadler at al., 1992). As discussed previously, we are applying the concept to the space occupied by boundary spanning employees and systems, as well as the processes and policies in support. The internal resources, internal frameworks, joint information exchange and joint improvement factors in Table 1 represent the levers available to affect the architecture of a relationship.

The model in Figure 2 suggests that maturity in managing relationships with strategic suppliers serves as a surrogate to relational capability. We leverage the ideas of learning and experiential wisdom to the investment and management decisions made to enhance relationships with strategic suppliers. Over time, the learning generated through multiple relationships, as well as the iterative and dynamic nature of a single relationship, develops into relational capability. To differentiate the respondents by strategic supplier relationship maturity (SSRM), cluster analysis was applied, with the results being forced into three clusters. Table 3 lists the items used to measure the maturity of a firm's approach to supplier relationship management, as

well as the cluster centers for each of the three clusters. The three clusters appear to break into low, medium, and high levels of maturity or relational capability.

Tables 4 – 6 show the results of the discriminant analysis, with two functions emerging. Only function 1 (Table 4) has an eigenvalue greater than 1.0 and it accounts for nearly all of the variance (99.2%). The discriminant function coefficients in Table 5 indicate that the first three factors (Internal Resources, Internal Frameworks, and Joint Information Exchange) are different in the two functions, indicating these three factors are contributing to differences in the cluster groups. Interpretation means these factors are central to differentiating strategic supplier management maturity; over time, firms have learned where to position the relational architecture levers to develop their relational capability. This result demonstrates support for Hypotheses 2-4.

The final link in Figure 2—between maturity (SSRM) and relationship quality (RQ)—is the surrogate for the theoretical model's relationship between relational capability and the creation of relational capital. Recall that relational capital is necessary to gain access to the resources that reside in suppliers or external organizations. It is relational capital that underpins the creation of relational rents (Dyer and Singh, 1998).

Tables 7 – 8 display the ANOVA results of the clusters on relationship quality (RQ). Table 7 lists the means the RQ means for each cluster and Table 8 shows the clusters differ significantly regarding the perceived relationship quality. In several studies, researchers have identified a collection of benefits associated with enhanced RQ, such as greater trust (Arino et al., 2001), improved supply chain performance (Fynes, et al., 2005), service quality (Woo and Ennew, 2004) and increased loyalty (Caceras and Paparoidamis, 2007).

Extensions to the RBV suggest that firms able to access resources and capabilities outside of their boundaries will be able to generate capture superior rents (Lavie, 2006). Our study investigated the linkages between structural decisions made in the firm and with partners (relational architecture), skill and maturity of managing relationships (relational capability) and the satisfaction and quality associated with those relationships (relational capital). We demonstrated a significant relationship between three elements of relational architecture (internal resources, internal frameworks, and joint information exchange) and maturity/capability in managing relationships with strategic suppliers. Finally, we demonstrated a positive and significant relationship between maturity (capability) and relationship quality (capital).

While many authors suggest close ties with suppliers is the right strategy in many cases, success of firms actually leveraging those relationships is spotty and inconsistent. We think that the decisions and structures built within the firm will help to develop the firm's capability in managing relationships, thereby allowing access the resources present—and available—in its network. Capabilities are exemplified by an organization that adapts its operating processes through a relatively stable activity dedicated to process improvements, and are the organization equivalent to the technological determinants of production efficiency (Collis, 1994). Capabilities clearly can be developed in regards to enhancing relationships and companies that

are realizing the most value from their relationships have learned how work with other firms to create that value.

6. Limitations and future research

Below is a list of topics and issues that future research in this area might address:

- Role of individuals' relational competency in supporting firm-level relational competency (Blyler and Coff, SMJ 2003)

- How do governance and relational skills evolve over time and what is their relationship to production skills? (Madhok, 2002)

- Relationship between division of labor in the firm and firm capabilities, and how the capabilities change and evolve (Jacobides, 2006)

- Corporate Cultural effects on relational competency (Lado, et al., 1992)

- Applying concept of social capital simultaneously to intra-(Tsai, SMJ, 200) and inter-organizational factors.

- More study in general on the contribution of intra-org processes to relational capability. (Liedtka, 1996)

- Adler et al. (1999) and Tushman (1996) and Smith and Tushman's (2005) work on ambidextrous organizations—and the inherent conflicts between exploring and exploiting strategies—suggest a requirement for different architectures. First, how are architectures different in exploitive vs. explorative relations?

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Table 1: Relational Architecture Factors
(Scale: 1 – 5; with extremes presented on survey as listed in table)

FACTOR		Cronbach's Alpha
Internal Resources		[α = .865]
There is no overall sponsor who 'owns' initiatives with strategic suppliers.		We have a main board/top executive sponsor for strategic supplier initiatives.
There are no dedicated relationship leaders for strategic suppliers.		Full-time, dedicated relationship leaders are in place for strategic suppliers.
We have not allocated a specific budget or resources to strategic supplier initiatives.		Our organization has allocated a budget and resources to strategic supplier initiatives.
We have not identified the business case and benefits of strategic supplier initiatives.		The business case and benefits of strategic supplier initiatives are identified.
We do not have cross-functional teams with clear responsibilities for strategic suppliers.		We have cross-functional teams w/ clear responsibilities for strategic suppliers.
Internal Frameworks		[α = .859]
We do not have guidelines or frameworks to share benefits with strategic suppliers.		We have guidelines and frameworks for sharing benefits with strategic suppliers.
We do not have a defined and structured process for managing strategic suppliers.		A defined process exists for managing strategic suppliers and is widely adopted.
We do not have documented relationship strategies for our strategic suppliers.		We have full documented relationship strategies for all our strategic suppliers.
We do not provide training in strategic supplier relationship leadership.		Strategic supplier relationship leaders have been in our adopted process.
Joint Information Exchange		[α = .861]
We do not formally review key data and information about strategic suppliers.		We have regular, open dialog with strategic suppliers about performance.
Performance metrics for strategic suppliers are undeveloped or non-existent.		We have forums and reviews to examine internal data About strategic suppliers.
There are gaps in our understanding of strategic suppliers' strategies and plans.		We have a full set of performance metrics for measuring strategic suppliers.
We do not have regular, open dialogue with our strategic suppliers about performance.		There is real understanding of strategic suppliers' business strategies.
Joint Improvement		[α = .829]
We do not work regularly with strategic suppliers on new ways of reducing costs.		We regularly work with strategic supplies to find new ways of reducing costs.
We do not focus with strategic suppliers on radically restructuring ways of working.		We regularly focus with strategic suppliers on radically restructuring ways of working.
We do not have jointly planned, detailed work streams with strategic suppliers.		We have jointly planned and detailed work streams with our strategic suppliers.
Relationship Quality (1 = Strongly Disagree, 5 = Strongly Agree): "Provide an assessment of how strategic suppliers currently view your organization" [α = .771]		
Tough but fair. The right balance between competition and collaboration.		
An improving organization. Strategic suppliers want to work with us.		
A great organization to do business with. A "preferred customer."		
Relationships are excellent, open and co-operative on both sides.		
Committed to maximising value jointly, and sharing the benefits with them.		

Table 2: Relational Architecture Factors – Discriminant Validity (latent variable correlation matrix)

	Internal resources	Internal frameworks	Joint Info exchange	Joint improvement
Internal resources	**.780**			
Internal frameworks	.767	**.801**		
Joint Info exchange	.675	.713	**.832**	
Joint improvement	.583	.634	.661	**.857**

Square root of AVE is on the diagonal. Discriminant validity is determined by looking down the columns and across the rows. Should the diagonal elements be larger than off-diagonal elements, discriminant validity is deemed satisfactory.

Table 3: Cluster results (Forced into three clusters)

Final Cluster Centers	Cluster		
Items	1	2	3
Cases in each cluster	189	261	209
The way we manage our suppliers is world class	1.70	2.52	3.35
We have a defined approach to governance, planning, and decision-making	2.69	3.26	3.95
A senior executive owns and leads strategic supplier relationships	2.30	3.37	4.04
Contracting has been restructured with new metrics, incentives and frameworks	1.61	2.72	3.39
We use corrective action teams, lean, 6-sigma, and kaizen-type tools to improve performance	1.70	2.63	3.59
We have joint cost down projects focused on cost drivers across the supply chain	1.56	2.79	3.53
We have integrated external supplier innovation into design and development	1.80	2.79	3.53
We have little or no organizational focus on strategic supplier management (reverse coded)	2.48	3.35	4.55
It is unclear who owns and controls strategic supplier relationships (reverse coded)	2.37	3.22	4.21
Procurement's involvement in strategic supplier management is low (reverse coded)	2.55	3.37	4.39
There is considerable scope for improvement in this area (reverse coded)	1.48	1.73	2.82

Table 4: Discriminant Functions

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	1.244[a]	99.2	99.2	.745
2	.010[a]	.8	100.0	.102

a. First 2 canonical discriminant functions were used in the analysis.

b. Wilks" Lambda = .441; Chi Sq = 460.502; Sign. = .000

Table 5: Standardized Canonical Discriminant Function Coefficients

Factor Scores	Function	
	1	2
Internal Resources	.787	-.657
Internal Frameworks	.702	.279
Joint Information Exchange	.675	.078
Joint Improvement	.573	.601

Table 6: Classification results (Cases Predicted by Discriminant Functions)[a]

		Cluster Number of Case	Predicted Group Membership			
			1	2	3	Total
Original	Count	1	122	44	2	168
		2	46	130	45	221
		3	2	54	122	178
	%	1	72.6	26.2	1.2	100.0
		2	20.8	58.8	20.4	100.0
		3	1.1	30.3	68.5	100.0

a. 66.0% of original grouped cases correctly classified.

Table 7: Cluster Means for Relationship Quality

	N	Mean
1	171	-.5926433
2	249	-.0644774
3	198	.5596688
Total	618	-.0106512

Table 8: ANOVA Results of Clusters and Relationship Quality

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	123.044	2	61.522	77.110	.000
Within Groups	490.675	615	.798		
Total	613.719	617			

Figure 1: Relationship Constructs

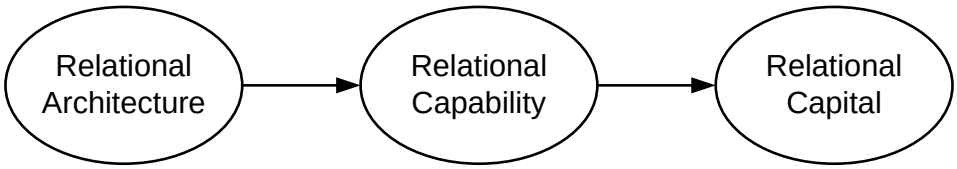
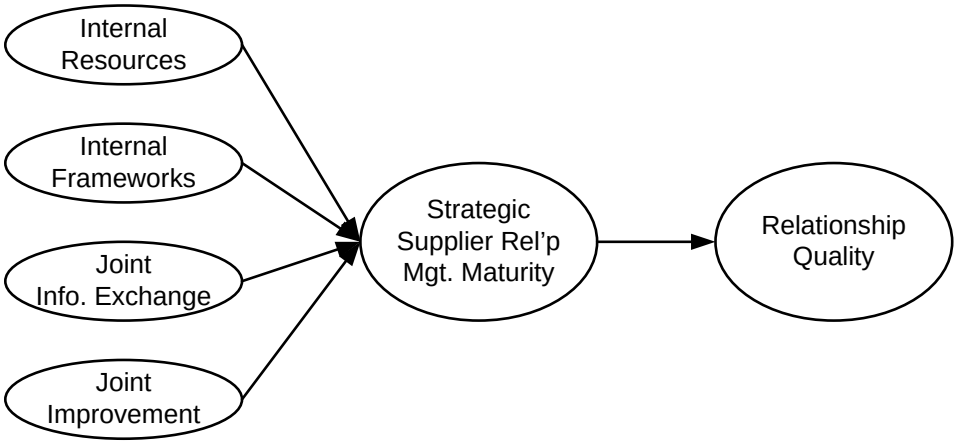


Figure 2: Theoretical Model of Relational Architecture



Purchasing Team Activities in the Supply Chain

P. Fraser Johnson[*a]
The University of Western Ontario

Michiel R. Leenders [a]
The University of Western Ontario

[a] *Richard Ivey School of Business, The University of Western Ontario, London, Ontario, Canada N6A 3K7*

Abstract

This paper presents findings from an exploratory study that examines the relationship between supply team objectives and supply teams with or without customer participation. Using a sample of 284 large North American firms, two general dimensions of purchasing team objectives were identified and empirically validated: strategic supply initiatives and performance and measurement. After controlling for sales and industry context, analysis found that both strategic supply initiatives and measurement and improvement purposes influenced the use of internal and customer teams. Our conclusion is that customer participation is not limited to strategic supply initiatives. Furthermore, firms look for broad customer engagement for team-based activities, rather than focusing on a narrow range of high-profile initiatives.

Key Words: purchasing and supply management, teams, resource based view, supply chain management.

[*] *Corresponding author*
Richard Ivey School of Business, The University of Western Ontario, London, Ontario, Canada N6A 3K7
email: fjohnson@ivey.uwo.ca, tel.: (519) 661-3219, fax: (519) 661-3485

Purchasing Team Activities in the Supply Chain

There has been considerable managerial interest in the opportunities to use purchasing teams as a means of enhancing external and internal integration (Ellram and Pearson 1993; Trent and Monczka 1994; Johnson et al. 2002; Johnson et al. 2007). Teams, directed toward the completion of a wide range of initiatives, have the advantage of combining the skills and resources of individuals, spanning across functions and business units. The effective management of teams is increasingly seen as a fundamental organizational capability as firms strive to achieve effective solutions to business issues that require a cross-functional perspective (Denison et al. 1996).

Much of the existing literature on purchasing teams tends to take a prescriptive approach that focuses on techniques for improving team performance (e.g., Trent and Monczka 1994; Giunipero and Vogt 1997). Teams can be deployed for a variety of strategic objectives related to development of organizational capabilities and deployment of resources, as suggested by the resource based view (RBV) (Dierickx and Cool 1989; Barney 1991).

Previous research has found that factors such as industry context and the strategic role of supply in the firm influence the use of team-based purchasing activities (Johnson et al. 2002). Notwithstanding the influence of such firm-level factors, purchasing teams are typically struck to fulfill a specific management objective, such as new product development, lower cost structures or improved quality. The success or failure of the team is frequently measured, at least in part, by its ability to achieve the objectives established at the outset. Consequently, the objectives of the team will likely influence a variety of factors, such as team composition, resources and structure.

This research makes a contribution by extending our understanding of how team objectives influence the use of team-based purchasing activities. By providing insights regarding the motivations behind the use of purchasing teams, the research provides a deeper understanding of how business objectives align with team use. The supply chain management literature stresses the importance of alignment between buyers and suppliers (Carr and Pearson 1999). Teams represent a common method of supply chain coordination in areas such as new product development, reduction in total costs of ownership and lead time reduction. Consequently, a second contribution of this research is to provide a better appreciation for when purchasing teams involve customers.

This paper is organized as follows. Drawing from the supply chain and resource based view (RBV) literatures, the following section defines the constructs and hypothesized relationships between team purposes and purchasing team usage. Next, the survey methodology and construct measurement are provided. Lastly, the results and discussion are presented along with the implications for future research and managerial practice.

Theoretical Development

Purchasing Teams

A team is a group brought together to achieve a shared goal, is independent and bound and stable over time, and has the authority to manage its own work and internal processes (Alderfer 1977;

Hackman 1990). Teams attempt to capture the benefits of cross-functional skills and orientation, and represent an accepted method for managing projects and activities in a wide variety of areas, such as new product development, information systems deployment and cost reduction initiatives. The formation and management of teams continues to present complex challenges, indicating that effective implementation is a strategic resource, possibly linked to organizational learning (Hult et al., 2003), social complexity and team-based skills (Coff 1999; Lewis 2003).

The resource based view (RBV) proposes that firms seek to acquire and control bundles of resources that when combined become sources of competitive advantage. Strategic resources are defined as assets, capabilities and organizational processes controlled by a firm which have value, are rare, difficult to imitate and have few substitutes (Barney 1991). A firm's resources, such as supply expertise, can either be acquired in the case of tradable resources or can be path-dependent, accumulating over time (Dierickx and Cool 1989; Black and Boal 1994).

While RBV is a widely applied perspective for studying firm strategy, it also has clear implications for internal firm structure. As noted above, firms also must have internal organizational structures, such as inter-functional teams, and business processes that enable it to acquire and leverage resources to facilitate the production and delivery of goods and services. Furthermore, firms can create competitive advantage when they are successful in creating linkages with critical suppliers that successfully exclude competitors from forming the same relationships (Rungtusanatham et al. 2003).

Purchasing Team Objectives

In a supply context, teams can combine skills and resources of several stakeholders, which can span across multiple functions or subunits, to facilitate the timely completion of a supply management goal that will benefit the organization, such as supplier selection, standardization of purchases, reduced total cost of ownership, improved supplier quality or reduction of lead times (Ellram and Pearson 1993; Denison et al. 1996; Trent 1998). Purchasing teams can consist of individuals from a variety of functional areas or from the purchasing function only (Trent and Monczka 1994). Finally, teams may include representatives from outside the organization, such as suppliers or customers (Carter and Narasimhan 1996). Such teams bring together stakeholders from the supply chain to address issues of mutual concern, such as quality problems or new product development (Dyer, 1996). Consequently, the success of supply chain initiatives can be influenced by the ability of firms to structure and manage long-term co-operative relationships with customers and suppliers, and sometimes with competitors (Bechtel and Jayaram 1997).

Firm-level adoption of purchasing teams can enhance both external and internal integration through the involvement of internal stakeholders, suppliers and/or customers. Prior research has supported a two-dimensional construct: internal teams and customer teams. Internal teams consisted of purchasing councils, supplier councils, commodity teams and cross-functional teams (Johnson et al. 2002). The common element among the four items in this construct was that they were concentrated and organized within the firm and/or the supplier aimed at reducing transaction costs. In contrast, customer teams had a strong downstream orientation, with active involvement of external customers in the supply chain.

Similarly, the motivation for the creation of internal and customer teams can differ. At a fundamental level, the objectives of internal purchasing teams are likely motivated by objectives related to supply improvement issues, such as supplier selection, development of product or service specifications or standardization of purchases, which do not require customer input. Such teams may be created to achieve departmental cost reduction targets, improve quality or meet supplier rationalization targets. In contrast, broader strategic corporate level initiatives, such as new product development, revenue enhancement initiatives and gaining access to new technology, are more likely to require customer participation. Such teams may be driven by customer needs, such as supplier involvement in new product development in the automotive industry (Choi 2004). Thus, we propose:

Hypothesis 1: The greater the emphasis on supply improvement team purposes, the greater the use of internal teams.

Hypothesis 2: The greater the emphasis on strategic corporate level team purposes, the greater the use of customer teams.

Research Design

A survey instrument was developed to understand both the relationship between purchasing team purposes and team usage. In the following sections, we describe our sample, data collection procedures, and constructs.

Survey Sample

A survey instrument was developed to examine the relationships between purchasing team purposes and purchasing team usage. The target population for this study was comprised of large manufacturing and services firms in the U.S. and Canada. The Title 1 membership list of the Institute of Supply Management (ISM) and the CAPS Research membership directory were used to identify U.S. respondents for firms on the *Fortune 1000* manufacturing and services lists. The membership database of the Purchasing Management Association of Canada (PMAC) was used to identify Canadian respondents for firms on the *Financial Post 100* list. In order to reduce the potential for single-respondent bias, we focused on high-level managers who tend to be more reliable sources of information than lower-level managers (Philips 1981). The title of the respondent sought was primarily vice president or director of purchasing or supply chain management.

The survey was nine pages in length and typically required 20 to 30 minutes to complete. The survey was pre-tested on a group of five chief purchasing officers (CPOs) and two academics. This group was asked to review the questionnaire for structure, readability, ambiguity and completeness, and the survey instrument was refined based on their feedback. Appendix A provides a summary of the relevant questions used in the survey instrument.

In an effort to increase the response rate, a modified version of the methodology of Dillman (2000) was followed. In October 2003, questionnaires were mailed along with a cover letter and stamped return envelope to 658 organizations. From the initial sample frame of 658, 18 were dropped because they had been inadvertently duplicated in the database, ceased operation or moved to a new location. Consequently, the effective sample frame was 640 organizations, consisting of 562 and 78 U.S. and Canadian firms, respectively. Four waves of contact were then conducted: initial mailing of survey, reminder emails or fax to all non-respondents; second mailing of the survey; and finally, a reminder telephone call.

To encourage the widest possible participation by both users and non-users of e-business technologies, respondents were given three options for the completing and returning the survey: mail in the stamped return envelope; fax; and Internet (web-based questionnaire). Nearly three-quarters of the responses were received via mail. Of the 640 targeted firms, 284 (44%) completed surveys were returned. In this study, nonresponse bias was tested by comparing the responses of early and late waves of returned surveys for firm size and respondent title (Armstrong and Overton 1977). No significant differences were encountered.

Team Purposes Construct

Sixteen purchasing team purposes were identified as generally accepted in the purchasing literature: access to new technology, achievement of lean supply initiatives, cost reduction, development of strategies congruent with corporate goals and strategies, insourcing, lead time reduction, new product development, outsourcing, performance measurement, quality improvement, revenue enhancement, specification development, standardization, supplier development, supplier selection and value improvement (Leenders et al. 2006). Respondents we asked to rate their organizations' level of use of each on a five-point Likert scale (1 = none to 5 = extensive). Table 1 summarizes the sample means and standard deviations for the 16 team purposes.

Exploratory factor analysis (principal components analysis with varimax rotation) was used to analyze the pattern of usage for the 16 forms of e-team purposes. Five items that cross loaded on both factors were removed from the analysis. Subsequently, both a scree plot and eigenvalue criterion (greater than one) supported the extraction of two factors. All 11 items loaded on one factor above the recommended level of 0.50 (Hair et al., 1995). Table 2 provides the results for the factor analysis of purchasing team purposes.

The first factor was labeled "strategic supply initiatives," and included access to new technology, cost reduction, develop supply strategies congruent with corporate strategies, insourcing, new product development and revenue enhancement. The reliability coefficient (Cronbach's α) for the dyadic coordination factor was 0.74, above the threshold recommended for exploratory research (Nunnally and Berstein 1994). The items included in the factor imply a broad range of corporate activities that may, for example, involve engineering (new product development), marketing and sales (revenue enhancement) or senior executives (corporate strategies). Cost reduction initiatives are frequently corporate-wide programs, guided by the CEO or CFO (Leenders and Johnson 2002).

The second factor was labeled "measurement and improvement," and included performance measurement, quality improvement, specification development, standardization and supplier development (α = .84). These items tend to concentrate on activities focused in specific areas aimed at driving performance improvements in the supply chain, in areas such as quality and enhancing supplier capabilities.

Team Usage Construct

Building on prior research, six types of purchasing teams have been identified and generally accepted in the purchasing literature; four are internally oriented and two directly involve customers (Trent and Monczka, 1994; Murphy and Heberling, 1996; Trent, 1998; Johnson et al., 2002; Johnson et al. 2007). Respondents were asked to rate the extent to which their organization made use of each type of team on a five-point Likert scale. Table 3 summarizes the sample mean scores for the relative usage of the six types of purchasing teams. Confirmatory factor analysis was used to assess the pattern of internal and customer team usage against the scales identified in prior research (Johnson et al., 2002). The earlier factor pattern, which employed a different sample, was replicated, and all parameter loadings on the two team factors were significant ($p < .01$) and overall model fit was good, although the chi square statistic was significant (AGFI = 0.93; CMIN/DF = 2.80; $\chi^2 = 22.3$).

Firm Sector and Size

Industry context (manufacturing and services sectors) and firm characteristics (firm sales) were included in this research as control variables. The sample included 171 manufacturing firms and 113 service firms. Manufacturing industry firms formed the reference group for the regression analysis.

Empirical Results

We used linear regression to explore the linkage between team purposes and purchasing team usage. Based on the preceding factor analysis, usage of internal teams and customer teams was assessed individually. Firm size and industry sector were included in the model as control variables. Dummy variables were used to model industry context (manufacturing and services).

Results of the regression model are provided in Table 4. The overall regression model for both team usage factors was significant, with $R^2 = 0.34$ and 0.11 ($p < .01$) for the use of internal teams and customer teams, respectively. For both models, collinearity diagnostics were within recommended limits.

First, H1 suggested a relationship between the measurement and improvement factor and internal teams, while H2 suggested a relationship between the strategic supply initiatives factor and customer teams. Findings, however, indicate that strategic supply initiatives and measurement

and improvement played a significant part in the usage of both types of purchasing teams. After controlling for firm sales and industry sector, internal teams and customer teams increased significantly for both strategic supply initiatives and measurement and improvement factors ($p < .01$).

Second, firm sales and industry context played a significant part in the usage of internal teams ($p < .01$), but not in the use of customer teams. Manufacturing firms favored the use of internal teams. Similarly, the use of internal teams increased as firm sales increased.

Discussion

The empirical results point to several important findings that contribute to a better understanding of management's use of purchasing teams. First, not surprisingly, cost reduction represented the most frequent team purpose and insourcing had the lowest mean score. However, the relatively high mean scores suggest a wide range of purposes. Overall, findings indicate a two-dimensional taxonomy for team purposes. The purposes for teams focus on strategic initiatives, such as revenue enhancement and new product development, or on measurement and improvement initiatives such as quality improvement and supplier development.

While previous research has examined the broad context of managing purchasing teams, in areas such as leadership, empowerment and authority (e.g., Trent and Monczka 1994; Trent 1996; Giunipero and Vogt 1997), this paper draws linkages between the underlying motivations for the creating purchasing teams and the type of team used. Findings did not support our original hypothesis that internal and customer purchasing team usage is influenced by different objectives. Instead, our research findings suggest that both forms of purchasing teams can be motivated by a desire to deliver broad corporate initiatives and to achieve measurement and performance objectives. These findings suggest that customer participation is not necessary to support strategic team-based initiatives. Cross-functional internal teams can be expected to deliver both strategic and operational benefits. Similarly, it is quite possible to involve customers in team-based activities motivated by measurement and improvement objectives. In addition, it may be impractical and/or undesirable to have customer participation in some strategic chain initiatives. Alternatively, in some circumstances customers may request supplier involvement in supply chain improvement projects.

Since most service organizations spend a smaller percentage of total revenue with suppliers one would expect less extensive and less sophisticated supply improvement initiatives than in manufacturing companies. On the other hand, the nature of the customer service firm provider interface, often with a high degree of intangibles, probably does require more supply teams which include customers. Consequently, it was not surprising to see that firm context did not influence the use of customer teams.

That internal team usage increases as organizational size increases should not be a surprise. Given the relatively small size of supply organization in relation to the firm as a whole, many smaller organizations lack the resources to use supply teams extensively. Also in small

companies a supply expert can probably access others in different functions easier and less formally than in larger companies.

Findings also provide important managerial implications. First, managers should attempt to cast a wide net when engaging customers on teams. Rather than focusing on customer engagement in broad strategic initiatives, such as access to new technology or revenue enhancement, we found regular contact across a broad range of initiatives. While working with customers on high profile projects such as development of new products and services, regular contact on continuous improvement teams exploring opportunities for quality improvements or lower total costs of ownership can be an effective approach to managing long-term supply chain competitiveness and developing deep relationships with supply chain partners.

Second, one explanation for the results of this research is that it is difficult to separate team purposes clearly into non-strategic and strategic. An improvement in quality can be viewed as strictly operational, but could also represent potential for competitive advantage. The same argument can be applied to any of the sixteen team purposes identified. The survey instrument applied in the research measured frequency of use. If one equates frequency of use with satisfaction with the process, one could imply teams with the highest means should be the most effective.

Third, while large firms and respondents from the manufacturing sector were more likely to use internal teams, firm sales and industry context did no influence the use of customer teams. Furthermore, it would appear, based on the high standard deviations for the customer team usage scores, that some firms make extensive use of customer teams, regardless of industry sector or firm size. It may be that such firms have identified opportunities to create linkages with customers that provide a source of competitive advantage by excluding competitors from developing similar relationships, as suggested by RBV. Additional investigation into customer team usage in the supply chain represents an opportunity for future research.

Lastly, supply initiated teams that include customers require sales/marketing agreement and assistance in inviting customer representation. On the other hand, supply initiated teams that include suppliers can be created directly, because supply “owns” the boundary/relationship between suppliers and the firm, but not the boundary/relationship between customers and the firm. Given the natural orientation of supply towards the supply market and the potential obstacles in supply’s access to the customer market, it is logical to see more supply teams including suppliers than customers. If customer permission needs to be sought to change a specification, supplier, schedule packaging etc., as would be the case in the consumer electronics and automotive industries for example, then customer inclusion on a supply team may be a way of speeding up the permission process. The high standard deviation around the means of team purposes suggests that some managers believe that being unconventional and using some types of teams more or less extensively than the mean is a sound practice, presumably reinforced by experience. The RBV argues that it is wise to exploit competitive advantage in processes or activities not widely used by others. Perhaps the effective use of certain types of supply teams represents a good example.

Conclusion and Future Research

The objective of this research was to test empirically the relationship between purchasing team use in the supply chain and team purposes. Exploratory factor analysis identified a two-dimensional construct for purchasing teams. After controlling for sales and industry context, analysis found that both strategic supply initiatives and measurement and improvement purposes influenced the use of internal and customer teams. Our conclusion is that customer participation is not limited to strategic supply initiatives. Furthermore, firms look for broad customer engagement for team-based activities, rather than focusing on a narrow range of high-profile initiatives.

Findings from the research suggest several opportunities for future research. First, the research can be extended to investigate the relationships between team purposes, team usage and firm performance. This could be achieved through the use of a large sample survey. Alternatively, case-based research could be used to investigate how purchasing team performance aligns with the benefits achieved. Are the original purchasing team expectations met or exceeded?

Given the relatively low use of supply teams including customers, it would be interesting to find out how many of such teams were actually initiated by customers demanding greater value, which ultimately required supplier cooperation and supply involvement. In addition, what reasons required supply initiated teams to involve customers at the request of supply? One might speculate that the relative power of each party in this trade relationship would influence team initiation.

Another research possibility is the examination of teams exclusively composed of firm employees versus teams including customers or suppliers. Does the presence of "outsiders" influence the behavior of the "insiders"? A third opportunity for research could be the study of "unconventional" team usage and to examine the reasons for and the results of such efforts.

Under the concept of open innovation, the search for technological options and specialty sources is more likely to require teams with the capability of accessing the market's potential to solve specific technological challenges. Supply's role on teams initiated by others would be a worthwhile topic of inquiry.

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Table 1
Purposes for Purchasing Teams

Team Purpose	Mean[†]	Std. Dev.
Cost reduction	4.21	0.93
Develop supply strategies congruent with corporate strategies	3.69	1.08
Supplier selection	3.62	1.12
Value improvement	3.59	1.13
Quality improvement	3.31	1.09
Performance measurement	3.16	1.17
Standardization	3.09	1.00
Supplier development	3.07	1.09
Achieve lean supply initiatives	3.02	1.18
Access to new technology	2.92	1.07
Outsourcing	2.88	1.14
New product development	2.86	1.28
Specification development	2.85	1.09
Lead time reduction	2.83	1.11
Revenue enhancement	2.81	1.25
Insourcing	2.00	1.00

[†] 1 = none, 2 = slight, 3 = moderate, 4 = substantial, 5 = extensive

Table 2
Purposes for Purchasing Teams: Factor Analysis

Team Purpose	Factor 1	Factor 2
Access to new technology	**0.726**	0.112
Cost reduction	**0.635**	0.220
Develop supply strategies congruent with corporate strategies	**0.601**	0.286
Insourcing	**0.576**	0.131
New product development	**0.624**	0.290
Revenue enhancement	**0.572**	0.240
Performance measurement	0.333	**0.728**
Quality improvement	0.388	**0.690**
Specification development	0.253	**0.655**
Standardization	0.074	**0.809**
Supplier development	0.252	**0.771**

† 1 = none, 2 = slight, 3 = moderate, 4 = substantial, 5 = extensive

Table 3
Purchasing Team Usage: Rating Based on Team Composition

Form of Team	Mean†	Std. Dev.
cross-functional teams	3.93	0.99
commodity teams (purchasing personnel only)	3.57	1.24
purchasing councils (purchasing personnel only)	2.83	1.30
supplier councils (primarily key suppliers)	2.11	1.10
teams with external customers	1.96	1.05
teams with suppliers and external customers	1.65	0.90

† 1 = none, 2 = slight, 3 = moderate, 4 = substantial, 5 = extensive

Table 4
Results of Regression Analysis

Independent variables	Internal teams		Customer teams	
	Control variables	Controls and factors	Control variables	Controls and factors
Sales	0.217** (0.039)	0.164** (0.035)	0.016 (0.047)	-0.029 (0.045)
Industry context	-0.370** (0.093)	-0.263** (0.082)	-0.093 (0.112)	-0.012 (0.107)
Strategic supply initiatives		0.316** (0.069)		0.194* (0.090)
Measurement and improvement		0.225** (0.059)		0.230** (0.078)
Constant	2.496** (0.143)	0.968** (0.206)	1.785** (0.173)	0.600* (0.270)
R^2	0.127	0.339	0.003	0.110
ΔR^2		0.212		0.107
F	20.422**	35.828**	0.367	8.611**

N = 284. Standard errors noted in brackets.
† $p \leq 0.10$
* $p \leq 0.05$
** $p \leq 0.01$

The Role of Drivers as Customer Contact Employees

Christoph Bode*
Swiss Federal Institute of Technology Zurich
Department of Management, Technology, and Economics
Scheuchzerstrasse 7, 8092 Zurich, Switzerland
Phone: +41 44 632 0882
Fax: +41 44 632 1526
e-mail: cbode@ethz.ch

Eckhard Lindemann
Swiss Federal Institute of Technology Zurich
Department of Management, Technology, and Economics
Scheuchzerstrasse 7, 8092 Zurich, Switzerland
Phone: +41 44 632 6425
Fax: +41 44 632 1526
e-mail: elindemann@ethz.ch

Stephan M. Wagner
Swiss Federal Institute of Technology Zurich
Department of Management, Technology, and Economics
Scheuchzerstrasse 7, 8092 Zurich, Switzerland
Phone: +41 44 632 3259
Fax: +41 44 632 1526
e-mail: stwagner@ethz.ch

* Corresponding author

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The Role of Drivers as Customer Contact Employees

Abstract

While the importance of a sales representative as customer contact employees is unquestioned, the role of drivers, i.e., the front-line employees who deliver the products, as customer contact employees has so far not been investigated. The purpose of this study is to investigate how and under what conditions drivers of a supplier firm may increase customers' contributions to the supplier firm's sales in an industrial buyer-supplier relationship. Specifically, we hypothesize and test, based on a sample of 207 industrial business-to-business relationships, a proposed theoretical model that explains the link between a customer's perceived personal contact quality (received from the delivering driver) and the customer's purchasing intention and, thus, the sales of the supplier firm.

Keywords: drivers, customer contact employees, buyer-supplier relationships, survey

1. Introduction

In many industrial business-to-business settings, the material flow along the supply chain is executed by logistics service providers (LSPs) (Lieb & Bentz, 2005). During the last decade, the usage and importance of outsourced transportation services has been steadily increasing, whereas the number of industrial firms that own and operate distribution and delivery assets has been decreasing (Deepen, Goldsby, Knemeyer, & Wallenburg, 2008). Industrial firms rely on LSPs to reduce costs and to improve the service quality towards their customers while focusing on their core competencies (Capgemini Consulting, Georgia Institute of Technology, Oracle, & Panalpina, 2009). Depending on the type of product and the structure of the supply chain, various LSPs, ranging from specialized carriers to CEP (courier, express and parcel services) providers, readily offer dedicated physical distribution and delivery services. Due to economies of scale (specialization, bundling opportunities, large networks), they are often able to offer the same (or even better) physical distribution services, at a better performance (e.g., timeliness, order accuracy, order condition), and at lower costs than industrial firms could do on their own (Bowersox, Daugherty, Dröge, Rogers, & Wardlow, 1989). Thus, it seems to make much sense for industrial firms to outsource their distribution needs.

However, viewing physical distribution and associated outsourcing decisions solely through the lenses of technical logistics service quality and logistics costs might be too narrow. Specifically, this logic neglects the marketing and customer contact dimension of physical distribution services (Mentzer, Flint, & Kent, 1999). The relationship marketing literature suggests that an important avenue for the creation of stable buyer-supplier relationships, and thus robust sales, lies in the personal interaction of customer contact employees with employees of the customer firm (Reynolds & Beatty, 1999; Ulaga & Eggert, 2006). While there is ample literature on sales representatives as customer contact employees (Bendapudi & Leone, 2002; Crosby, Evans, & Cowles, 1990), the role of drivers, i.e., the front-line employees that transport and deliver the products from the supplier firm to the customer firm (outbound freight transport), as customer contact employees has received little attention. This is astonishing given that drivers are situated at the supplier-customer interface and, thus, represent the supplier firm to customers. Certainly, in comparison to sales representatives, the drivers' interaction with employees of customer firms is rather limited. Nonetheless, if drivers constantly frequent the same set of customer firms, they may slip into the role of a relevant customer contact employee. Beyond the provision of a high-quality technical service to the customers (e.g., unloading the product at the customers' place of business, interacting with the customers for signing receipts for goods) (Bienstock, Mentzer, & Bird, 1997), the quality of the drivers' personal contact with the customers may affect the customers' purchasing behavior (Mentzer et al., 1999).

The purpose of this study is to shed light on this issue by investigating how and under what conditions drivers of a supplier firm may increase customers' contributions to the supplier firm's sales in an industrial buyer-supplier relationship. Drawing on service quality and customer contact literature, we hypothesize a proposed theoretical model that explains how a customer's perceived personal contact quality with the delivering

driver may affect its purchasing intention and, thus, the sales of the supplier firm. In addition, our model suggests that this direct effect is conditional on the size of the customer firm, the relationship length, and the frequency of contact. We test the model using a sample of 207 industrial business-to-business relationships. The results contribute to an improved understanding of the role of drivers in buyer-supplier relationships. Our findings have important managerial implications for logistics outsourcing, training of drivers, and sales and marketing plans. In particular, new light (from a new direction) is shed on the benefits of owning and operating transportation and distribution assets (e.g., truck fleets) – benefits that might be obstructed after outsourcing to a LSP.

2. Literature Review

Physical distribution and other logistics activities, if managed appropriately, may contribute to customer value, customer satisfaction, and firm performance (Dresner & Kefeng, 1995; Perreault & Russ, 1976). In order to understand the specific role of drivers in this context, we draw on (1) service quality and (2) customer contact literature. Drivers are front-line employees in physical distribution who transport materials from point of origin to point of consumption.

2.1. Logistics and Physical Distribution Service Quality

The “service quality” approach attempts to understand (1) the relationship between a provided service and the perceived service quality by the customer and (2) the behavioral consequences of perceived service quality (Mentzer et al., 1999). Service quality was first addressed in business-to-customer-contexts (Grönroos, 1984; Parasuraman, Zeithaml, & Berry, 1985). Parasuraman, Berry, and Zeithaml (1988) proposed a multi-dimensional instrument for service quality which comprised five dimensions: tangibles, responsiveness, empathy, reliability, and assurance. Later, the service quality concept and the measurement instrument were refined (Cronin & Taylor, 1992; Parasuraman, Berry, & Zeithaml, 1991; Parasuraman, Zeithaml, & Berry, 1994). The essence of this literature for the present research is the acknowledgement that service encounters, which usually involve personal interactions (face-to-face contact and personal communication), may affect the customer’s perception of service quality. For example, Brady and Cronin (2001, p. 38) noted that “the interpersonal interactions that take place during service delivery often have the greatest effect on service quality perceptions.” Likewise, the interaction of service employees with customers has been shown to influence the impression of the brand (Aaker, 1997; Berry, 2000; Wentzel, 2009).

Moreover, a central tenet of the service quality literature is that service quality has a positive impact on the purchasing intention of the customer – but the research evidence is mixed (Rust, Zahorik, & Keiningham, 1995; Zeithaml, Berry, & Parasuraman, 1996). Zeithaml, Berry, and Parasuraman (1996, p. 31) stated that “the link between service quality and profits is neither straightforward nor simple.” In particular, the proposed multidimensional second-order models of service quality did not consistently show to be good predictors of behavioral consequences. Direct measures of overall service quality seemed to perform significantly better (Cronin & Taylor, 1992). To link higher-order

service quality models with behavioral consequences (purchasing intention), customer satisfaction was often used as a mediator between service quality and purchase intentions (Dabholkar, Shepherd, & Thorpe, 2000). However, whereas perceived service quality and customer satisfaction have been argued to be distinct concepts (Parasuraman et al., 1988), they are usually highly correlated and often empirically inseparable (Rust et al., 1995).

The service quality concept and research on physical distribution services (Perreault & Russ, 1976) informed the conceptualization of "physical distribution service quality" (Bienstock et al., 1997; Mentzer, Gomes, & Krapfel, 1989) and of "logistics service quality" (Mentzer, Flint, & Hult, 2001; Mentzer et al., 1999). Bienstock, Mentzer, and Bird (1997) operationalized physical distribution service quality as a multidimensional second-order factor along three dimensions (timeliness, availability, and condition). They maintained that, in industrial contexts, technical aspects (what service is delivered) determine physical distribution service quality, whereas process aspects (how a service is delivered) and the social dimension of the service encounter are less relevant. Later studies (Mentzer et al., 2001; Mentzer et al., 1999), however, did not follow this argument and pointed out that the interactions that customers have with people involved in delivering the products should affect the customers perception of logistics service quality. They introduced the term "personal contact quality" to capture the customer orientation of a supplier's logistics contact people and found a positive relationship between personal contact quality and customer satisfaction. However, neither did these studies focus on drivers nor did they investigate the direct link between personal contact quality (as one dimension of physical distribution service quality) and purchasing behavior of the customers. Until now, there has been little study of personal contact quality provided by drivers.

2.2. Customer Contact Employees

Similar to the service quality literature, most of the research on customer contact employees has been aimed at the end-user customer or at service firms. Particularly in the service marketing literature, the role of customer contact employees has been extensively discussed (Bitner, Booms, & Tetreault, 1990; Czepiel, 1990; Gwinner, Gremler, & Bitner, 1998). When employees from supplier firms interact with employees of customer firms on a regular basis, personal relationships may be formed (Bendapudi & Leone, 2002). In this regard, extant research suggested that empathy and professionalism (Pilling & Eroglu, 1994), likeability and attractiveness (Jones, Moore, Stanaland, & Wyatt, 1998), as well as trust (Doney & Cannon, 1997) contribute to strong personal relationships and may lead to positive emotional ties (Price & Arnould, 1999). These personal bonds are important for the success of buyer-supplier relationships (Seabright, Levinthal, & Fichman, 1992). Ulaga and Eggert (2006) argued that regular personal interactions between employees of supplier firms with employees of customer firms constitute an important driver for the creation of value in the exchange relationship. Customer firms' relationships with contact employees may even be more intense than with the supplier firm itself (Czepiel, 1990; Gwinner et al., 1998). Here, the terms "relationship manager" (Crosby et al., 1990) or "key contact employee" (Bendapudi & Leone, 2001) were proposed to identify the person who is closest to the customer firm. While the role of a firm's sales representatives as customer contact employees is

unquestioned, the driver who delivers the products to the customer has so far not been investigated in this context.

3. Conceptual Framework

Figure 1 presents a model that draws on the service quality and customer contact literature to explain *how* and *under what conditions* drivers of a supplier firm may increase customers' contributions to the supplier firm's sales in an industrial buyer-supplier relationship.

Insert Figure 1 about here

3.1. Main Effect

While the role of a firm's sales representatives as customer contact employees is unquestioned, the driver who delivers the products to the customer has so far not been investigated in this context. Narver and Slater (1990) argued that market-oriented firms benefit from high sales performance and customer retention rates. However, they also pointed out that market orientation can only be effective, if firms are able to disseminate the firm's market and customer-oriented values and beliefs in a way that inspires customer contact employees to be customer focused. In a similar way, Bitner (1990) suggested that customers are more satisfied with a service, when the customer contact employees possess the ability, willingness, and competence to solve problems. Bitner, Booms, and Tetreault (1990) observed that a customer contact employee's ability to adapt to special needs and requests of the customer enhances customers' perception of the service encounter. Further, they reported that the friendliness and attentiveness of contact employees positively affect customers' perceptions of service quality. In a similar vein, drivers may be viewed as information dispensers, giving customer aid and technical information, and, in doing so, create positive customer perceptions of themselves as well as the parent firm. Although their main duty is delivering the product to the customer, their skills, customer orientation, and service mindedness are of critical importance to customers' perception of the firm. Gummesson (1987) used the term "part-time marketer" to argue that customer relations are influenced by everybody. During the service encounter, the drivers can influence the perception of the customer thorough their individual attributes. Therefore, we expect that there is a positive relationship between the satisfaction with the driver and the satisfaction with the firm which, in turn, should translate into lower levels of switching the supplier and higher purchase intentions. Thus,

Hypothesis 1. *The higher the personal contact quality provided by the driver, the greater the customer's contribution to the supplier firm's sales.*

3.2. Moderator Effects

In order for the hypothesized main effect to become operational, it is necessary that the driver as well as his or her performance are noticed by the customer firm's employees

who are in charge of the purchasing decision. Large firms, however, have an incoming goods department with specialized employees that interact with the drivers and take care of processing the products. These employees are usually not involved in the purchasing decision-making. Hence, their satisfaction with the driver performance is unlikely to affect the exchange relationship. While large firms are more likely to have comprehensive supplier evaluation schemes, driver performance is often not included. Hence, the smaller the customer firm, the more likely that the driver is recognized and, thus, is able to positively affect the perception of the relevant decision-makers. Thus,

Hypothesis 2. *The positive relationship between the personal contact quality provided by the driver and sales is weaker when the buying firm is large than when it is small.*

Based on the literature that suggested that buyer-supplier relationships follow a life cycle (Jap & Ganesan, 2000; Palmatier, 2008b), we suggest that the driver's influence on sales is likely to be moderated by relationship length, i.e., the main effect changes over the course of a exchange relationship. Jap and Ganesan (2000) distinguished four phases: exploration, buildup, maturity, and decline. They argued that "the exploration phase is a search and trial phase in which the potential obligations, benefits, and burdens of continued exchange are considered" (p. 231). Hence, during this phase, the customer will likely evaluate the performance of the supplier firm along all relevant dimension – the service provision of the driver being one of them. In later phases of the exchange relationship, when the relationship is well established (maturity) or even in decline, the driver will less likely be able to affect the purchasing decision of the customers. Thus,

Hypothesis 3. *The positive relationship between the personal contact quality provided by the driver and sales is weaker when the relationship length with the customer is long than when it is short.*

The relationship marketing literature argues that repeated interactions represent a prerequisite for the establishment of personal relationships between customer contact employees and employees of the customer firm (Bendapudi & Leone, 2002). Indeed, concepts such as trust, commitment, and loyalty can only become operational on a personal level, if the persons involved interact frequently to get to know and understand each other better. However, as our models attempts to explain sales on the level of the supplier firm, these mechanisms may be less relevant. In contrast, if a customer firm is often in contact with a driver, it may become accustomed to the performance of the driver. The performance of a driver might be considered a given. This "habituation effect" may dilute the positive effect of the satisfaction with the driver on sales. Thus,

Hypothesis 4. *The positive relationship between the personal contact quality provided by the driver and sales is weaker when the frequency of contact between the driver and the customer firm is high than when it is low.*

4. Method

4.1. Research Context

In order to test the proposed hypotheses, we investigated a focal supplier firm (in the following *SunCo*) that owns and operates a truck fleet for delivering its products to its customers. *SunCo* is a medium-sized manufacturer (around 500 employees) of construction material located in Germany. During the time of investigation, *SunCo* served around 2,500 customers in seven different countries. Most of the customers were craft enterprises (with 10 or less employees) and the largest customer accounted for about 3% of total sales. About 96% of the customer base were located in Germany and France. The remaining 4% were spread over Austria, the Netherlands, Switzerland, Belgium and Luxemburg. All transportation and distribution operations were managed and executed in-house with direct shipping to the customers (i.e., every shipment was transported directly from its point of origin to its destination without passing through any kind of hub). Specifically, a "one-to-many"-shipment setup was used which means that customer destinations were clustered into regional districts and, in a single tour, a driver served several destinations within one district (an instance of the travelling salesman problem) (Chopra & Meindl, 2006). We were provided access to all relevant information about the customer base and the truck fleet available from *SunCo*'s database. *SunCo* employed 32 drivers (full-time permanent) that frequented always the same districts. This setup allowed the drivers to have a profound knowledge of the handling of the products and of the customers' specific situation. In summary, this research context appropriately set up the conditions for testing the hypotheses.

4.2. Data and Procedure

The empirical basis of this study comprises primary and secondary data. We conducted a survey among *SunCo*'s customers in France, Germany, and Austria and subsequently matched this data set with secondary data from *SunCo*'s accounting records.

As shown in Table 1, most of the customer firms were located in France and in Germany. Self reports from single key informants were used to collect the data (Kumar, Stern, & Anderson, 1993). We explicitly addressed the person that is in charge of the business relationship with *SunCo* (mainly purchasing managers or CEOs) and framed the questionnaire as a customer satisfaction survey. We offered anonymity (on the level of the respondent) and confidentiality to reduce the chances of responses that were socially desirable or consistent with how respondents believe researchers want them to respond.

Insert Table 1 about here

We restricted the sampling frame to customers that purchased at least one item during the last 18 months (N = 1,611). Only 708 of these customers had email addresses in *SunCo*'s customer relationship database. These firms were invited to participate in the study via email. The emails included a direct link to the online-based questionnaire. The

remaining 903 customers without email information were contacted via fax. These respondents had the possibility to answer the questionnaire on paper returnable by fax/mail or use the provided link to the online survey. In exchange for participation in the survey, the questionnaire offered all respondents the chance to win two Apple iPod mp3-players in a lottery. Three follow-ups via email and telephone generated 207 usable questionnaires yielding a response rate of 12.8%.

The annual sales volumes of the participating firms ranged from US-$ 0.04 million to US-$ 12.00 million.[1] The number employees (full-time equivalent) ranged from 1 to 90. The majority of informants were owner managers or CEOs of the customer firms. Other informants were managers from the fields of purchasing or operations.

Two approaches were used to assess whether non-response bias was present in the sample. We inspected the differences between early (initial invitation) and late respondents (second and third reminder) on all survey items in our model (Armstrong & Overton, 1977) and no statistically significant mean differences were found ($p < 0.05$). We additionally compared the study sample of 207 informants to 100 randomly selected non-respondent firms from the initial sample in terms of (1) annual order volume and (2) the amount of orders in the previous year drawn from *SunCo*'s customer database. No statistically significant differences between the two groups were found ($p < 0.05$). In sum, these two tests suggest that non-response bias does not pose a significant threat to the validity of our results.

4.3. Measures

Only the variables *personal contact quality* and *customer firm size* were obtained from the primary data collection. All other variables were taken from *SunCo*'s accounting database to avoid problems associated with common method variance (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Following standard techniques, the survey instrument and its measures were developed in several stages (Churchill, 1979; Dillman, 2006). First, a preliminary questionnaire was drafted on the basis of the literature from the logistics and marketing field. Second, five employees of *SunCo* (the chief executive officer, the head of production, the head of physical distribution and logistics, and two employees from the sales force department) commented on the items included and their feedback was incorporated into the questionnaire. Third, to refine the survey instrument, it was pre-tested through interviews with employees from three customer firms. Their comments were incorporated into the final version of the questionnaire. To make the survey applicable for most customers it was administered in French and German. To enhance translation equivalence, the original German questionnaire was translated first into French by one bilingual translator and then it was back translated into German by a second bilingual translator. Any differences between the two translators were reconciled (Brislin, 1970). Summated five-point rating scales (Likert-type) were used and all items were formulated as indirect, reflective indicators and scored so that higher numbers reflect increases in the underlying construct.

[1] The informants provided €-values which were converted into US-$-values according to the official currency exchange rate of December 31, 2006 (€1 = US-$1.32).

Personal contact quality was measured by adapting a scale developed and validated by Keller (2002). The employed four-item scale captures the driver's friendliness, consciousness, and helpfulness as well as the expertise about the delivered product and the customer. Translations of the measurement items appear in Table 2. *Customer firm size* was measured as the number of employees in the customer firm. *Relationship length* was measured as the period of time that *SunCo* had worked together with the specific customer. *Frequency of contact* was measured as the average number of deliveries per month during the last 18 month.

In order to eliminate undesirable sources of variance, our analysis included control variables that could influence and confound the hypothesized relationships. First, we controlled for country effects. Economical and cultural differences might affect the perception of the driver performance as well as strategic and operational possibilities of firms and, therefore, might influence purchasing behavior. Following the procedure suggested by Cohen, Cohen, West, and Aiken (2003), French firms were coded as one, whereas German and Austrian firms were used as base. Since Germany and Austria have very similar cultural backgrounds (Hofstede, 1980, 2003) and previous inter-organizational relationship studies have not revealed any statistical differences (e.g., Wagner, 2006), these two country subsamples were treated as a single sample. Second, we also controlled for the potential effects of relationship lifecycle by including the square of *relationship length* (Palmatier, 2008b).

The dependent variable *sales* was measured as operating revenues earned by *SunCo* from each customer during the last 18 month prior to data collection.

Customer firm size, relationship length, sales were logarithmically transformed.

4.4. Measure Assessment

The measurement model for *personal contact quality* was assessed by means of confirmatory factor analysis (CFA) using Mplus 5.2 (Muthén & Muthén, 1998-2007). We employed full-information maximum likelihood estimation. The model fit the data well (χ^2/df = 0.21, $\chi^2_{(2)}$ = 0.42, p = 0.81; CFI = 1.00, TLI = 1.00, SRMR = 0.00, RMSEA = 0.000 with 90% confidence interval = [0.000; 0.085])[2]. Details of the measurement model appear in Table 2.

Insert Table 2 about here

The CFA results indicated that the used reflective items capture the underlying latent variable well and implied a satisfactory level of convergent validity and internal consistency. Each item loaded on the latent factor with large, significant loadings, all being significant at the 0.1% level. Composite reliability (0.97) and average variance extracted (0.90) exceeded the common cut-off values of 0.70 (Nunnally & Bernstein,

[2] CFI refers to comparative fit index; TLI refers to Tucker-Lewis index (also non-normed fit index , NNFI); SRMR refers to standardized root mean square residual; RMSEA refers to root mean square error of approximation.

1994) and 0.50 (Bagozzi & Yi, 1988; Fornell & Larcker, 1981), respectively. Having established validity and reliability, we used the scale average (unweighted) as latent variable score for the final estimation.

For all observed variables, the univariate distributions were examined for both skewness and kurtosis and found to be within acceptable ranges (skewness below |2.0| and kurtosis below |7.0|). No obvious outliers were detected by means of visual inspection (Cohen et al., 2003). Inter-factor correlations appear in Table 3.

5. Analysis and Results

Hierarchical multiple regression analysis (OLS estimation) was used to test the four hypotheses. All independent variables were mean-centered and interaction terms were created by multiplying standardized variables scores (Cohen et al., 2003).

Control variables were entered as a block in Model 1, followed by the direct effects in Model 2, and the interaction terms in Model 3 (simultaneous within blocks, stepwise across). The critical assumptions underlying OLS estimation were thoroughly checked for each model, i.e., (1) the residuals are normally distributed, (2) the residuals are of constant variance (homoscedasticity) over sets of values of the independent variables, and (3) multicollinearity of the independent variables is within an acceptable range. To this end, each linear model was subjected to a visual residual analysis using normal Q-Q plots: no obvious outliers were detected and residuals appeared to be approximately normally distributed. The scrutinized influence diagnostics did also not raise concerns over outliers. Homoscedasticity was checked using the Breusch-Pagan test ($p > 0.10$) and the Goldfeld-Quandt test ($p > 0.10$). Both tests indicated the absence of serious problems with heteroscedasticity. The bivariate correlations between the independent variables were within acceptable ranges (i.e., bivariate correlation < 0.70) as well as the variance inflation factors (VIF) (i.e., VIF < 3), thus indicating that multicollinearity did not pose a serious problem to the regression analyses. In summary, these analyses did not give reason to assume that the chosen method was inappropriate.

Insert Table 4 about here

The results are presented in Table 4. All estimated models were statistically significant and, in each step of the hierarchical procedure, the increment in variance explained was significant. We ask, first, whether personal contact quality provided by the driver leads to more sales (Hypothesis 1). The results from the main-effects-only model (Model 2) reveal that personal contact quality, in fact, positively affects sales (standardized regression coefficient $\beta_6 = 0.11$, $p = 0.03$). Thus, the better the (perceived) personal contact quality, the higher the customer's contribution to the supplier firm's sales.

Beyond this main effect, the predictive power of the three hypothesized interaction terms was tested. Inclusion of the hypothesized interaction terms (Model 3) resulted in a significant increase in variance explained (ΔR^2), thus indicating that the direct effects are not just additive in nature (Cohen et al., 2003). To better understand the nature of the

interaction effects, we conducted a simple slope analysis and plotted the significant effects in Figure 2.

Hypothesis 2 states that the positive relationship between personal contact quality and sales is weaker when the buying firm is large than when it is small. The associated regression coefficients was significant and in the expected direction ($\beta_7 = –0.10$, $p = 0.04$). As shown in Figure 2, the slope which indicates the relationship between personal contact quality and sales is weaker for larger firms than for smaller firms. This provides support for Hypothesis 2.

Hypothesis 3 posits that the positive relationship between personal contact quality and sales is weaker when the business relationship between the two firms is long than when it is short. The corresponding regression coefficients was significant and in the expected direction ($\beta_8 = –0.10$, $p = 0.04$), thus supporting Hypothesis 3.

Finally, Hypothesis 4 received support. It states that the positive relationship between personal contact quality and sales is weaker when the frequency of contact between the driver and the customer firm is high than when it is low. The associated regression coefficient was significant and in the expected direction ($\beta_9 = –0.11$, $p = 0.03$).

6. Discussion and Implications

Logistics outsourcing decisions are among the most frequent decisions that logistics managers in industrial firms are facing (Murphy & Poist, 2000). Few studies have explicitly addressed the relationship marketing potential of front-line employees in logistics (Mentzer et al., 1999; Voss, Calantone, & Keller, 2005) or, more specifically, physical distribution (Bienstock et al., 1997). This study focused on drivers that serve a fixed set of customer. We started from the premise that driver-customer interactions may be viewed as service encounters which may affect the purchase intention of the customer. The central finding is that drivers may, in fact, act as a (hidden) sales force for industrial firms, as they have the possibility to influence the purchasing behavior of customers. This result is in line with both the service quality literature as well as the relationship marketing literature and supports the call that a firm should coordinate its logistics function with its marketing function (Kahn & Mentzer, 1996; Mentzer & Williams, 2001). To leverage the “sales force”-potential of drivers, firms need (1) to operate distribution operations in a way that enables the drivers to frequent a same set of customers and (2) “customer-oriented” drivers who are motivated and trained. Indeed, prior research suggested that high service quality is achieved though high job satisfaction and commitment to service quality (Hartline & Ferrell, 1996). Given that the results suggest a direct positive link between the personal contact quality a customer receives from the driver and the customer’s purchasing behavior, training and job-enrichment of drivers seems to be justified. The attitudes investigated in this research (friendliness, courtesy) are less a matter of substantial knowledge but more of internalizing service values and norms (Bell & Menguc, 2002; George, 1990). This represents a main difference in comparison to the training of sales force personnel, as these employees need a solid technical background to perform in a desired manner. Consequently, the drivers’ service performance might be “cheaper” to establish than

sales force performance. This suggests that costly relationship marketing efforts might be saved, if excellent drivers are able to “pitch in” as “relationship managers.”

Beyond this main effect, our model investigated some conditions under which drivers may affect the exchange relationship. The findings indicate that the influence of the driver on the customers’ sales volume is conditional on other variables. First, if the customer firms are rather large, which implies that the employees that facilitate the contact with the driver (e.g., the incoming goods department) may not have a significant influence on the order behavior of their firm, the effect of personal contact quality vanishes. This represents an important implication for logistics outsourcing decisions. Often, logistics managers think in the dimensions of economies of scale and capacity utilization and, thus, consider the shipments to smaller customers (those who account for only a small amount of orders) as rather cumbersome. Hence, a common approach in outsourcing of distribution operations is to turn smaller customers to LSPs, while serving larger customers (with frequent demand) with own delivery vehicles. Our results sound a note of caution to this logic. Larger firms may not notice whether they are served by varying drivers of a LSP or by an experienced driver of the supplier firm. Thus, the desired “personal contact quality”-effect does not become operational. In contrast, smaller firms may value and notice an experienced driver who knows their firm, is experienced in handling the product, and listens to their requests and complaints. In such contexts, established personal contacts between drivers and customers may also imply a risk for supplier firms. If the driver suddenly fails to deliver as usual (e.g., due to outsourcing to a LSP), the customer’s purchasing behavior may be negatively affected.

Second, the driver is particularly important during the early stages of a buyer-supplier relationship. The results indicate that the effect of the driver on sales is more pronounced in “younger” buyer-supplier relationships (exploration and build-up phase). This is consistent with the relationship marketing literature. Palmatier (2008a, p. 86), for example, argued that “in the initial stages, the quality of the bonds may be most critical because these initial bonds form the seeds of interfirm norms.” Therefore, directly after the acquisition of a new customer, the delivering drivers should be briefed to provide a superior service.

In a similar vein, our findings suggest that the frequency of contact between a driver and a customer firm influences the form of the investigated main effect. With increasing frequency, the personal contact quality becomes less relevant for the customer’s purchasing behavior. At a first sight, this finding is counterintuitive as many relational constructs such as interpersonal trust and loyalty are formed through a repeated train of beneficial interactions. However, in case of a high frequency of contact, the personal contact quality may be considered as given (similar to a “habituation effect”) which dilutes the effect of the driver on sales. Thus, given a smaller number of interactions, a driver can positively affect the exchange relationship. But this does not imply that a good performance of the driver becomes irrelevant to the relationship. In contrast, such customers might be particularly vulnerable to defecting. Failed expectations have been reported to create discomfort and perplexity and to function as strong promoters for information-search processes and triggers for change (Ellis & Davidi, 2005; Weiner, 1985). Therefore, if a customer is familiar with a driver and accustomed to a certain service quality, a sudden change of the personal contact quality (e.g., after an

outsourcing decision) may have negative repercussions on the buyer-supplier relationship (Anderson & Robertson, 1995; Jap & Anderson, 2005).

7. Limitations

The results and findings of this study are based on a survey among customers of a single industrial firm which cautions the generalizability of the findings. Physical distribution varies from firm to firm and the investigated setting may not be comparable to other firms.

Certainly, cost-benefit considerations are an important factor that our analyses do not include. Our conceptual framework focuses only on the marketing effect of drivers, i.e., the additional benefits from owning and operating a distribution network, but do not compare this effect to the cost of operating the network. These costs can easily override the additional revenue potential from the drivers' service performance and might lead to a completely different outcome and, thus, advice for managerial actions.

Furthermore, firms might not be able to build up their truck fleets in the manner the number of customers and sales volumes grow. At this point, LSP offer the possibility to increase flexibility without increasing investments and risks. Especially today the current economic crisis hits firms with own truck fleets twice, as they continuously have to pay for their fleet operations even if they are not needed because of the lower number of deliveries.

Finally, recent research has argued that it is important to distinguish level and strength of satisfaction with a service (Chandrashekara, Rotte, Tax, & Grewal, 2007). Although stating a high level of personal contact quality, customers could still be vulnerable to defection if the strength, with which the contact quality judgment is held, is weak. An overtly-satisfied customer could have a weakly-held satisfaction if she is covertly concerned about losing the key contact employee (e.g., the driver) (Chandrashekara et al., 2007). Furthermore, Mittal, Ross, and Baldasare (1998) argued that perceptions of attributes of a contact employee might not be linked symmetrically with satisfaction, i.e., one unit of negative performance on an attribute (e.g., politeness) could have a stronger effect on satisfaction than a corresponding unit of positive performance. Hence, further research should aim at identifying the key attributes of drivers that affect customers' perception of personal contact quality. This would enable firms to more specifically invest resources to enhance customer satisfaction and repurchase intentions.

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FIGURES

FIGURE 1
Conceptual Framework

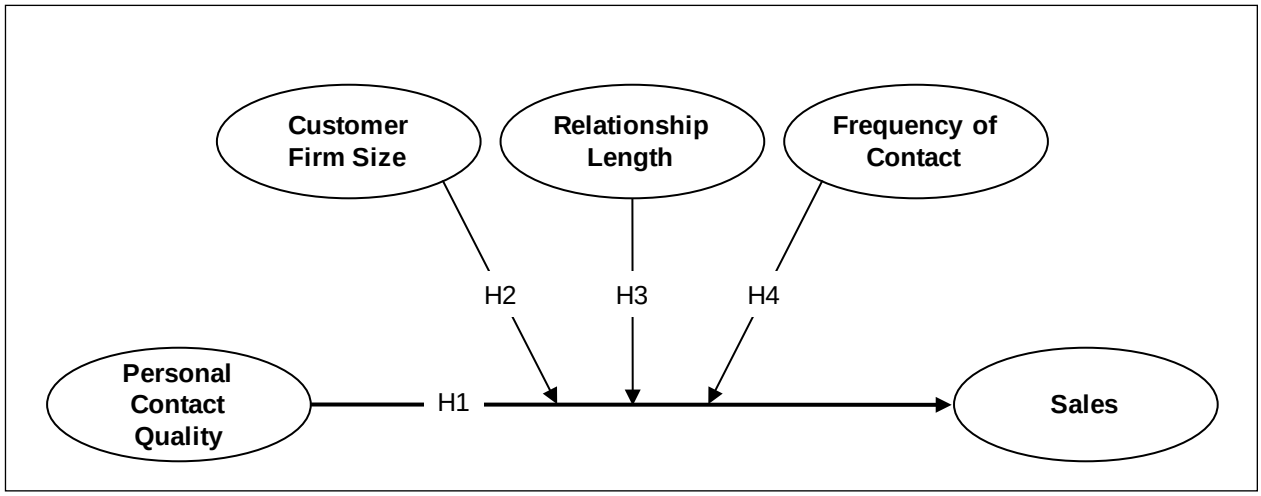
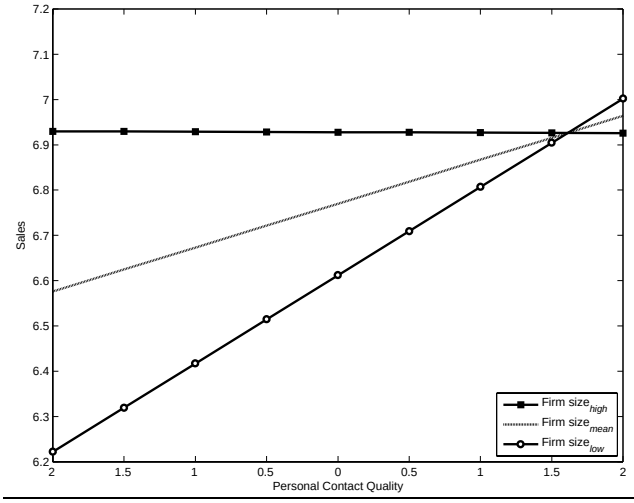
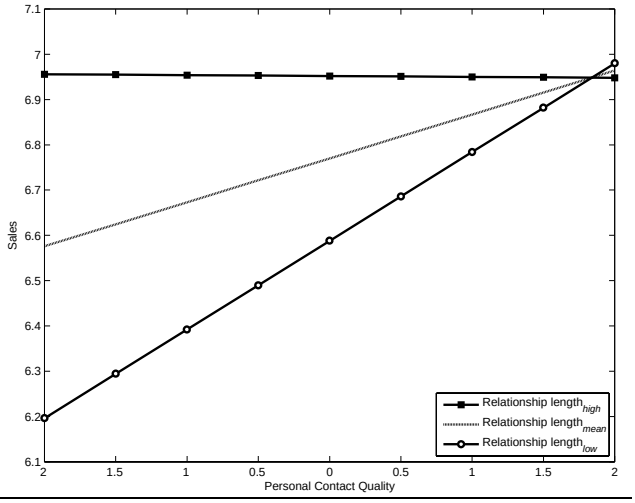


FIGURE 2
Interaction Effects

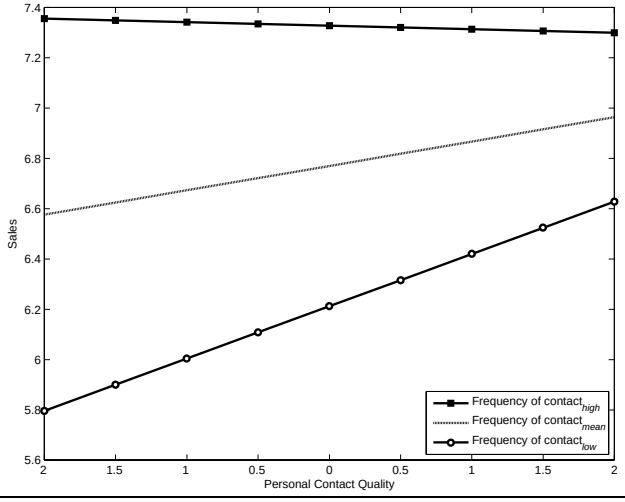
Personal Contact Quality and Customer Firm Size on Sales



Personal Contact Quality and Relationship Length on Sales



Personal Contact Quality and Frequency of Contact on Sales



Note: The model variables not taken into account in the plots were held constant at their mean values. Simple slopes termed “high” refer to M + 1SD and “low” refer to M – 1SD.

TABLES

TABLE 1
Sample Composition

	f	%
Number of employees (in 2006)		
1 – 4	106	51.2
5 – 9	54	26.1
10 – 14	24	11.6
15 – 19	7	3.4
20 – 29	6	2.9
30 – 49	5	2.4
50 – 99	5	2.4
Location of headquarters		
Austria	7	3.4
France	122	58.9
Germany	77	37.2

TABLE 2
Measurement Scale

Construct name/ Item	Coefficient alpha	Composite reliability	λ	*t*-value[a]	*SE*	R^2
Personal contact quality	0.92	0.97				
Please assess the driver(s) of SunCo that usually deliver(s) your orders along the following criteria in comparison to the drivers of other suppliers: (1: significantly worse – 5: significantly better)						
DRI1 Friendliness of the driver(s)			0.86	–[b]	–[b]	0.74
DRI2 Consciousness of the driver(s)			0.81	14.33	0.06	0.66
DRI3 Helpfulness of the driver(s)			0.91	17.36	0.06	0.83
DRI4 Specific knowledge of the driver(s) about our company			0.85	15.67	0.06	0.73

Note. Items were measured on five-point rating scales (Likert-type). All items were scored such that higher scale points represented increases in the underlying construct. λ refers to standardized factor loading, *SE* refers to standard error.

[a] *t*-values are from the unstandardized solution. All factor loadings are significant at the $p < 0.001$ level (two-tailed).

[b] Factor loading was fixed at 1.0 for identification purposes.

TABLE 3
Correlation Table and Descriptive Statistics

	M	*SD*	(1)	(2)	(3)	(4)	(5)
(1) Personal contact quality	3.99	0.77	1				
(2) Customer firm size[a]	2.50	1.00	–0.15 *	1			
(3) Relationship length[a]	1.67	0.68	–0.14 *	0.14 *	1		
(4) Frequency of contact	5.57	9.51	0.09	0.37 **	0.12	1	
(5) Sales[a]	9.80	1.50	0.23 **	0.34 **	0.19 **	0.63 **	1

Note. Pearson correlation coefficients are shown.

* $p < 0.05$, ** $p < 0.01$ (two-tailed).

[a] Transformed using the natural logarithm.

TABLE4
Results of Regression Analysis

	Model 1: Controls			Model 2: Main Effects			Model 3: Moderator Effects		
Variable	***β***	***b***	***t-value***	***β***	***b***	***t-value***	***β***	***b***	***t-value***
Country (dummy variable)	0.35	1.06 ***	7.00	0.31	0.95 ***	5.96	0.32	0.97 ***	6.30
		(0.15)			(0.16)			(0.15)	
Customer firm size	0.13	0.19 *	2.46	0.15	0.22 **	2.83	0.16	0.24 **	3.11
		(0.08)			(0.08)			(0.08)	
Relationship length	0.19	0.43 ***	3.51	0.20	0.43 ***	3.61	0.18	0.40 **	3.43
		(0.12)			(0.12)			(0.12)	
Relationship length^2	–0.06	–0.07	–1.13	–0.05	–0.06	–0.96	–0.07	–0.08	–1.39
		(0.06)			(0.06)			(0.06)	
Frequency of contact	0.53	0.08 ***	10.15	0.51	0.08 ***	9.84	0.56	0.09 ***	10.44
		(0.01)			(0.01)			(0.01)	
Personal contact quality				0.11	0.22 *	2.16	0.10	0.19	1.81
					(0.10)			(0.10)	
Pers. cont. quality × Customer firm size							–0.10	–0.16 *	–2.04
								(0.08)	
Pers. cont. quality × Relationship length							–0.10	–0.16 *	–2.05
								(0.08)	
Pers. cont. quality × Frequency of contact							–0.11	–0.27 *	–2.14
								(0.13)	
Constant		7.57 ***	27.06		6.67 ***	13.26		6.77 ***	13.41
		(0.28)			(0.50)			(0.50)	
R^2		0.54			0.55			0.58	
ΔR^2		–			0.01			0.04	
F		46.29 ***			40.23 ***			30.56 ***	
F of ΔR^2		–			4.67 *			5.63 **	

Note. Ordinary least squares (OLS) estimation was used (n = 207). ***β*** refers to standardized OLS regression estimates, ***b*** refers to unstandardized OLS regression estimates (standard errors in parentheses).
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ (two-tailed).

The Outcome-Driven Supply Chain: Towards A New Paradigm

Steven A. Melnyk, Professor of Operations Management
Michigan State University
517/432-6410; melnyk@msu.edu

Joe Sandor, Hoagland-Metzler Professor of Practice in Supply Chain Management
Michigan State University
517/432-6386; sandor@msu.edu

Ed Davis, The Oliver Wight Professor
Darden School, the University of Virginia
434/924-4819; Davise@darden.virginia.edu

Robert E. Spekman, Tayloe Murphy Professor of Business Administration
Darden Business School, the University of Virginia
434/924-4860;spekmanr@virginia.edu

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Abstract. This paper presents a new framework for supply chain design and management based upon findings and insights drawn from the *SCM 2010 and Beyond Research Initiative*. This framework argues that supply chains should be designed to deliver certain outcomes. We argue that there are six "pure" outcomes that supply chains can be designed to deliver: "efficiency" (a combination of cost, delivery and quality), responsiveness, sustainability, security, resilience, and innovation. We explore some of the factors associated with the six "pure" supply chains, present guidelines for judging when various types of supply chain outcomes should be mixed and, as importantly, when they should not be.

Introduction. One of the most important business developments of the last 15 years has been the emergence and increasing acceptance of supply chain management as a vehicle for improving and enhancing corporate competitiveness. The benefits offered by an effective supply chain management system have been widely documented and include reduced inventory, lower costs, enhanced responsiveness, and improved strategic focus in terms of design, execution, and capital investments (Harvard Business Review, 2006). Yet, as managers and researchers gain familiarity with supply chain management, they are coming to realize that designing and managing the "right" supply chain is more complex than has been initially assumed. As noted by Lee (2004), it is not enough for a supply chain to be efficient. It must also be adaptable and agile.

This paper examines the question of supply chain design by focusing on the relationship between supply chain structure and desired outcomes. Specifically, drawing on the results and insights generated by a recently completed study into future trends affecting supply chain management, this paper identifies six major outcomes that appear to be at the heart of the supply chains studied. It examines these six outcomes and it explores the implications of these trends for supply chain design.

Background – SCM 2010 And Beyond – An Overview. To identify the changes taking place in supply chain management theory and practice, a research consortium consisting of faculty drawn from several business schools interested in supply chain management was organized. The work of this consortium began in winter 2005. Since its inception, the consortium has carried out a large-scale review of the supply chain management literature (to identify major management themes and concerns and to identify major leaders in research and in the practice of effective supply chain management) and developed a survey instrument for identifying major issues associated with supply chains of today and the future. To date, this initiative has completed four research workshops1 focusing on issues and developments in supply chain management (September 2006 – Michigan State University; June 2007 – IMD, Lausanne Switzerland; October 2007- University of Virginia, (Darden Graduate School of Business); April 2008 – the University of Alberta, Edmonton, Alberta).

initiative, we found that three major themes emerged from these workshops:

- A significant and fundamental shift (a "sea change") is taking place in the very nature of supply chains;
- The new, evolving supply chains of "tomorrow" are inherently more complex because more is demanded of them; and,
- While these emerging supply chains are more varied, underlying them are several common outcomes, around which these supply chains are organized.

The Sea Change In Supply Chains. The participants almost universally agreed that there exist two generic supply chains (the supply chain of today and the supply chain of tomorrow) and these two supply chains are very different.

Today's Supply Chain: Strategically-Decoupled And Price-Driven. Today's supply chain is relatively simple, unidimensional, and driven by three critical issues: supply chain disruptions/risk; supply chain leadership; and, managing the timely delivery of goods and services. One major outcome of this supply chain is that it effectively decouples the supply chain from the firm's intended corporate strategy, with the result that these managers are not invited to the strategy table. Since cost reduction is the dominant goal, such a supply chain typically fails to explore/exploit possible revenue-enhancing opportunities.

Tomorrow's Supply Chain: Strategically-Coupled And Value-Driven. Tomorrow's supply chain is far more complex, where issues such as performance alignment, product design, environmental performance, and power/influence are critical. It is no longer enough to have a standard price-driven supply chain. Now the supply chain is designed and assembled to determine specific types of value. It exists in a global world where product design and innovation play increasingly more important roles and emphasis is given to adaptability, cost avoidance and its managers look for opportunities to contribute to top line growth.

Supply Chain as Outcomes – Rethinking the Supply Chain Design Decision. In reviewing the experiences of the participants from "SCM 2010 +", we were able to identify six different, major outcomes that the supply chain could deliver:

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[1] The workshops involved a total of over 150 participants from industry and academia in a ratio of approximately 2 practitioners for every academic participant.

- *Efficiency* – reducing price (initially) and cost (ultimately) is the key focus.
- *Responsiveness* –the ability to respond quickly to change in terms of volume, mix or location. Often, responsiveness warrants a higher price.
- *Security* – This involves supply chains that are safe and protected from external disruptions.
- *Sustainable* – This outcome involves "Green" supply chains that are environmentally responsible.
- *Resilient*– This refers to supply chains which can deal with unexpected disruptive conditions or threats to supply. Resilient outcomes embody traits of robustness. Robustness is the ability of the supply chain to withstand potential disruptions created by internal and external pressures. Resilience ensures that, given a disruption, the supply chain can recover quickly and relatively cost-effectively.
- *Innovation* – In recent years, many firms have increasingly relied on their supply chain as a source of product and process innovation. Increasingly, we are now seeing the addition of two new dimensions of innovation: supply chain (innovation that focuses on changes in the supply chain to generate value – examples of such innovation can be found in companies such as IKEA, Netflix and Lenscrafters) and service (changes that focus on the service aspect of the value proposition – an example of this type of innovation can be found in GM's On-Star system and Apple's Apps).

While the supply chain can deliver specific outcomes such those described above, it should be noted that the outcomes also dictate critical supply chain characteristics and practices.

Single versus Multiple Outcome Supply Chains. To regard these six outcomes as independent with no overlap in capabilities is both ill advised and simplistic. In fact, there are multiple outcomes that can be achieved.

As Hau Lee (2004) observed from his extensive study of supply chains (and which was supported during the course of the "SCM 2010 +"), supply chains that focused on only one outcome (in Lee's case, efficiency) were fatally flawed. These supply chains could not develop and maintain a sustainable advantage over their competition. In particular, high-speed, low-cost supply chains were unable to respond adequately to unexpected changes in demand and supply. Similarly, the SCM 2010+indicated that such "over-focused" supply chains are sometimes unable to meet the demands and requirements of emerging supply chains.

In combining the outcomes, the goal is to design a very competitive supply chain that offers key customers an array of outcomes all of which are attractive and yield a higher price. Below are a series of propositions about blending outcomes that are both logical and are partially supported by the results of the SCM 2010 and Beyond project.

- *Blending outcomes means making trade-offs*: When supply chain outcomes are mixed across all six outcomes, the resulting supply chain is unlikely to outperform on any single dimension. This is the price paid for having an adaptive supply chain that helps the firm differentiate itself in the marketplace. A greater mix may also position a supply chain for faster reaction to a new dominant focus when market conditions change.
- *When blending outcomes, it is important to emphasize specific outcomes*: It might be tempting to try to build a supply chain that does a "decent" job on every outcome but

fails to excel on any one or two outcomes. The major weakness of this approach may be that it suffers from the curse of mediocrity.

- *Blending outcomes places greater emphasis on alignment of incentives within the supply chain*: The flexibility gained by blending allows greater responsiveness to the needs of key customers which will result in a more competitive supply chain. But the incentives needed to ensure the appropriate actions and performance can be radically different for different outcomes. The topic of incentives alignment under conditions of blended outcomes has received little attention with the exception of work by Narayanan and Raman (2004) who have reported significant insights into design and management issues.
- *Blending outcomes complicates the performance measurement process*: Dealing with only one outcome makes it easier to design a simple, mutually consistent set of metrics. However, when blending more than one outcome, the performance metrics becomes by necessity more complex. Accepting reduced performance along one dimension might be necessary to gain improvements in performance in other dimensions.
- *Under certain conditions, blending outcomes allows for the leveraging of practices and resources:* It might appear that blended supply chains are inherently inefficient and that is the price paid for increased agility and adaptability. But this may not be the case. There are some combinations of outcomes that can be considered as complementary because the particular mixture of outcomes produces benefits from the shared practices and resources required to support different outcomes. For example, an efficient supply chain, with its emphasis on waste reduction and control can be more easily transformed into a sustainable supply chain since many of the same processes, tools, and practices can be used to reduce pollution. Also, responsive supply chains often demand buffers in the form of capacity, lead time and inventory which can increase resilience to supply chain disruptions. Finally, innovation and responsiveness can be viewed as complementary because both require the presence of excess resources and system slack.
- *The same, outcomes can be achieved by following different paths.* Given the different ways in which firms can achieve their supply chain objectives, there is no one monolithic approach to a set of supply chain outcomes. For instance, if a firm wants to skim the price-insensitive segments of the market to recoup its cost of innovation, and another firm attempts a penetration strategy to gain large market share at a lower margin, the end results could be the same. What differs is the manner in which both firms address their customer base.

The Limits To Blending. While some outcomes can be effectively blended, there are other outcomes that probably should never be blended. A primary example involves radical innovation and efficiency. Here, the practices used to attain one outcome negatively affect the ability of the firm and its supply chain to attain the second outcome. Efficiency-oriented supply chains regard slack as a form of waste and radical innovation demands such slack if innovation is to succeed. Efficiency-driven supply chains that draw on lean principles and practices typically demand standardization of processes. In such systems, the mantra is often, “without standardization, there is no opportunity for improvement.” Yet, for radical innovation to be truly successful, diversity of processes and approaches is often demanded.

Concluding Comments. Supply chains have evolved to reflect the more varied needs of customers. While traditional measures of supply chain management are important, they are

no longer adequate to reflect the complexities of competing in a global environment. Cost, delivery and quality remain important goals but do not solve customer challenges related to innovation, responsiveness and flexibility. Our goal here has been to propose that supply chains are ultimately driven by the set of desired outcomes and that there are six basic outcomes on which the outcome-driven supply chain is built. Ultimately, as shown in the hypothesized key supply chain traits, this framework exposes numerous potential areas for future research. Consequently, it is hoped that this framework will encourage more research into supply chain design.

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Procurement Structures for Low-Cost Country Sourcing

Gisela Lanza
Stefan Weiler
Philipp Mall

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Abstract
Low-cost country sourcing (LCCS) offers the opportunity to considerably save costs and enter new attractive markets. In order to tap the potential of low-cost country sourcing successfully, the barriers and challenges coming with it need to be systematically specified and the procurement structures must be oriented towards LCCS. This paper will analyze and categorize the barriers and challenges which are given in literature. Based on this literary analysis, this paper will give recommendations on how to implement different aspects of low-cost country sourcing. The results of a practical example from industry will finally be presented. As part of this, a company's strengths and weaknesses with regards to LCCS were analyzed by using a checklist which was developed based on these recommendations.

1. Introduction
In recent years, globalization has developed rapidly and has turned from an option to a must for a wide range of industries [Bha-04]. Global sourcing is one of the areas in which globalization is no longer an abstract concept but has become real [Tre-05]. The implementation of such a strategic global sourcing strategy is increasingly considered crucial for gaining competitive advantages [Pet-00]. In this respect, the permanent reduction of the value added plays a key role. In many branches, companies are procuring approximately 60% of their turnover externally [Bog-05]. In the present global economic crisis, procurement is stepping into the limelight as funds can be released in this area. According to a global survey in which 430 procurement departments were interviewed, around 60% of procurement managers stated that their saving targets were increased [Mäg-09; Acc-08]. In order to achieve these aims, 57% relied on low-cost country sourcing (LCCS). Cost benefits mainly result from considerably lower labor costs in these countries [Bha-04]. When global sourcing is exclusively geared towards suppliers from low cost countries, the term low-cost country sourcing is used, making it a special variety of global sourcing [Loc-07]. Low-cost country sourcing does not only offer savings potentials but also opportunities to enter attractive and growing markets. Many managers, however, are still hesitating to approach low-cost country sourcing [Bha-04] since LCCS does not only offer opportunities but also a number of challenges resulting from external and internal barriers (see Figure 1). These have a major impact on the results of LCCS schemes and, for example, lead to the fact that savings potentials are often lower than initially expected or may even result in additional costs compared to procurement in the home country [Pri-08]. Professional planning and implementation of LCCS is necessary to successfully carry out

an LCCS project [Jah-07]. If challenges and barriers are, however, systematically analyzed and approached, LCCS can provide an important competitive advantage for the company.

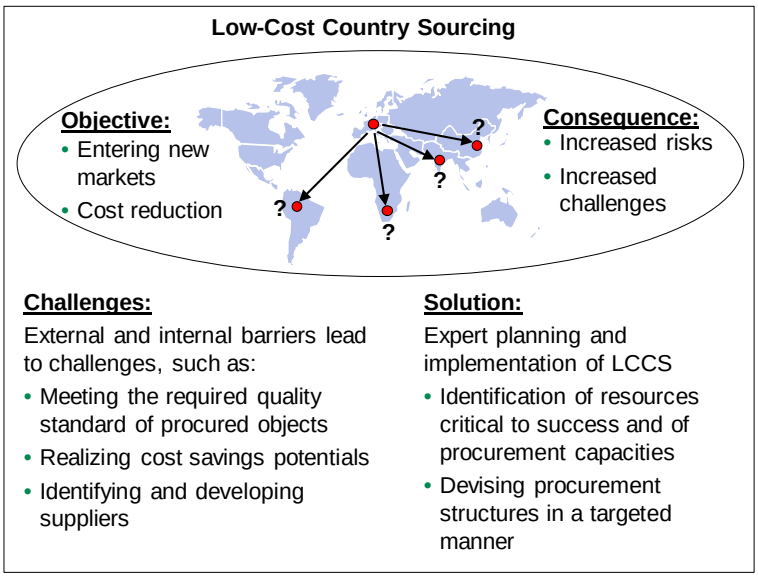

Figure 1: Correlation between objectives and consequences with regards to LCCS

Several different aspects are to be taken into account with regards to mastering LCCS (see Figure 2). First of all, a suitable procurement market (and later a suitable supplier) needs to be chosen which can best help achieving company objectives. This requires an exact procurement market analysis (and, later on, assessment, choice and, if applicable, development of suppliers) [Lan-08; Lan-09a]. Furthermore, if the products to be sourced are allocated to the respective procurement markets and chosen accordingly, the situation on the procurement market can easier be taken into account [Lan-09b; Str-09]. The adaptation of product design, which is referred to as design for low-cost country sourcing, can also offer advantages [Lan-09c]. A third aspect is to develop one's own structure in order to adapt to the high demands of LCCS [Tre-05]. The lack of internal capacities and resources within one's own company is one of the main reasons for unsuccessful low-cost country sourcing (cf. [Hem-07]). These resources and capacities therefore need to be considered closely with regards to LCCS [Jah-07]. In order to do so, the company's procurement structures need to be analyzed in detail to identify strengths and weaknesses and to derive development measures.

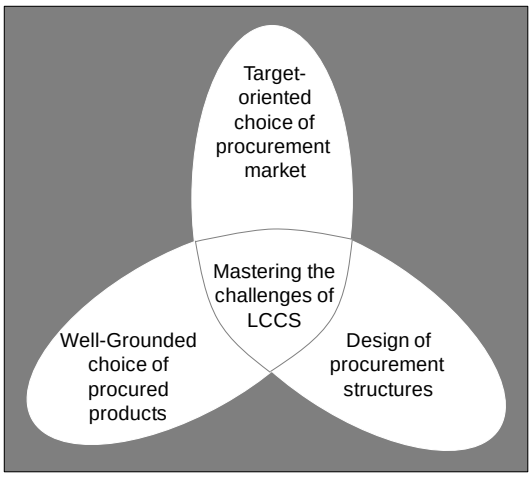

Figure 2: Facing the challenges of LCCS

2. Research Objective

This paper aims at facing the challenges and overcoming the barriers posed by LCCS by tailoring the company's procurement structures to low-cost country sourcing.

In **chapter 3**, scientific literature serves as the basis for identifying the barriers and challenges of LCCS before then being categorized. **Chapter 4** of the paper will then present a framework on the basis of which procurement structures can be analyzed. This will allow for a comprehensive analysis of procurement structures which takes all the important aspects into account. **Chapter 5** will then focus on the resources and capacities of procurement structures with regards to LCCS. This poses the question of which resources and capacities are particularly important to make LCCS successful and how they shall be structured. Although various different aspects of company structures with regards to LCCS have been discussed in scientific literature, there have so far been no comprehensive approaches which take a holistic look at all aspects of procurement. This paper therefore aims at assessing the different theoretical approaches in scientific literature. The results of this assessment shall then be illustrated systematically in a comprehensive procurement framework. Recommendations on how to structure procurement will be given for all the important aspects of LCCS. These recommendations were edited to a checklist. As part of a workshop, this checklist served as the basis for analyzing the strengths and weaknesses of a German company with regards to its low-cost country procurement structures. The results will be presented in **chapter 6** of this paper.

3. Barriers of LCCS

Companies sourcing in low-cost countries are facing a number of challenges which have an impact on the success of their LCCS activities. In order to be able to take these challenges into account when planning LCCS, we identified and categorized the challenges and barriers posed by LCCS and stated in scientific literature. The following eight barriers to LCCS were identified from the literature (see Figure 3): lack of competencies, lack of infrastructure, different cultural and linguistic backgrounds in combination with different market conditions, cost incurred by global coordination, piracy and legal issues, political and social risks, currency and payment risks as well as internal opposition to LCCS.

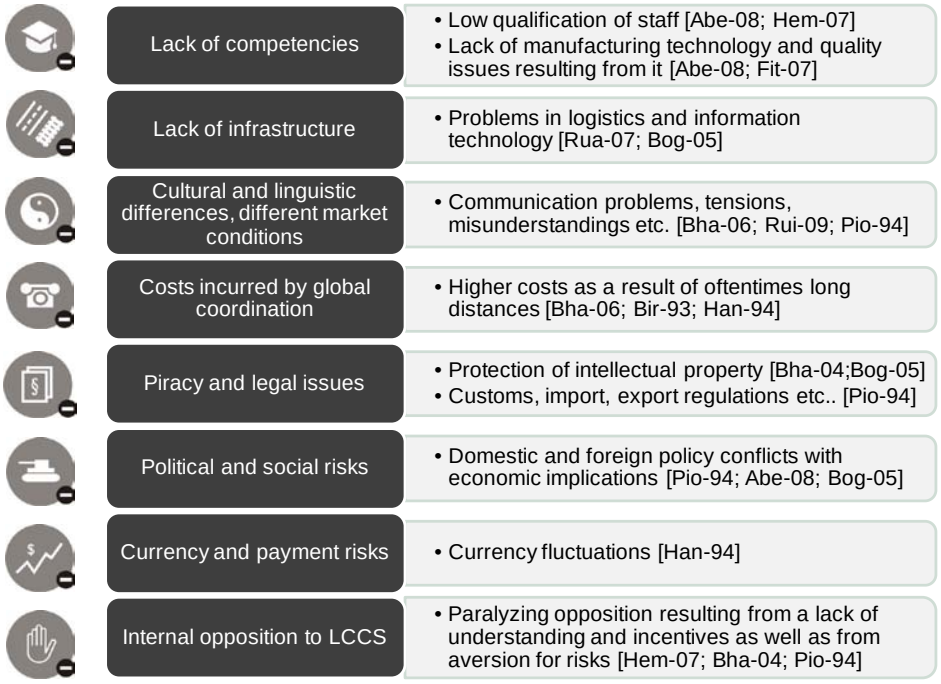

Figure 3: Internal and external barriers of LCCS

Barriers and risks can vary widely within the group of low cost countries, which makes a thorough analysis of the conditions that prevail in the potential procurements markets indispensable. This helps to become aware of the risks which must be taken into consideration when selecting a procurement market. Risk identification is therefore part of any procurement market analysis and selection and must be repeated on a regular basis as risks are subject to continuous changes, which holds particularly true for low cost countries [Bha-04]

4. The dimensions of procurement structures

This paper will analyze procurement structures based on the management modules of the supply management navigator developed by Jahns (cf. [Jah-05]). The supply management navigator is a framework analyzing these areas and topics in a company which are necessary for successful supply management. The navigator shall serve as a roadmap giving managers and employees an overview of supply management and enables them to structure this area. The supply management navigator consists of sixteen modules, the main focus of this paper being on management modules building the main body of the navigator (see Figure 4). The management modules stretch over three levels. The strategy level consists of the modules supply vision, supply strategies and supply value management; the process level comprises the modules supply key account management, supply process management and supply organization; the potential level consists of the modules supply human resource management and supply controlling.

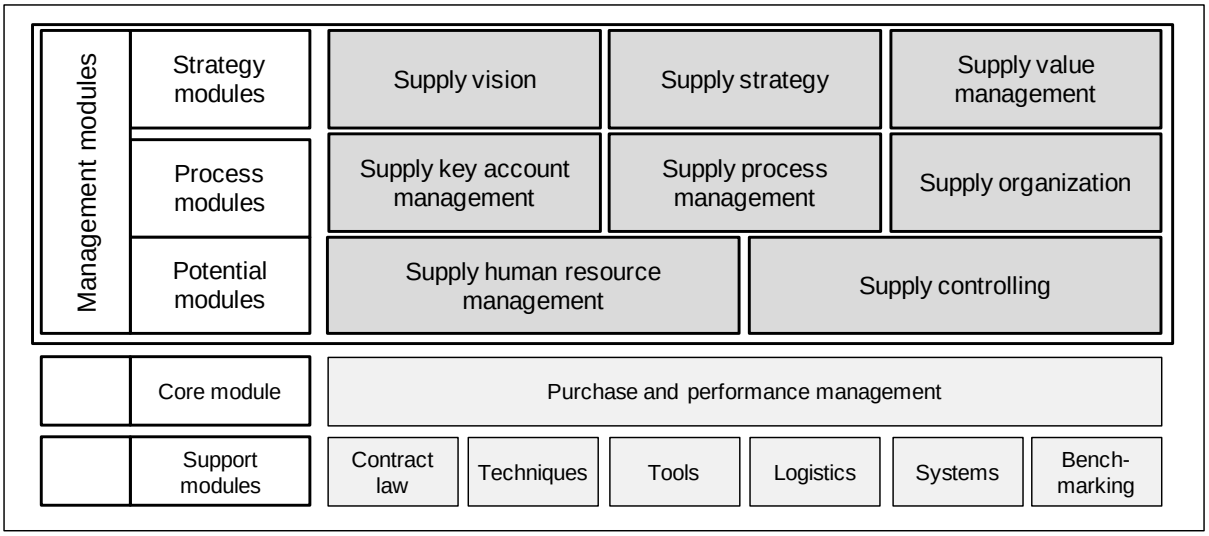

Figure 4: Supply management navigator (cf. [Jah-05])

5. Structure recommendations for efficient LCCS

LCCS must always factor a company's own resources and capabilities into the equation. They must be structured according to how important they are for the success of the enterprise and what would be the best way to use them. The literature discusses different aspects of company structuring for LCCS as a separate topic. There are no comprehensive approaches including all aspects of procurement, however. This article means to evaluate the different theoretical approaches and to systematically present the results within an extensive frame of refererence, which includes structure recommendations for LCCS concerning all important procurement aspects. The results are integrated into a check list to make them useable for industry.

In this paragraph, structure recommendations for LCCS will be derived from scientific literature for the management modules of the supply management navigator. It will be pointed out which resources and capacities needed for successful LCCS are considered

important in scientific literature. A checklist was devised based on these recommendations. It can be used by companies to carry out a systematic internal analysis with regards to LCCS and to critically analyze the company's own resources and capacities. It thus helps to adjust company structures to the barriers and obstacles of LCCS.
Given the overall scope, only the analysis of 3 modules, i.e. supply vision, supply key account management and supply process management will be described here.

5.1 Supply vision in the context of LCCS

Internal resistance against LCCS is often found at the levels of management and functions. Managers at these levels perceive the relocatiion of resources to LCCs as a risk because it means they must give up control while still being responsible for results and outcome [Bha-06]. For this resistance to be overcome, top management must be fully committed to the idea. Clear and ambitious goals which will gear the company towards LCCS must be set out at the top [Bha-06]. This should be achieved through a vision, among other means. It is therefore important for LCCS that there is a senior executive who holds sufficient authority, has a strong influence on development and communication of the vision and is able to lead by example [Tre-05]. Peterson et al. conducted an empirical study which showed the positive impact a strong commitment by the top management has on the effectiveness of global sourcing [Pet-00]. Bhattacharya et al. even consider committed leadership by the top management the most important factor for capitalising on the opportunities LCCS has to offer [Bha-04].
Figure 5 shows the factors that have an impact on the structuring of LCCS and the barrier of internal resistance they influence.

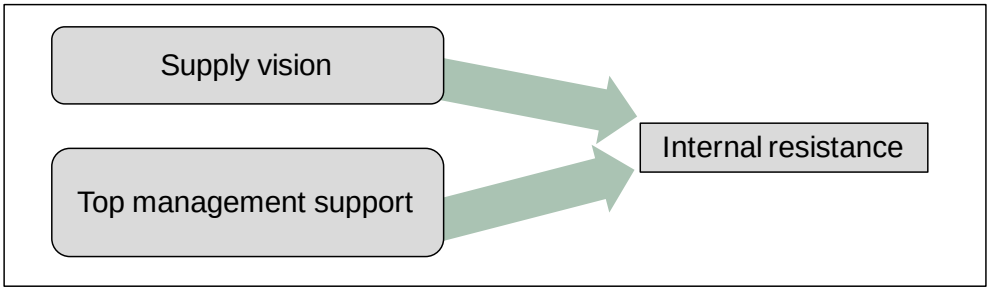

Figure 5: Structuring factors and related barrier of the procurement vision

Factors

All of the above raise the following questions for an internal company analysis:

1. Is there a supply vision, has it been written down and communicated, and how detailed is it?
2. To what extent has LCCS been inclued in the supply vision?
3. To what extent does the company management support the supply vision, and how well is it communicated within the company?

5.2 Supply key account management in the context of LCCS

The advantages of supply key account management hold benefits for LCCS. One of the biggest obstacles for LCCS is the internal resistance against it. This resistance is said to be the result of a lack of understanding, a lack of incentives and a high risk perception [Hem-07; Bha-04; Pio-94]. The concept of key account management is aimed at improving communication with internal customers, which helps to increase appreciation of the idea and reduce the perceived risks. Transparency is created for internal customers which will have one contact person they can discuss their concerns with. These concerns can come up in the product development department, for example, because the staff may see LCCS as possibly detrimental to their quality and functional requirements. It is important to ensure

that thorough assistance is provided for important internal customers and that communication is good. A structured communication strategy is an important criterion for effective global sourcing [Tre-05].
An increased involvement of internal customers (in particular of product development) allows for the use of procurement market knowledge for the product creation process at an early stage. This way, product design can be adapted to the conditions prevailing in the low cost country, which will allow for an improved exploitation of the opportunities offered by LCCS [Bha-04].
Figure 6 illustrates the effects thorough assistance given to key account customers has on the aforementioned barriers and challenges posed by LCCS.

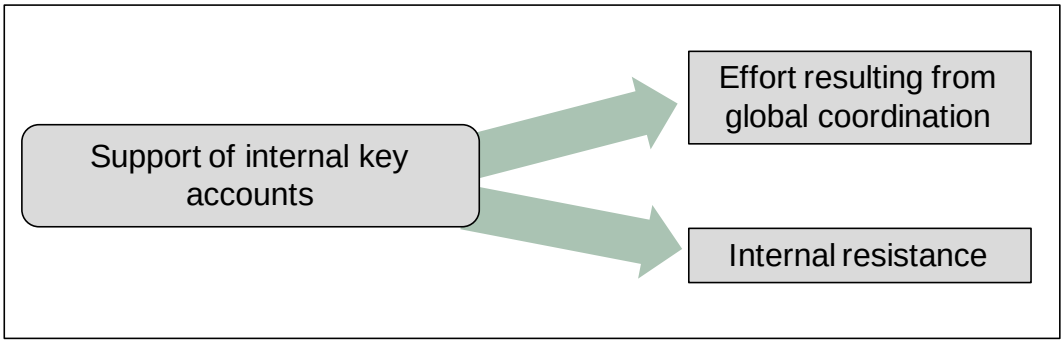

Figure 6: Structuring factor and related barriers of supply key account management

Factors
From the above, the following relevant factors for an internal company analysis can be derived:

1. How well is procurement aware of who the most important customers (i.e. key account customers) are?
2. How thorough is the assistance given to the internal key account customers, and are customer relations continuously improved, for example through supply key account management?
3. How well are the internal customers aware of who their contacts in procurement are?
4. How well are the internal customers being prepared for LCCS?

5.3 Supply process management in the context of LCCS

The global sourcing and LCCS literature considers process structuring an important criterion.
Global sourcing structures and processes are rated as an important factor for the development of global sourcing capabilities according to an empirical study conducted by Petersen et al. [Pet-00]. According to Petersen et al., these capabilities include an awareness of intercultural business practices, the management of international risks and uncertainties), knowledge of where information, exerience and skills important for critical global sourcing products can be found and international negotiation skills. These capabilities can only be developed when global structures and processes are already in place, for example in logistics and supply chain management.
Trent and Monczka consider a well-defined, rigorous and strictly followed global sourcing process (including all subprocesses) a key factor for successful global sourcing [Tre-02]. The empirical study asked international companies for their most and their least successful experiences with global sourcing. Out of a catalogue of 22 factors, a well-defined process was identified as the most important differentiating factor for successful experiences and failures. According to Trent and Monczka, such a process has got several characteristics [Tre-05]. It is well communicated and generally understood, making it a basis for tracking the global sourcing strategy. This means that internal process customers must be trained.

In addition to all this, a process owner must be designated who will be responsible for the process. He is in charge of monitoring and improving the process. Another important characteristic of successful processes consists in the implementation of a 'lessons learned' round at the end of each project, the results of which will be communicated to all team members worldwide and to management. During the process, strict milestones must be complied with and reported. Trent and Moczka see several advantages in such a global sourcing process, which will be briefly listed below [Tre-05]. A global sourcing process improves the learning curve of the staff, because they will become increasingly familiar and experienced with the defined process. In addition, processes help to deeply root best practices and knowledge in the company. Clearly defined processes allow for documenting, measuring and continuously improving corporate activities. The transparency created this way is considered important for LCCS by other sources, too, and is regarded as one means to overcome internal resistance [Ulu-07; Hem-07.]. Besides, processes help to overcome differences between different company locations. Different cultures, different languages and different market conditions which companies involved in LCCS are facing have already been mentioned as one of the challenges. Clear and strict processes can help to overcome this challenge. Different process participants and practices can be compared and aligned in line with the general company interest. Closer cooperation and an improved understanding between partners sitting in different regions of the world are facilitated. For this to be achieved, only processes which work for all regions can be selected. Sometimes it may have to be necessary to adapt processes to local conditions in order to make them work, to be able to capitalise on specific LCCS benefits and to mimimise risks such as piracy [Bha-06; Bha-04].

The scientific literature also provides additional thoughts on the structuring of processes. For organizational barriers to LCCS within the company to be overcome, appropriate structural links and mechanisms must be firmly established in the organisation. This includes processes that facilitate cooperation between functions, regions and departments. Cooperation between different departments is considered a success factor for LCCS [Bha-04]. Cooperation with suppliers must also be intensified, including the involvement of strategic suppliers in business processes [Har-08]. Support of processes linking the home country and the LCCs by simple tools is just as important [Bha-04]. These tools may include data bases, check lists, etc., which must usually be created from scratch. The IT structure must also be able to support the processes.

Figure 7 gives a summary of these recommendations in connection with the corresponding barriers and challenges.

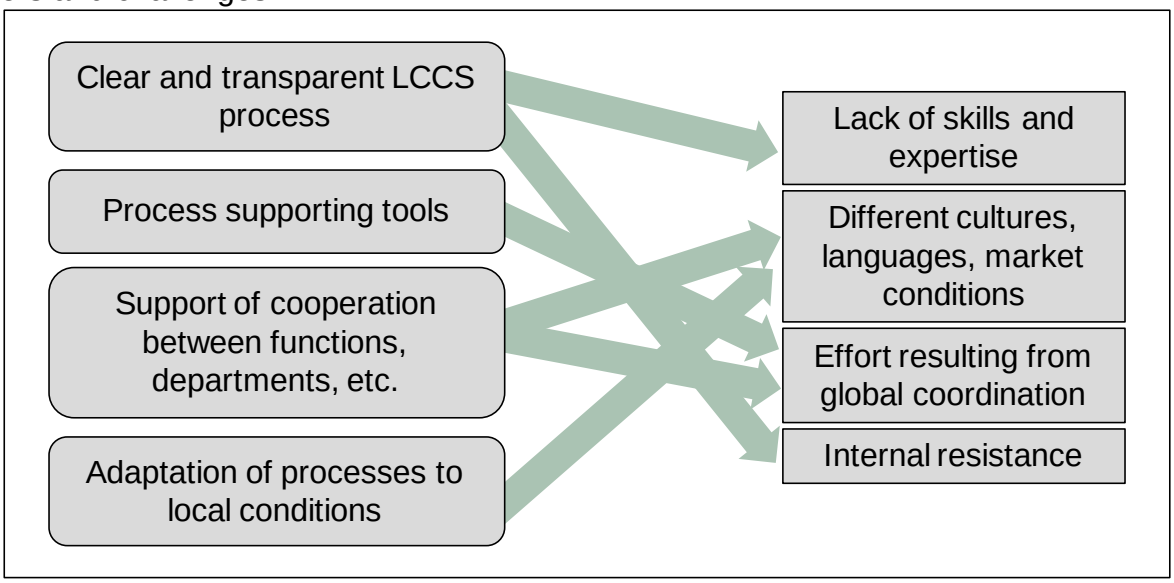

Figure 7: Structuring factors and corresponding barriers of supply process management

Factors
The following factors for an internal company analysis result from the aforemented aspects:

1. How transparent is the LCCS process for the company staff (Is it clearly communicated, documented and generally understood)?
2. Is there a process owner, and does everyone know who he is?
3. Is there a 'lessons learned' round at the end of each project?
4. Have the process milestones been clearly defined?
5. Are there process-supporting tools, and how good are they (data bases, check lists, intranet platforms)?
6. To what extent is cooperation between functions and regions supported and facilitated?
7. To what extent has the process been examined for the need to have it adapted to local conditions?

6. Practical checklist application

As part of a workshop, the devised checklist was applied to a manufacturing and medical technology company. The company has got a global footprint and generated a turnover of more than two billion euro in 2008. The company's procurement manager manufacturing material/central procurement manager and the procurement manager medical systems were present to discuss relevant issues. The main focus was on China where new suppliers are to be qualified. The checklist was discussed and evaluated with regards to procurement structures.
Below, the results of the checklist are illustrated for each oft he three modules, and conclusions are drawn.

6.1 Supply vision:

The company has a procurement manual that specifies the basic conditions and goals of procurement. One of the conditions states that no supplier can generate more that 40% of his sales revenue with the company, for example. The manual however, does not include a vision. According to what the interlocutors said, the general company vision is used for procurement as well. It provides a frame of reference for procurement matters. Consequently, there is no separate procurement vision that would take LCCS into consideration, meaning that the top management does not explicitly communicate that LCCS is rated as important. One reason for this might be the company's motiviation behind LCCS. Sourcing from low cost countries is not explicitly planned, for example for the specific target of achieving cost savings. It is rather a result of production being relocated to these countries. Local procurement is meant to compensate exchange rate fluctuations. LCCS is therefore, a result of the general internationalization of the company.

6.2 Supply key account management:

The concept of key account management in the field of procurement was not known to the company. The recommended structuring measures however, were already partly being implemented. The contact persons for internal customers are known to procurement and vice versa, for example. A homogeneous company structure and a telephone list published on the intranet prove helpful. Procurement has not designated a specific member of staff who would be responsible for mutual contacts and for preparing internal customers for LCCS. The company relies on the internal network and on personal relationships instead.

6.3 Supply process management:

There is no overall process for LCCS in place. Supplier search and supplier release for suppliers from low cost countries have to follow a defined process, though. There is a project sheet including information circle, objective, milestones and project initiator. This

overview is transparent and fits onto one page. ‘Lessons learned’ rounds are not carried out at the end of a project. Results are documented in the form of a project report. There are supporting tools such as check lists, for example, for the field of supplier management. As mentioned above, there are no such tools for the overall LCCS process however, meaning that there is still room for development. There is no systematic support for cooperation between functions and departments with regards to LCCs, either.

It was generally noted that many aspects of procurement are not specifically geared towards LCCS. There are visions and strategies, but LCCS is not specifically taken into consideration. Rather, there are intentions towards transferring general and generic strategies from the procurement manual to low cost country sourcing. There are no company-wide key indicators to measure performance with regards to LCCS. As mentioned above, the reason probably is the motivation behind LCCS which is rather driven by general internationalization and only to a lesser extent by cost motives. This represents some potential for gearing the company more towards LCCS and exerting the required pressure by taking a systematic approach to LCCS and by defining concrete processes and goals. One of the first measures to take can consist in the elaboration of a procurement vision that takes sourcing from low cost countries into consideration. This can help shift the focus from procurement localization determined by production to an active LCCS that capitalizes on the opportunities offered by low cost countries. For this to be implemented, the procurement manual must be adapted to LCCS including the establishment of clear objectives. A clear process should be defined for the subsequent implementation of LCCS. This facilitates the implementation and increases transparency by simplified measurement, documentation and continuous improvement of LCCS activities. In addition, such a process improves the learning curves of the company staff who will become more familiar and experienced with the defined process. A ‘lessons learned’ round at the end of each project is also helpful. A process has so far been only defined for general supplier search and supplier release.
Cooperation between the different functions and departments of the company can also be further extended. Instruments such as cross functional teams, workshops and strategy meetings are hardly used to support cooperation. They are indispensable for projects such as LCCS, though, because they include several departments. Coordination is generally mostly achieved through personal agreements. Time and financial resources should be freed and made available for procurement staff from all over the world to be able to meet and have a workshop on a regular basis. Furthermore, teams should be established for special tasks concerning LCCS including staff from different company functions. This way, engineering and logistics, for example, can get involved in the supplier search at an early stage. Communication and the exchange of experience between different functions and departments should also be given better support. It might be helpful to have an internal corporate wiki for procurement in general or for LCCS. This wiki could include relevant knowledge from the entire company and could be made generally available. Currently, it is possible to get access to knowledge and skills from other parts of the company which are already active in China, such as production, for example, which can be rated as positive. There is no structured exchange, though.

7. Conclusions

Low-cost country sourcing harbors pitfalls for Western companies which may lead to unsatisfying results. Professional planning and a consistent approach to procurement are thus required in order to seize the great opportunities of LCCS. A procurement structure which is conceived to these ends needs to be part of this approach. Based on eight different aspects of procurement structures this paper illustrated how these individual areas shall be structured in order to overcome the barriers and master the challenges of LCCS. This paper shall help companies on the verge of low-cost country sourcing to meet the high demands

of these projects. The procurement measures identified in scientific literature were also applied in a practical example. Based on the checklist that was derived from structural recommendations the procurement structures of a company were analyzed with regards to LCCS. Measures on how to improve the approach to LCCS were then derived from the analysis of strengths and weaknesses. The check list proved to be viable for application and helpful for getting an overview over the strengths and weaknesses of procurement. The selection of structuring fields was rated as helpful by the interlocutors. Using these fields as guidelines allowed for the subdivision of the workshop into separate parts.

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The Effect of Institutional Pressures and Top Managers' Posture on China's Product Recovery, Product Returns and Firm Performance

Fei Ye, Associate Professor
South China University of Technology
Yefei@scut.edu.cn

Xiande Zhao, Professor
The Chinese University of Hong Kong
Xiande@baf.msmail.cuhl.edu.hk

Carol Prahinski, Assistant Professor
Michigan State University
517/432-6434; Prahinski@bus.msu.edu

Abstract. Pearl River Delta (PRD), as one of the most developed regions in China, suffers from serious pollution. It is thus a prime candidate for the strategic implementation of reverse logistics in an effort to address the environmental concerns. This study investigates the effects of three institutional pressures – government, customer and competitor pressures – on top managers' posture towards implementing reverse logistics. Based on data collected from 209 PRD manufacturers, the results suggest that institutional pressures have significant positive influences on top managers' posture. In addition, while top managers' posture towards reverse logistics implementation is strongly related to product recovery, it is not related to product return. We also find that product recovery has a significant positive impact on both economic and environmental performance of a manufacturing firm while product return negatively affects a firm's economic performance.

1. Introduction. Although the economic performance of a manufacturing firm is of utmost importance, pressures for sustainable operations have increasingly emphasized environmental performance. As manufacturers face intense competitive, regulatory and consumer pressures, managers may increasingly come to view reverse logistics as a feasible solution that manages these dual performance objectives. Reverse logistics refers to the series of activities necessary to retrieve a returned, used or damaged product from the point of consumption to either dispose of it or recover economic and/or environmental value (Prahinski and Kocabasoglu, 2006).

There are two key advantages of reverse logistics. First, firms are able to reduce their resource consumptions and operating costs. Second, firms can generate revenue from products and materials that were previously discarded (Stock et al., 2002).

In China, reverse logistics has not attracted sufficient attention. The Pearl River Delta (PRD), an area composed of nine major cities in Guangdong province, represents more than 10% of China's GDP, and is the top global producer of electronics products. However, it is also one of the most seriously polluted areas in China; environmental protection is receiving increased attention.

In this study, through the lens of institutional theory, we provide insights into why manufacturers engage in reverse logistics implementation. This study assumes organizational decisions are based on the social structure in which the firm operates – both external and internal to the firm. The individual preferences of top managers are likely to mediate and buffer these organizational and interorganizational influences. Thus, we test whether top mangers' posture, which refers to the top managers' attitude towards reverse logistics implementation, is a mediator in the relationship between institutional pressures – government, customer and competitor pressures – and reverse logistics implementation.

2. Theoretical Background and Research Hypotheses.

2.1 Institutional Pressures. Institutional theory is based on the premise that individuals and organizational structures become institutionalized through the formation of established, stable, and socially integrating patterns that add value, or constraints, to the firm's structure or activities (Scott, 2003). Stakeholders influence top managers' decisions to implement reverse logistics (Carter and Ellram, 1998). In aligning relevant stakeholders with institutional theory, we rely upon DiMaggio and Powell (1983), who determined three predominant sources of the decision maker's pressure: coercive (from government regulations), normative (from customers) and mimetic (from competitors).

Coercive Pressure. Although government regulation can be an impetus for innovative environmental practices, managers typically interpret it as a coercive pressure (Carter and Ellram, 1998). Government officials throughout the world, including the Chinese government, are paying close attention to sustainable development by establishing a series of laws and regulations aimed at environmental protection**.** These laws exert coercive institutional pressures on Chinese manufacturers to implement reverse logistics, and may have a profound impact on the attitudes and behaviors of top management.

Hypothesis 1: *Government regulations on environmental protection have a positive influence on top managers' posture towards reverse logistics implementation.*

Normative Pressure. As a form of social legitimacy, each firm is subject to the norms, standards, and expectations of its external stakeholders. Customer's requirements form a core normative pressure and are cited as an important driving force in the implementation of reverse logistics and other environmental initiatives. In recent years, customers increasingly expect Chinese suppliers to offer a return policy, which has placed normative

pressures on these firms. Simultaneously, customers prefer environmental products. A reverse logistics process can not only help reduce the volume of emissions, but can extend product and material lives through the adoption of a product and material recovery process.

Hypothesis 2: *Customer pressure has a positive influence on top managers' posture towards reverse logistics implementation.*

Mimetic Pressure. Firms in social networks tend to imitate the behaviours of other network members. Effective reverse logistics management has become an important point of difference, especially as more companies have high-quality products, good customer service and other competitive advantages (Stock, 1998). As multinational companies' invest in China, Chinese firms are under increasing pressure to implement environmental protection practices, including reverse logistics practices. Thus, we hypothesize that:

Hypothesis 3: *Competitors' reverse logistics management strategies have a positive influence on top managers' posture towards reverse logistics implementation*.

2.2. Top Managers' Posture. Some firms reactively implement reverse logistics to comply with laws and regulations or to meet customer demands, while others proactively attempt to develop a strategic and competitive advantage. These different approaches suggest that top managers' posture may play an important role. For a reverse logistics initiative to be successful, top managers must have a supportive attitude and be committed to seeing the initiative through, particularly when it comes to obtaining the financial and staff resources required to support structural and infrastructural change. Top managers' posture is particularly relevant in China, given its pervasive hierarchical structures and high power distance culture, whereby power in a firm is distributed unequally.

2.3 Reverse Logistics. Similar to the definition used by the Chinese government, we consider reverse logistics to be composed of product return and product recovery. Product return refers to the physical distribution of used or defective goods from the point of consumption to the point of origin for the purpose of remanufacturing, reusing or destroying them. Product recovery refers to the transformation of used or defective goods in an effort to recover value by repairing, reconditioning, remanufacturing and/or recycling them.

In the Kocabasoglu et al. (2007) study, top manager's risk propensity towards involvement with the reverse supply chain was directly related to the reconditioning process, an aspect of product recovery. Although we were unable to find any studies that link top manager's posture to activities associated with product return, anecdotal evidence suggest that manager's attitude is instrumental to the success of a product return implementation (Padmanabhan and Png, 1995). Therefore, we hypothesize that:

Hypothesis 4: *There is a direct positive relationship between top managers' posture toward reverse logistics and the implementation of product return*.

Hypothesis 5: *There is a direct positive relationship between top managers' posture toward reverse logistics and the implementation of product recovery.*

2.4 Performance. We examine two forms of performance associated with the firm's reverse logistics process: economic and environmental. There is no agreement on whether product return is positively related to performance. Some researchers believe that product return policies generate additional costs for manufacturers (Stock et al., 2002). Others argue that a well-managed product return system generates profits because (a) manufacturers can increase sales by encouraging retailers to hold higher levels of inventory to reduce stock outs (Padmanabhan and Png, 1995), and (b) organizations can enhance their relationships with consumers and supply chain partners thereby enhancing future purchase intentions and increased revenues. Therefore, we hypothesize that:

Hypothesis 6: *There is a direct positive relationship between product return and the firm's economic performance.*

Hypothesis 7: *There is a direct positive relationship between product return and the firm's environmental performance.*

Product recovery has the potential to improve profitability by reducing raw materials costs, compliance and liability costs, gaining access to new customers and increasing revenues (Prahinski and Kocabasoglu, 2006). When industries implement a product recovery process, the environmental impact is improved by reusing materials, cutting energy use and reducing the need to send products to landfill (Guide et al., 2000). We hypothesize that:

Hypothesis 8: *There is a direct positive relationship between product recovery and the firm's economic performance.*

Hypothesis 9: *There is a direct positive relationship between product recovery and the firm's environmental performance.*

3. Research Methodology.

3.1 Questionnaire Development. Content validity was supported by a review of the literature, managerial interviews and a pre-test. Based on the feedback and insights gained, slight modifications were made to clarify meanings and tailor previously tested items to Chinese management practices. Eight constructs were measured by 29 items.

3.2 Sampling and Data Collection. We randomly selected 1,000 manufacturing plants from the China Telecom yellow pages for Pearl River Delta. The questionnaires were

mailed with a cover letter highlighting the study's objectives. We received 642 responses, of which 33 responses contained incomplete information. Therefore, the effective response rate was 60.9% (N=609). Because not all businesses are actively involved in reverse logistics, those that had not implemented four or more of the six reverse logistics activities were eliminated. This left us with a total of 209 questionnaires.

3.3 Factor Analysis. Using exploratory factor analysis, all items loaded with their intended constructs. All Cronbach's alpha values are above the limit of 0.60, thus, the reliability of the factors is supported. A confirmatory factor analysis model was estimated to assess convergent and discriminant validity. All factor loadings are greater than 0.5; all t-values are greater than 2.0; and all eigenvalues are greater than 1.0, thus supporting the validity.

3.4 The Structural Model. The goodness of fit indices were $\chi^2 = 681.61$ with $d.f. = 365$, RMSEA=0.065 with a 90% confidence interval of [0.057,0.072], NNFI=0.902, CFI=0.901 and the standardized RMR=0.074, all of which are better than the threshold values. Again, the statistical power of this model is sufficiently high and close to 1.00. Therefore, the model is acceptable and no modifications were made. The structural equation model and the standardized coefficients of each path are reflected in Figure 1.

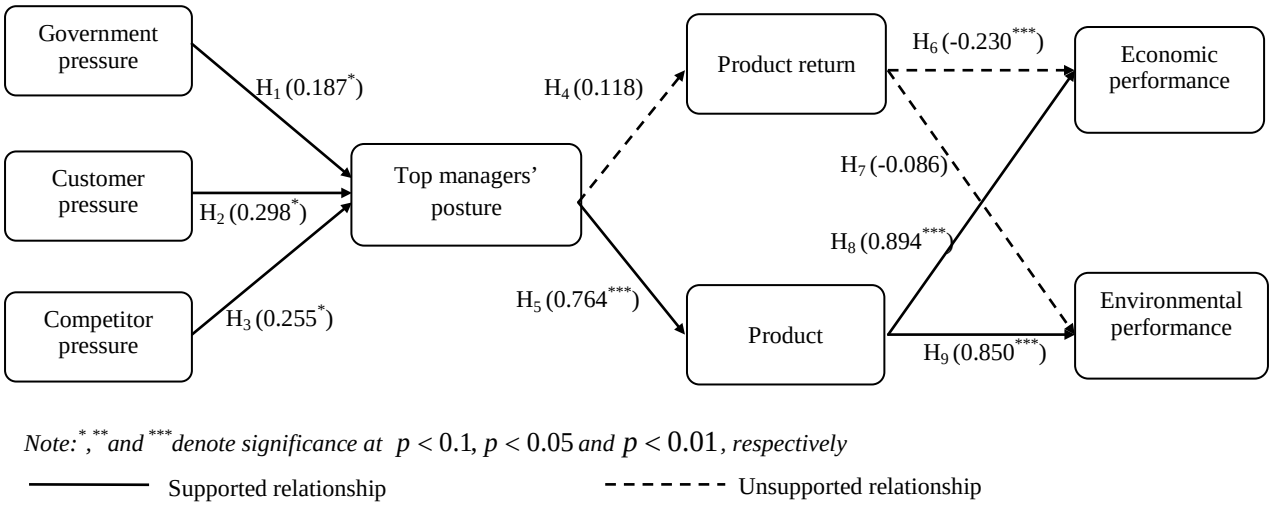

Figure 1 Structural equation model

4. Discussion and Conclusion. The empirical results suggest that the government, customers, and competitors have a significant influence on top managers' posture towards reverse logistics implementation. However, top managers' posture appears to affect only product recovery practices. We find that product recovery has a significant positive impact on its economic and environmental performance, but product returns have a negative impact on its economic performance and no effect on its environmental performance.

The lack of significant results associated with product returns leads to several interesting insights. First, it is possible that Chinese managers are not willing to establish a product

return system due to the Chinese culture of saving face and a propensity to avoid admitting errors. Second, government regulations emphasize product recovery while neglecting opportunities associated with product returns. Third, China's product traceability system is nascent (Zhao et al., 2009) and is complicated by the large number of small suppliers. Fourth, the considerable time, money and effort required to establish and maintain a complex product return system that relies on collaboration and cooperation is a significant barrier. These factors may explain why top Chinese managers have not emphasized product return and why the existing product return system is poorly managed, has a negative effect on economic performance and has no effect on environmental performance.

Based on managerial responses from enterprises based in the Pearl River Delta, this study provides a Chinese perspective on reverse logistics. Top managers can gain valuable insights from this study by realizing that reverse logistics is a tool that can be used to gain competitive advantage and is one that should be incorporated into their strategic agenda.

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Trust Signals in Supply Chain Alliances: Moving Toward a Robust Measure of Trust

Stephen L. Jones, Research Assistant
Brigham Young University
801/318-8243; stephen.l.jones@gmail.com

Stanley E. Fawcett, Professor
Brigham Young University
801/422-5890; sfawcett@grifflink.com

Amydee M. Fawcett
Lateral Line Analytics
801/851-0005; deefawcett@gmail.com

Cynthia Wallin, Assistant Professor
Brigham Young University
801/422-4933; cynthia.wallin@byu.edu

ABSTRACT

Trust is a vital ingredient in modern supply chain alliances. Yet, most measures of trust are rather simplistic. This article reviews the trust literature to identify the different facets of supply chain trust. A multi-faceted measure of trust is then developed and used to examine the extent to which trust signals are used in alliance management. Results of the multi-method approach show that most companies lack the know-how and ability to develop high levels of trust. Most companies have implemented strategies to signal their performance capability, leading to a level of transactional trust. However, few companies have recognized the need to signal to their supply chain partners their commitment to the relationship—leaving them without the ability to establish the trust levels needed to drive breakthrough collaboration. This paper introduces the importance of signaling trustworthiness in a supply chain context, develops relationship commitment as an important dimension of trust, and takes steps toward developing a more robust and meaningful measure of supply chain trust.

Keywords: Trust, signals, collaboration, supply chain management

INTRODUCTION

Value creation and competitive success depend on a firm's ability to use resources found among its supply chain (SC) partners (Dyer and Singh, 1998). Creating value across organizational boundaries through resource integration requires collaborative supply relations and routines. Trust is among the most essential ingredients in cultivating these collaborative relations and developing strong, mutually-beneficial relationships capable of achieving competitive advantage (Fawcett, Magnan, and Ogden, 2007; Kumar, 1996).

Trust yields several benefits to SC relationships including lower transaction costs (Dyer and Chu, 2003; Dyer, 1997), increased value-creation opportunities (Handfield and Bechtel, 2002), and enhanced collaborative learning (Dodgson, 1993). Further, trust-based relationships have been shown to lead to higher levels of profitability, innovation, and growth. Buyers have indicated that these key measures improve when they and their suppliers trust each other and collaborate together (Johnston *et al.*, 2004).

Although the benefits of trust are desirable, the ability to build trust-based relationships is missing in many firms. Highly touted theories such as the industrial organization theory and the resource-based view prescribe behaviors designed to increase the firm's bargaining power and reduce its willingness to share scarce resources (Barney, 1991; Porter, 1980). However, to build trust, powerful firms must refrain from exploiting their power—an uncommon behavior (Fawcett, Magnan and Williams, 2004). Moreover, building trust is resource intensive, requiring confidence that today's investments will bring future benefits (Zaheer and Harris, 2006). Because few managers understand the nature of trust and the practices that build it, they lack the foresight to make such investments. The tension between the enabling power of trust and the difficulty in establishing it raises questions of what constitutes SC trust, what behaviors comprise and promote the trust needed for breakthrough collaboration, and how we can better measure and promote the development of high-levels of trust.

BACKGROUND: THE RELATIONAL VIEW OF TRUST

Because trust is central to strong SC relationships, it is vital to accurately characterize and operationalize a trust construct. Over the past 20 years, numerous scholars have proposed alternative definitions of trust (Anderson and Narus, 1990; Ring and Van de Ven, 1992; Mayer *et al.*, 1995; Zaheer *et al*., 1998; Liu and Ngo, 2004). Although the variety of definitions and trustworthiness factors indicates that trust is complex, scholars appear to agree on two core dimensions of trust. First, trust is confidence that a firm's partner will not act opportunistically and exploit the firm's vulnerabilities (Kwon and Suh, 2005; Sabel, 1993; Sako, 1998; Barney and Hansen, 1994; Dyer and Chu, 2003; Laeequddin *et. al.*, 2009). Goodwill mitigates opportunism, allowing buyers and suppliers to work collaboratively despite the existence of vulnerability. Second, for trust to emerge fully, SC partners must have the intent and ability to perform to promise. Underperformance undermines the trust-enhancing power of goodwill.

The prominence of goodwill and competence as trustworthiness dimensions suggests that the relational view of the firm can provide insight into the complexities involved in defining trust and understanding how it is built. The relational view argues supernormal returns are obtained when firms acquire valuable resources or competencies that reside in different members of the supply chain (Dyer and Singh, 1998). Firms create competitive advantage from collaborative, idiosyncratic relationships with alliance partners who have complementary resources. Although the resource-based view emphasizes resources *within* a firm (Barney, 1991), the relational view leverages resources across SC partners to create advantage and supernormal returns. Trust enables collaboration, making it possible to bring heterogeneous, but complimentary capabilities together to create distinctive value and achieve competitive advantage.

Trust in Supply Chain Relationships

The extant research on SC trust suggests that the nature of trust and its enabling role in the creation of distinctive performance capabilities may vary considerably based on certain relationship characteristics including intensity and maturity. The following discussion thus describes trust in both transactional and collaborative SC relationships.

Trust in Transactional SC Relationships. In arms-length relationships, low cost and transactional efficiency are sought after and switching trading partners has little penalty (Williamson, 1985; Ghoshal, 1995). These relationships do not have the ability to create relational rents because "there is nothing idiosyncratic about the exchange relationship that enables the two parties to generate profits above and beyond what other seller-buyer combinations can generate" (Dyer and Singh, 1998). Trust in transactional relationships is primarily concerned with equity and efficiency (Fawcett and Magnan, 2001). Trust exists when SC partners have confidence that each party is acting fairly and with respect. Efforts are made to minimize hassle and transaction costs. This type of trust is described as contractual trust and competence trust, which is confidence in a partner's capability and motivation to perform according to its obligations (Sako, 1998; Lui and Ngo, 2004).

Trust in Collaborative SC Relationships*.* A distinctive performance capability is generated between SC partners when a valuable idiosyncratic relationship is formed (Dyer and Singh, 1998). Longer-term collaborative relationships require a higher level of trust than is needed for arms-length relationships. Such trust, often described as goodwill trust, is confidence that a firm's partner will look beyond the relationship and act with the focal firm's interest in mind (Sako, 1992; Humphrey, 1998). Goodwill trust focuses on the mutual commitment to the SC relationship and includes mutual expectations of reciprocity (Hardy *et al.*, 1998; McAllister, 1995; Ireland and Webb, 2007). Even as contractual trust and competence trust are closely tied with fulfilling contractual obligations, goodwill trust is based on a partner's motivation and ability beyond such structured obligations.

The relational view clearly articulates that high-level trust—a comingled combination of competence and goodwill trust—is needed to bring complementary competencies together in a way that leads to collaborative advantage. As firms seek to use SC resources to build distinctive competencies, they will naturally seek to establish high-level, collaborative trust. This notion leads to our first proposition:

Proposition 1: *Buyer firms include developing SC trust with suppliers as an important component of their competitive strategy.*

Theoretically, as companies invest in and execute their trust-building strategies, higher levels of SC trust should emerge. Thus, our second proposition is:

Proposition 2: *Current trust-building strategies are leading to high levels of trust between SC partners.*

Developing Supply Chain Trust

The complex, multi-faceted nature of trust creates a serious barrier to its establishment. Since managers do not fully understand the nature of trust, the levels of trust that exist in most SC

relationships are insufficient to enable a relational advantage. Interestingly, the measures of trust in the SC trust literature illustrate this challenge and point to a possible resolution (see Table 1). That is, most researchers evaluate trust using a single construct consisting of three to five items that comingle facets of goodwill and competence. As a result, these trust constructs tend to oversimplify trust while confusing the characteristics of trust. Given trust's centrality in the relational view's theoretical argument, a more comprehensive perspective of trust is needed. By evaluating the behavioral signals that lead to trust development, we propose a more-complete conceptual understanding of SC trust and begin to develop a construct to capture core, but distinctive facets of the two trust dimensions—goodwill and competence.

Each member in a SC relationship influences the other's perception of its trustworthiness via behavioral signals (Barney and Hansen, 1994; Spence, 1973). That is, signals are manifest by specific behaviors that instill or diminish trust. Different signals are related to the diverse trustworthiness factors discussed in the literature. Thus, a comprehensive measure of trust needs to be rooted in core trustworthiness signals. Through a combination of interviews and focus groups, Fawcett, Magnan and Williams (2004) identified five signals that influence trustworthiness perceptions: performance-to-promise signals, professional-relationship signals, openness signals, benevolent-collaboration signals, and empathy signals.

Performance to promise signals a partner's trustworthiness by reducing ambiguity and creating a history of positive interactions. If a supplier repeatedly delivers product on time with the expected quality, the buyer will gain confidence that the supplier is honest and capable (poor performance likewise erodes trustworthiness). Consistent, credible behavior also increases the supplier's reputation in the industry, which positively impact others' trust in the supplier (Barney and Hansen, 1994). Performance-to-promise signals are an important determinant for trust in both arms-length and collaborative relationships. It is also widely recognized in the literature as requisite for trust. Therefore, our third proposition is:

Proposition 3: *Performance-to-promise signals are widely used by buyer firms to develop trust with suppliers.*

Professional relationships signal trustworthiness because an agent is an important face for her company, and perceptions of her equity and integrity are a proxy for her organization's intent and ability to keep its promises. A supplier's agent will trust a buyer firm more when there is a consistent, credible, and positive interface with a buying agent. Agents who demonstrate respect and act with integrity will build their firm's trustworthiness (Fawcett, Magnan and Williams, 2004). Professional relationship signals are very visible and provide an opportunity for a partner firm to build credibility, which will significantly influence trust in both arms-length and collaborative relationships. Proposition four thus states:

Proposition 4: *Professional relationship signals are widely used by buyer firms to develop trust with suppliers.*

Openness sends a powerful signal of a partner's intent to perform as expected by diminishing the uncertainty that a partner has about the firm's actions (Kwon and Suh, 2004). For example, a buyer may be unable to predict if a supplier will fulfill a contractual agreement because the buyer has little visibility to the supplier's operations. This uncertainty can be overcome as the

Table 1
Supply Chain Trust Construct Measures

Author(s)	Number of Items	Items In Construct	Trustworthiness	
			Factor	Dimension
Cheng, Ye, and Tu (2008)	3	Partner is open in dealings	Openness	Competence
		Partner promises are reliable	Promise Keeping	Competence
		Partner does not make false claims	Honesty	Competence
Claro, Claro, and Hagelaar (2006)	4	Expect long-term work relationship	Reliability	Competence
		Partner is even-handed in negotiations	Fairness	Competence
		Confidence that partner will keep promises	Promise Keeping	Competence
		Partner is trustworthy	--	
Johnston *et al.* (2004)	7	Do not use proprietary information to partner's disadvantage	Non-exploitation	Goodwill
		Neither party is expected to make demands that might damage the other	Non-exploitation	Goodwill
		More powerful party restrains the use of power	Non-exploitation	Goodwill
		Personal confidence in one another	Promise Keeping (Agent)	Competence
		Business confidence in one another	Promise Keeping (Reputational)	Competence
		Rely on one another when it counts	Reliability	Competence
		Partner will maintain close relationship in the future	Reliability	Competence
Kwon and Suh (2005)	5	Confident that partner is telling the truth	Honesty	Competence
		Partner provides inaccurate information	Honesty	Competence
		Partner keeps promises	Promise Keeping	Competence
		Partner shares best judgment	Openness	Competence
		Can count on partner to be sincere	Honesty	Goodwill
Zaheer *et al.* (1998)	5	Supplier has always been evenhanded in negotiations	Fairness	Competence
		May use opportunities to profit at our expense	Non-exploitation	Goodwill
		Cannot rely on supplier to keep promises	Promise Keeping	Competence
		Hesitant to transact with supplier when specs are vague	Honesty	Competence
		Supplier is trustworthy	--	

supplier shares greater amounts of information, such as forecasts or pertinent operational details. Further, a buyer and supplier may establish information linkages or jointly implement a CPFR system to better share information. Involving other SC members in the target costing process exposes a firm's costs to its partners. Such openness demonstrates a partner's interdependency, which is important for the development of a long-term relationship. Scholars have recognized the importance of information sharing, but because shared information creates vulnerabilities, establishing informational linkages across firm boundaries can be difficult. Therefore, our fifth proposition argues:

Proposition 5: *Information-sharing signals are moderately used by buyer firms to develop trust with suppliers.*

Benevolent collaboration signals include relationship-specific investments and sharing risks and rewards. By making investments in a supplier, a buying organization can signal that it is worthy of trust. In a retail environment, a vendor could train a retailer's sales people in merchandising (Ganesan, 1994). In a manufacturing setting, a buyer might provide process engineering help to enhance supplier capabilities (Nelson *et al*., 1998). Also, sharing risks and rewards signals a partner's desire to have a long-term relationship with its partner. If a buyer shares the savings from supplier-initiated efficiency improvements in its operations, then the supplier will perceive the buyer as fair and the supplier's trust in the buyer will increase. Yet, collaborative behaviors tend to be both costly and risky. Thus, our sixth proposition states:

Proposition 6: *Collaborative-behavior signals are rarely used by buyer firms to develop trust with suppliers.*

Empathy signals are decisions and actions that consider a partner's wellbeing, even when power is asymmetrical (Fawcett, Magnan and Williams, 2004). Acting with empathy signals that a firm will not exploit the vulnerabilities of its partner (Kumar, 1996). Firms that act with empathy have policies to treat their partners fairly and consider their needs when making decisions. If the external environment changes such that a firm is in trouble, a partner may choose to alter its contract to safeguard the relationship. By contrast, opportunistic behavior signals a partner's lack of commitment to the relationship and damages trust. Empathetic actions send powerful signals of a partner's trustworthiness. However, many firms focus on their own needs and struggle to mitigate the adverse impacts of their decisions on SC partners. This reality leads to our final proposition:

Proposition 7: *Empathy signals are rarely used by buyer firms to develop trust with suppliers.*

RESEARCH METHODOLOGY

Because issues involving the role, influence and measurement of trust in SC relationships are complex, dynamic, and not well understood, an exploratory multi-method research framework was employed. Two preliminary steps were undertaken to firmly ground the research:

1. A series of 50 preliminary managerial interviews were conducted to identify the critical antecedents of successful SC alliances. Trust emerged as the most frequently identified and stressed building block of high-performing SC alliances.

2. A comprehensive literature search on the topic of trust was conducted. Issues including interpersonal, firm-based, and SC trust were evaluated. Interestingly, much more research has been done in the area of interpersonal trust than on SC trust.

These efforts provided the context to analyze and interpret the survey findings regarding the existence and influence of trust in SC relationships.

The survey process followed Dillman's Total Design Method; that is, three mailings of a cover letter, an instruction sheet, and the survey were sent to potential respondents at two-week intervals (Dillman, 1978). The mailing list consisted of 1,700 senior purchasing managers drawn from the Dun and Bradstreet database. The mailing list was designed to provide broad geographic and manufacturing industry coverage across America. To increase the response rate, managers were offered a copy of the study findings and the opportunity to be entered into a drawing for one of ten iPod Nanos. Overall, 189 usable surveys were returned for a response rate of 11 percent.

Non-response bias was evaluated using two methods. First, a comparison of early versus late responses revealed no problematic response patterns (Armstrong and Overton 1977). Second, to more clearly verify that the respondents and non-respondents were not uniquely different, the profiles of the two groups were compared. Respondents were tracked so that mailing and survey administration costs could be minimized. Non-respondents could also therefore be identified. Demographic profiles for 100 randomly selected non-respondents were developed using Dun and Bradstreet databases. These profiles were compared to those of the respondents. No significant differences were found.

FINDINGS AND DISCUSSION

Buying managers were asked to respond to a series of questions relating to 1) trust's influence on corporate strategy as well as 2) essential signaling behaviors. In each case, a seven-point scale (1 = strongly disagree, 7 = strongly agree) was employed.

Trust's Strategic Influence

According to respondents, most companies recognize SC trust as a valued element of their competitive strategies (mean = 5.86). The results shown in Table 2 reveal that buyers agree that trust leads to higher levels of collaboration (5.98) and improved competitive performance (5.91). The overall construct mean of 5.92 was the highest in the survey. Importantly, the Cronbach's alpha (a measure of internal consistency) of 0.726 suggests that this three-item Strategic-Role-of-Trust construct demonstrates strong reliability. Proposition 1 is thus affirmed.

However, managerial responses suggest that the desire for trust exceeds that actual level of trust achieved. When buyers were asked whether trust exists with suppliers, the mean level of agreement was 5.25. This result reveals a significant 0.67 gap ($p < 0.01$) between the strategic importance of trust and the actual trust achieved—a reality confirmed in the preliminary interviews. A consistent theme in these interviews was that trust is vital to better relationships and higher-level collaboration, but that managers were not fully cognizant of how to invest in trust-based relationships. Moreover, to the extent that building trust requires longer-term

investments, company climate is not perceived as supportive. Thus, Proposition 2 is not supported—many trust-building strategies are not leading to higher levels of trust.

Table 2
Perceptions Regarding the Strategic Role of Trust and Its Existence

Question	Mean	Std Dev
Strategic Role of Trust		
Trust-based supplier relationships lead to higher levels of collaboration	5.98	0.97
Trust-based supplier relationships lead to improved competitive performance	5.91	1.06
Establishing trust with valued suppliers is an important part of our strategy	5.86	1.08
Composite Index α = 0.726	***5.92***	***0.83***
Existence of Trust		
Our suppliers trust us to do what is right for the health of our LT relationship	5.40	1.24
We trust our suppliers to do what is right for the health of our LT relationship	5.14	1.24
Correlation = 0.623	**5.25**	**1.14**

Trustworthiness Signals

Performance to Promise. Perhaps the strongest and most easily measured trust signal is a company's actual performance to promise. Three questions were asked to assess the buyer's intention and ability to keep promises and commitments (see Table 3). The Perform-to-Promise construct score of 5.88 reveals that buyers believe that they score highly on this measure of competence trust. The Cronbach's alpha of 0.767 suggests a high level of construct reliability. Proposition 3 is thus confirmed. Indeed, the respondents note that throughout the negotiation process, they only make promises they intend and are prepared to meet. The mean level of agreement of 6.25 for this statement is the highest of all the items assessed. Buyers believe that they are honest and objective agents as they represent their companies in buyer-supplier negotiations.

Buyers do, however, acknowledge that their companies' performance is not quite as good as advertised. Regarding follow through on all commitments (5.72) and delivering to promise with respect to purchase of promised order quantities (5.67), the agreement scores are significantly lower ($p < 0.01$) than that for the promises made during negotiations. Although these scores are still high, given the prominence of this trust signal for both transactional and collaborative relationships, the finding that a gap exists between the talk and the walk is problematic. After all, the perform-to-promise signal focuses more on the confidence a company can place on a partner's promises than on actual performance. A buyers' delivery (or failure to deliver) to promise gives suppliers immediate feedback concerning the buyer's trustworthiness.

Professional Relationships. Three questions were asked to evaluate how and to what extent buying organizations are striving to encourage high levels professional-relationship trust (see Table 3). The overall composite score of 5.77 suggests that buying organizations appear to understand that creating equitable and respectful relationships are a contributor to the

collaborative trust needed for breakthrough SC performance. The Cronbach's alpha of 0.759 suggests an adequate level of construct reliability. Thus, Proposition 4 is affirmed.

Table 3
Assessing the Development of the Five Trust Signals and Associated Constructs

Questions Used to Assess Trust Signals	Mean	Std Dev
Performance to Promise		
In negotiations, we only make promises we are prepared and intend to keep	6.25	0.91
We follow through on all commitments we make to suppliers	5.72	1.06
We always deliver on promises made to suppliers	5.67	1.13
Composite Index α = 0.767	***5.88***	***0.86***
Professional Relationships		
Our culture encourages buyers to treat suppliers with fairness and respect	5.94	1.13
Fairness and integrity accurately characterize all our dealing with our suppliers	5.92	1.03
We are always perfectly honest and truthful with suppliers	5.45	1.23
Composite Index α = 0.759	***5.77***	***0.93***
Openness		
We do not use any proprietary information to our suppliers' disadvantage	5.93	1.13
We willingly share long-term production forecasts with our suppliers	5.77	1.30
We willingly share all information that might help our suppliers make better decisions	5.56	1.19
We proactively share our future technology and market entry plans with suppliers	4.29	1.61
We willingly share detailed cost information with our suppliers	3.37	1.57
Composite Index α = 0.671	***4.98***	***0.91***
Benevolent Collaboration		
We proactively work with our suppliers in planning and problem solving	5.59	1.07
We actively share resources with our suppliers to help improve their capabilities	4.31	1.65
We actively help our suppliers achieve certification & become dock-to-dock suppliers	4.19	1.72
We integrate supplier personnel into new product and other value-added teams	3.91	1.69
We offer technical training/education to suppliers to help them improve performance	3.90	1.73
We always share profits gained through collaborative efforts with our suppliers	3.82	1.52
Composite Index α = 0.762	***4.29***	***1.07***
Empathy		
Our success depends directly on the success and financial health of our suppliers	5.21	1.46
We do not make demands we feel will adversely impact our suppliers	4.92	1.34
Out of concern for our suppliers' welfare, we occasionally agree to pay higher prices	4.27	1.58
When making decisions, we explicitly evaluate the impact on supplier well being	4.25	1.41
Composite Index α = 0.647	***4.66***	***0.91***

Specifically, the respondents suggest that their organization's cultures do a good job (5.94) of encouraging them to treat suppliers with fairness and respect, which are foundational elements of good relations. Buyers also indicate that fairness and integrity accurately characterize their dealings with suppliers (5.92). However, when asked about the level of honesty and truthfulness in communications with suppliers, buyers report a significantly lower score (5.45, $p < 0.01$). As with the perform-to-promise signal, we see higher scores for the high-level, less-concrete questions than for the questions regarding specific behaviors. Thus, it seems that companies are interested in trust, but either are not sure exactly how to inculcate it or are not yet willing to invest fully in its development.

Openness. Respondent buyers were asked to indicate how openly their companies share information ranging from production forecasts to cost details (see Table 3). The composite index score of 4.98 affirms Proposition 5; however, it is significantly lower than for perform to promise and professional relationship trust. At 0.671, the Cronbach's alpha score was also somewhat lower. Although acceptable for exploratory research, this alpha score suggests that additional construct development is needed in the area of openness and information sharing (Nunnally, 1978).

Not surprisingly, buyer responses vary significantly depending on the type of information sharing being described. Buyers note that they are very willing (5.77) to share long-term production forecasts with suppliers. Sharing forecast information poses few risks for the buying firm while providing clear relationship benefits. Buyers also suggest an overall willingness (5.56) to share all information that would help suppliers make better decisions.

However, buyers do not include potentially sensitive information in their calculation of "all" relevant decision-making information. When asked specifically about their willingness to share future technology or market entry plans with suppliers, a very neutral 4.29 mean response is obtained. Buyers do not perceive such information as providing a quick or easy-to-see-and-measure benefit, and they also worry about potential opportunistic behavior. Buyers responded even less enthusiastically (3.37) when asked about their willingness to share detailed cost information. A buyer who shares its cost structure with a supplier loses the power that comes with information asymmetry. Suppliers might use these cost details to negotiate a higher price to force more equitable profit sharing between parties.

To summarize, companies are only moderately using openness signals in their trust building strategies. Buyers believe in the notion of selectivity—they feel that only certain types of information need to be shared to build trust. They still perceive information as power and are reluctant to give away any more than necessary to achieve short-term operational goals. Although sharing potentially proprietary information allows for relationship-specific investments and demonstrates commitment to the relationship, buyers have not adopted a strategy of sharing *all* information because some information exposes them to potential opportunistic behavior and a loss of information advantage.

Benevolent Collaboration. The preliminary interviews identified several behaviors that support or diminish trust. Survey respondents were asked to evaluate six of the most commonly observed practices (see Table 3). Not surprisingly, buyers are more hesitant to share resources than they were to share information. Thus, the overall composite score of 4.29 is the lowest among the five signals, affirming Proposition 6 and highlighting the fact that resource

sharing is not yet fully leveraged as a trust-building signal. The Cronbach's alpha is an acceptable 0.762.

Specifically, buyers agree that only one behavior is commonly exhibited in their supplier relationships: proactively working with suppliers in planning and problem solving (5.59). Joint planning and problem solving provide a direct and immediate buyer benefit without large risks. However, three other behaviors, which require higher commitment and increase risk, are much less employed: resource sharing = 4.31; dock-to-stock certification = 4.19; technical training/education = 3.90. The fear of supplier opportunism and uncertainty related to the long-term nature of the relationship exacerbate the sense of trepidation. Interestingly, the hesitancy to integrate resources extends to "borrowed" resources from suppliers. The respondents noted that their companies do not actively integrate supplier personnel into new product and other value-added teams (3.91). Finally, buyers do not equitably share profits from collaborative efforts with suppliers (3.82). Sharing rewards diminishes the short-term gains from joint efforts, so the motivation to do so is absent for a buyer who is primarily focused on meeting the current quarter's numbers. Yet, real relationship commitment requires a partner to signal its desire for interdependency by equitably sharing risks and rewards.

Empathy. The preliminary interviews showed that most companies acknowledge interdependence with supply chain members but only passively manage it. To better understand this phenomenon, respondents were asked four questions to assess how broadly this interdependence is recognized (see Table 3). The composite score for empathy is 4.66, affirming Proposition 7. Consistent with Proposition 7, the items within the construct demonstrate a bimodal response. That is, the general questions elicit high scores, but questions regarding specific behaviors reveal that empathy plays a much lesser role in decision-making. The Cronbach's alpha score is 0.647—acceptable for exploratory research, but in need of improvement.

Buyers agree that their success depends on the financial health of their suppliers (5.21). Buyers also note that they do not make demands that would adversely affect suppliers (4.92). Yet, the other responses tacitly denote that buyers are focused on their companies' own short-term well-being—even if suppliers will be negatively affected and the company's long-term competitiveness is injured. This point was clearly demonstrated as buyers noted that they are not disposed to pay higher prices out of concern for a supplier's financial health (4.27). Moreover, buyers note that they do not explicitly consider the impact of their decisions on supplier well-being (4.25). In essence, although buyers acknowledge their dependence on the "success and financial health" of their suppliers, they demonstrate an independent attitude in their overall approach to supplier management.

CONCLUSION: BUILDING COLLABORATIVE TRUST

Although trust is central to building the relations and routines needed to create unique value across organizational boundaries, our research findings suggest that few firms have achieved truly high levels of SC trust. Managers simply do not understand the multi-faceted and inter-connected nature of SC trust. Their companies are therefore unable to unlock the competitive potential of SC collaboration. Fortunately, the interview process and survey data analysis not

only helped define and measure trust more robustly but also led to following important managerial and theoretical implications.

Managerial Implications

To develop collaborative SC relationships with key suppliers, managers must adopt practices beyond those used with transactional partners. Performing to promise and building professional relationships will create trust sufficient for arms-length relationships, but they alone will not develop trust requisite for collaborative relationships that bring competitive advantage. Sharing all information, adopting collaborative behaviors and acting with empathy are all needed for developing strategic relationships with critical suppliers.

If they do not already exist, SC leaders must first develop high levels of performance-capability trust with their partners. Performing as promised and developing equitable and honest professional relationships are key to high performance-capability trust. When performance certainty is high, managers may invest in key partners, share rewards from successful endeavors, and keeping partners' interests in mind when making decisions. Through continued use of trustworthiness signals, managers can help create alliances that bring true collaborative competitive edge.

Theoretical Implications: A More Robust Trust Construct

Although we benchmarked the use and development of a variety of signals in the trust-building process, a primary focus of the research was to begin to develop a more robust construct for trust. Many empirical contributions have measured trust, but there is little consensus on how it should be measured, which leads to confusion to how these contributions can be compared and synthesized. Each of the five signals discussed above represents a factor of trustworthiness that needs to be measured—especially given trust's complexity and trust's centrality to SC collaboration. Measuring all five signals not only creates a more holistic concept of SC trust but also provides some guidance regarding where efforts need to be made to improve trust.

Future Research

Although we have made progress toward a more robust conceptualization and measurement of trust, more work is needed to adapt and strengthen our proposed measures. Further, because trust is a complex but critical concept, additional research is needed to understand 1) the organizational antecedents of SC trust and the moderating environmental factors that promote or impede high-level trust. Improving trust measures will help create a more accurate and complete conceptualization of trust and its role in the relational view of the firm.

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Sources of Buyer Bargaining Power and its Impact on Performance

Tobias Schoenherr, Ph.D.[1]
Assistant Professor of Supply Chain Management
Department of Supply Chain Management
The Eli Broad Graduate School of Management
Michigan State University
517/432-6437; Schoenherr@bus.msu.edu

Vincent A. Mabert, Ph.D.
Emeritus Professor of Operations Management
Editor - Production & Inventory Management Journal
Kelley School of Business
Indiana University
812/855-2661; mabert@indiana.edu

Summary. Buyer bargaining power has been a central variable in industrial procurement. This symposium paper offers a first attempt to place buyer bargaining power within a comprehensive framework, investigating its sources and its subsequent impact on purchase performance. Potential antecedents considered include market uncertainty, information search, extent of analysis, item difficulty, and supply base availability. These are integrated into a framework leading to buyer bargaining power, whose impact on purchase performance is subsequently assessed. This proceedings publication conceptually develops the framework and its hypotheses.

Introduction. Buyer bargaining power has been a central variable in influencing the competitiveness of a firm (Porter, 1980), and has been studied as a key component influencing how supply chain management and sourcing is conducted by organizations (Benton and Maloni, 2005; Kraljic, 1983). Although there has been a shift during the last two decades from adversarial buyer-supplier relationships to more collaborative bonds, possessing bargaining power continues to be a competitive advantage (Dowlatshahi, 1999). This power position can provide leverage for the procurement function and increases the company's competitive market position (Spekman, 1985; Ellram and Carr, 1994), and needs to be considered when developing a firm's supply chain strategy (Dorling, Scott and Deakins, 2006).

Despite a proliferation of literature on power in buyer-supplier relationships, empirical research exploring this domain is still limited (Caniëls and Gelderman, 2007), with some researchers suggesting buyer bargaining power be investigated with various theoretical lenses (Wallin, Rungtusanatham and Rabinovich, 2006) and within the context of supply chain management (Maloni and Benton, 2000). In addition, while studies exist that examine how buyer bargaining power can be increased (e.g., Cachon and Zhang, 2006), no identified research looks at the issue of bargaining power in a comprehensive context, exploring several of its antecedents,

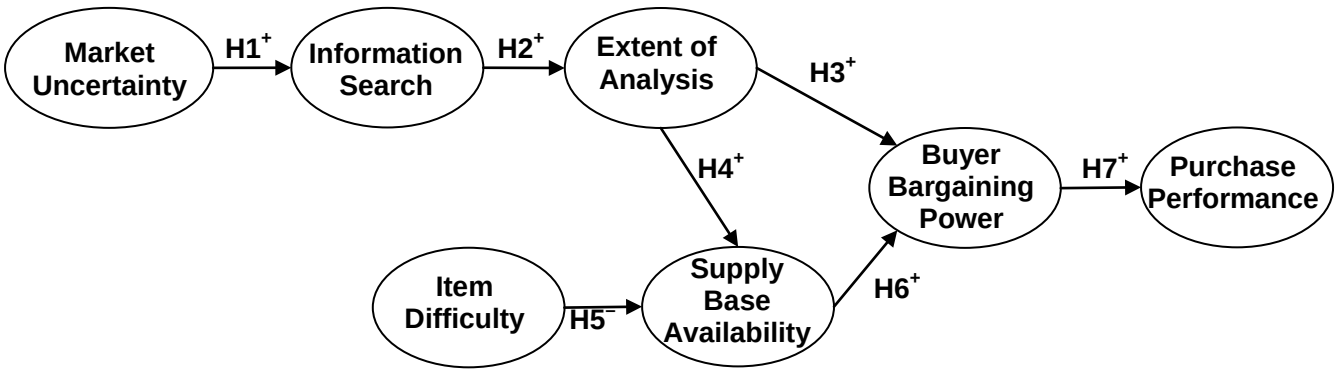
[1] Corresponding author

and the subsequent impact on performance. This paper focuses upon buyer bargaining power in context and examines it within a comprehensive framework.

Literature review and research model. The bargaining power of buyers is a central component of Porter's (1980) Five-Forces-Model and has received much attention as a variable in explaining buyer-supplier relationships (Cox et al., 2002). For example, Knudsen (2003) and Kotabe, Murray and Javalgi (1998) use power to explain the competitiveness of markets. Dowlatshahi (1999) compares the traditional adversarial buyer-supplier relationship approach with a more cooperative one, and the relative implications on the distribution of power. Caniëls and Gelderman (2007) investigate power and interdependence in buyer-supplier relationships based on Kraljic's (1983) stages of purchasing sophistication, and find that the power symmetry in the strategic quadrant no longer holds. Kumar, Scheer and Steenkamp (1999) look at power in buyer-supplier relationships in terms of interdependence, punitive capability, and the reciprocation of punitive actions. Power has also been the subject of operations and supply chain management literature. For example, Cox (2001a) provides a framework for procurement and supply competence based on the power of buyers and suppliers. This framework is extended beyond the immediate relationship of buyers with their first-tier suppliers in Cox, Sanderson and Watson (2001) and includes complex power regimes within upstream supply networks. In addition, Maloni and Benton (2000) found that power plays a significant role in supply chain management, noting that power, when used in a judicious manner, can lead to higher levels of integration and performance. In another study Benton and Maloni (2005) investigate the impact of power in buyer-supplier relationships on the satisfaction of the supplier, and conclude that power-affected relationships influence both performance and supplier satisfaction positively.

The investigation of industrial buyer behavior has its origins in the models by Robinson, Faris and Wind (1967), Webster and Wind (1972), and Sheth (1973). These important models provide the first conceptual frameworks to analyze, explain, and describe industrial buyer behavior. For the interested reader, Johnston and Lewin (1996) provide a good summary and synthesis of articles that have been using some aspect of industrial buyer behavior. The selection of our variables and the development of our research model, which is presented in Figure 1, were guided in large part by this body of literature.

Figure 1. Research model.



Hypothesis development. *Linking market uncertainty to information search.* A crucial component in sourcing is the company's ability to obtain valuable supplier and market information that can aid in the decision making process (Monczka, Nichols and Callahan, 1992). Knowledge about the supply base and the item characteristics is absolutely necessary to develop the most appropriate sourcing approach (Anderson and Katz, 1998; Monczka and Trent, 1992), with information search being a key variable in industrial buying (Sheth, 1973). For example, it has been suggested that a buyer should possess as much high-quality information about their suppliers as possible due to an associated increased level in power (Knudsen, 2003; McDonald, 1999; McDowell Mudambi, 1994). From the old axiom that "knowledge is power", information search should therefore play a critical role in our model of buyer bargaining power.

The motivation and desire to search for information can itself be triggered by the uncertainty in the market. Market uncertainty refers to the unpredictable variability of outcomes present in the supply market (Achrol and Stern, 1988) and the associated difficulty and challenge to develop a clear and consistent assessment. It characterizes the market environment (Heide and John, 1988) and is an indication of its dynamic (Cannon and Perreault, 1999). Industrial purchasers are expected to engage in a heightened search for information when there is higher market uncertainty. This is in line with arguments by Moriarty and Spekman (1984) who suggest that more information is sought when the buying situation is risky; by Weiss and Heide (1993) who associate a faster rate of change with more extensive search efforts; and by Garrido Samaniego et al. (2006) who write that personal sources of information are of special importance as uncertainty increases. This leads to hypothesis #1:

H1. Heightened market uncertainty leads to increased information search.

Linking information search to extent of analysis. Once information has been collected, it can be used as input for analyses to help in the decision making process. Oftentimes, the raw data collected possess only limited usefulness in an unanalyzed form, not necessarily representing a competitive advantage. The extent of raw data available does not always equate to their potential value, since the data need to be analyzed to create knowledge and influence appropriate behavior. When more effort is expended to collect information, a more thorough analysis should follow to convert the available information into knowledge, which should enhance the buyer's advantage (cf. Hunter, Bunn and Perreault, 2006). Additionally, a more involved analysis can also substantiate the expenses incurred in information gathering; as noted by past research suggesting that the larger the number of information sources accessed, the more time is required to make the purchase decision (Dholakia, Johnson, Della Bitta and Dholakia, 1993). Therefore, hypothesis #2 is as follows.

H2. Heightened information search leads to an increased extent of analysis.

Linking extent of analysis to buyer bargaining power and supply base availability. Analysis of available information is an important aid in sourcing decision making (Sashi and Kudpi, 2001). As such, a heightened extent of analysis devoted to the particular RFQ should make the buyer more confident in his or her position. Additionally, more analysis conducted with the available information should also facilitate the development of a more advantageous sourcing approach for the buyer. The effort expended in the analysis should enhance and be a source of the buyer's bargaining power. A similar link, between information search and bargaining power,

was suggested in prior research (Clopton, 1984; Bunn and Clopton, 1993; Cachon and Zhang, 2006). Cox (2001a) also wrote about the value of information and the effect in can have on the leverage of parties in supply markets. We hypothesize, however, that this information needs to be processed and analyzed first, then leading to a better bargaining position for the buyer. This aligns well with Cox (2001b) who linked procurement competence with increased buyer bargaining power. Hypothesis #3 is therefore formally stated as:

H3. A greater extent of analysis leads to increased buyer bargaining power.

Supply base availability assesses the extent of the supplier choice set available to the buyer (Cannon and Perreault, 1999). We propose that a more involved analysis of the available information can result in better supply base visibility. With little analysis some supply sources may never be found by industrial buyers, limiting their choice set. More analysis conducted should thus lead to better supply market availability, motivating hypothesis #4:

H4. A greater extent of analysis leads to better supply base availability.

Linking item difficulty to supply base availability. Supply base availability is influenced by the uniqueness or difficulty of the purchased items. This dimension is an assessment of how customized or highly-engineered the individual items are. Prior studies posited that as the difficulty (i.e., specifications and/or manufacturing) of the item increases, buyer bargaining power should decrease (Heide, 1994), and even switch to the supplier's side (cf. Wallin, Rungtusanatham and Rabinovich, 2006). However, if items from different suppliers cannot be differentiated from each other, bargaining power should be retained by the buyer (cf. Kotabe, Murray and Javalgi. 1998). Wallin et al. (2006) also proposed that transaction cost economics, with the dimension of asset specificity, may provide a theoretical justification for such decision drivers as the uniqueness of the item. While above studies suggest a link between item difficulty and bargaining power directly, we hypothesize that item difficulty first impacts the supplier choice set, which then in turn affects bargaining power. Homburg and Kuester (2001) argue firms facing more difficult purchase situations generally utilize fewer suppliers, supporting hypothesis #5:

H5. Increased item difficulty leads to restricted supply base availability.

Linking supply base availability to buyer bargaining power. Buyer bargaining power can be influenced by the availability of qualified and capable suppliers. Better supplier availability should increase competition, and thus the bargaining power of the buyer. This position is supported by past research (Bakos and Brynjolfsson, 1993; Perdue, 1992). It is also consistent with a study by Dorling, Scott and Deakins (2006) who associated a large number of suppliers and low switching costs with high bargaining power. Similar arguments were provided in the research by Kotabe, Murray and Javalgi (1998), Murray, Kotabe and Wildt (1995), and in a case study published by Chiesa, Manzini and Tecilla (2000). Along this same line, Wallin, Rungtusanatham and Rabinovich (2006) associated a larger number of available suppliers with the buyer's ability to demand concessions, and based their argument on work by Heide (1994), Handfield (1993) and Pfeffer and Salancik (1978). This suggests hypothesis #6.

H6. Better supply base availability leads to increased buyer bargaining power.

Linking buyer bargaining power to purchase performance. One factor that is widely acknowledged to affect performance in negotiations is power (Bacharach and Lawler, 1981; Fisher, Ury and Patton, 1991; Cox et al., 2002). Power can also influence how supply chain relationships are pursued (Dorling, Scott and Deakins, 2006), can help buyers gain a competitive advantage (Knudsen, 2003; Spekman, 1985), and can determine the performance of bidding events for industrial purchases (Schoenherr and Mabert, 2007). Besides impacting sourcing leverage, the power structure between buyers and suppliers can also enable one party to drive favored integration agendas, such as the implementation of interorganizational systems (Saeed, Malhotra and Grover, 2005). While this relationship has widely been recognized, the reverse argument that increased supplier power will decrease business outcomes, was not supported (Cousins and Lawson, 2007). Nevertheless, within the context of this study, we put forward hypothesis #7:

H7. Increased buyer bargaining power leads to better purchase performance.

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A Decision Support System for Supplier Selection in a Chemical Firm Supply Chain: A Case Study Leveraging Analytic Hierarchy Process Model

Chris I. Enyinda, Ph.D., Ph.D.
Professor and Coordinator of Logistics/Supply Chain Management & International Business Programs
Department of Management and Marketing
School of Business
Alabama A & M University
Normal, AL 35762
256-372-5610/chris.enyinda@aamu.edu

Denver Tolliver, Ph.D.
Director of Ph.D. Program
Department of Transportation and Logistics
Upper Great Plain Transportation Institute
North Dakota State University
Fargo, ND
Denver.tolliver@ndsu.edu

Khalid Backhar
Doctoral Student
Department of Transportation and Logistics
Upper Great Plain Transportation Institute
North Dakota State University
Fargo, ND
Khalid.backhar@ndsu.edu

Abstract. Supplier selection has been acknowledged as one of the most important function of purchasing and supply chain management and thus a crucial decision for chemical firms. This paper discusses multi-criteria decision making employing Analytic Hierarchy Process (AHP) model for supplier selection problem in a chemical firm. Supplier selection attributes are developed by using previous literature and through a survey questionnaire sent to a group of decision makers in a chemical firm. Based on the literature review, eight major attributes were identified. Supplier selection lends itself to a multi-criteria decision making problem as suppliers can be evaluated based upon a number of attributes. Leveraging the identified attributes, an AHP model is developed for prioritizing and/or ranking the suppliers. Expert Choice software is utilized in implementing the AHP model as well as performing the sensitivity analysis. Previous studies suggest that quality, cost and delivery Performance are considered the most important criteria when selecting a supplier. However, in the current study, we found that risk management, green purchasing, and CSR supply chain criteria are the most important for the selection of right supplies followed by cost, delivery Performance etc.

Keywords: AHP, Supplier Selection, Sensitivity Analysis, Green Purchasing, Corporate Social Responsibility Supply Chain, Risk Management, Chemical Firm Supply Chain

Introduction. In today's hypercompetitive global marketplace environment, selecting the right suppliers is inordinately imperative to the survival and success of any manufacturing firm. Choi and Hartley (1996) note that "determining which suppliers to include in the supply chain has become a key strategic consideration" for many companies. Indeed, supplier selection process and evaluation has become one of the essential parts of logistics and supply chain management. The need to select high quality suppliers is imperative because they are vital resource for manufacturing firms seeking to attain competitive advantage (e.g., Monczka et al. 1993; Handfield and Pannesi 1995; Richardson 1993; Handfield et al. 1999; Weber et al. 1991). Therefore, chemical firms must select potential suppliers that can deliver world-class quality at least cost to meet and exceed customer requirements. Arguably, suppliers, the quintessential part of supply chain can play a crucial role in supporting manufacturing firms deliver customers' value expectations. And to meet customers' value expectations means that manufacturing firms must endeavor according to Onesime et al. (2004), "to obtain products at the right cost, in the right quantity, with the right quality at the right time from the right source…" through the selection of world-class suppliers. Pi and Low (2005) assert that the purchasing function directly contributes to a firm's competitiveness through its influence on quality, purchasing cost, technology, and supplier responsiveness. Selecting the right suppliers can have considerable direct impact on organizations' cost/price, quality, lead time, delivery reliability, technology, availability of its products, and time-to-market of new products (Robert et al. 1999; Pearson and Ellram 1995; Sarkis and Talluri 2002; Bobler and Burt 1996). Li et al. (1997) describe the primary objective of supplier selection process as a strategy to mitigate purchase risk, develop mutual and long term relationships between the buying firms and suppliers, and optimize overall value expectation of the buyer. However, wrong selection of suppliers can erode the financial and competitive position of a firm.

The selection process simply entails the evaluation of different alternative suppliers based on the relevant criteria. This selection process represents a multi-attribute decision making problem affected by different tangible and intangible attributes such as the identified traditional attributes, risk management, environmental or green purchasing, ethically and corporate social responsibility (CSR) supply chain. A number of methodologies that have been used in supplier selection and evaluation studies include linear weighting models, the categorical model, weighted point model, total cost of ownership, multiple attribute utility theory, artificial neural network, principal component analysis, analytic network process, AHP, combined AHP and linear programming, among others.

The present research leverages AHP model developed by Saaty (1980) for supplier selection in a chemical firm in which the goal being pursued has multiple, often conflicting attributes. AHP is a multi-attribute decision making process which enables decision makers set priorities and deliver the best decision when both quantitative and qualitative aspects of a decision must be considered. AHP encompasses three basic functions, including structuring complexity, measuring on a ration scale, and synthesizing. It is a powerful operational research methodology useful in structuring complex multi-criterion problems or decisions in many fields such as logistics and supply chain management, marketing, engineering, education, and economics. Merits associated with AHP include its reliance on easily derived expert judgment data, ability to reconcile differences (inconsistencies) in expert judgments and perceptions, and the existence of Expert Choice Software that implements the AHP (Calantone et al., 1998).

The objective of this research is to identify relevant criteria or attributes for selecting the best supplier for a Chemical firm and extend the AHP-based model which incorporates the identified attributes into the supplier selection process and evaluation. Because supplier selection problem represents a typical multi-attributes decision making problem, the AHP methodology is chosen to assist purchasing and supply chain managers in their supplier selection problem. The AHP-based model has been acknowledged in the purchasing and supply chain management literature as a reliable approach that can assist decision makers to effectively select suppliers for long-term collaborative relationship.

The remainder of this paper is organized into the following major sections. In section 2, we present a brief background on the chemical industry, including the challenges and issues confronting it. In section 3, review of literature is presented. In section 4, we address the applicability of AHP methodology to supplier selection in a chemical firm supply chain. In section 5, we present the methodology employed to develop the AHP model. In section 6, we discuss the empirical results. Finally, section 7 presents the conclusions and managerial implications.

Background on Chemical Industry. The chemical industry produces chemicals that are used to produce virtually everything for the end-users. The chemical industry is the most diverse of U.S. industries, represented by about 10,000 organizations that transform raw materials, including oil, natural gas, air, water, metals, and minerals into different commodities. In 2007, BASF chemical firm purchased about 500,000 different raw materials and technical goods as well as services for plant construction, maintenance and logistics (http://report.basf.com/2007/en/managementsanalysis/supplychain.html). Like many firms, global chemical firms seek suppliers who possess global capabilities, are reliable and responsive in supply, and service and quality. Chemical firms expect their suppliers to deliver world-class service and raw materials that will enable them attain competitive strategic advantage. For suppliers that meet the value expectations will be rewarded with large volumes of purchases of commodities. Also, increasing customer demands and environmental complexity are the key trends driving change in the chemical industry. However, chemical industry is challenged with increasing manufacturing cost (raw material cost, energy cost, price and margin pressure); increasing global operations in emerging markets; and increase risk and regulation (financial compliance, global trade compliance, and environmental compliance). The chemical industry is facing new regulatory challenges such as homeland security.

The chemical industry is experiencing growing instability in terms of consolidation, regulatory compliance, globalization and global volatility in feed stock prices present significant threat. A combination of technological advancements, health, safety and privacy issues, and unrelenting demanding customer base add to the volatile challenges, market opportunities, and threats to chemical firms (IBM Consulting Services 2004).

Literature Review. Supplier selection has received a significant coverage in the purchasing and supply management literature (e.g., Petroni and Braglia 2000; Weber et al. 1991; Weber et al. 1992; Ellram 1990; Dickson 1966; Ghodsypour and O'Brien 1998; Verma and Pullman 1998; Krause and Ellram 1997; Youssef et al. 1996; Wilson 1994; MIN 1993; Motwani et al. 1999; Narasimhan 1983; Swift 1995; Akine 1993; Soukup 1987). Based on Dickson's (1966)

empirical study, 23 criteria were identified that purchasing managers generally consider when selecting a supplier. Of the identified criteria, quality, on-time delivery, and supplier's performance history were found vital in supplier selection regardless of the type of purchasing environment. Dempsey (1978) identified quality, delivery capability, and technical capability as imperative in supplier selection. Ellram (1990) emphasized the need not only to base supplier selection decisions on the traditional price and quality criteria but also on longer term and qualitative attributes such as strategic match and evaluation of future manufacturing capabilities.

Although these and other past studies considered the traditional supplier selection attributes such as quality, cost, flexibility and delivery Performance, they have not considered adequate integration of contemporary issues such as environmental initiatives (Handfield et al. 2002; Humphreys et al. 2002). In addition to the traditional selection attributes, the current research considers green purchasing, ethical and CSR supply chain, and risk management.. Supplier selection literature is endowed with all kinds of methodology, including multi-criteria decision-making techniques or decision support systems (e.g., AHP), conceptual papers, empirical research, simulation techniques, among many others. Stream of research that have applied AHP methodology in supplier selection include (e.g., Handfield et al. 2002; Barbarosoglu and Tazgac 1997; Bhutta and Huq 2002; Chan 2003; Onesime et.al. 2004). This research contributes to the existing stream of research by integrating green supply chain purchasing, ethical and CSR supply chain, and risk management into supplier selection process in a chemical firm supply chain

Research Methodology. Saaty (1980) developed AHP that can be used to handle relatively complex multi-attribute decision making problems. It enables a decision maker to represent the simultaneous interaction of several factors in complex and unstructured situations. For supplier selection, the derived expert judgments are introduced into the AHP model for each attribute of the hierarchy. Supplier selection problem is a typical multi-attributes decision making that entails multiple attributes that can be both qualitative and quantitative. AHP is selected because it permits decision-makers to model a complex problem in a hierarchical structure; showing the relationships of the overall goal, criteria, and alternatives. Although the positive attributes associated with AHP has been widely reported in the literature, there has been a small number of descending opinions (e.g., Belton and Gear, 1986; Dyer and Wendel, 1985). However, because of its usefulness, AHP has been widely used in supplier selection (e.g., Bhutta and Huq 2002; Chan 2003; Ghodsypour et al. 1998; Nydick and Hill 1992; Chan et al. 2007; Maggie and Tummala 2001). The hierarchy structure for supplier selection problem in a chemical firm is composed of three levels as depicted in Figure 1. The top level contains the overall goal of the problem, the middle level contains the multiple selection criteria that define the decision alternatives, and the lower level contains competing alternative suppliers.

Model Development of AHP for Supplier Selection Problem. Supplier selection process encompasses four parts, including problem definition; formulation of attributes; qualification of potential suppliers; and the ultimate selection of best suppliers (De Boer et al. 2001). The AHP methodology decomposes a problem and performs pair-wise comparison of all the elements. For chemical firms, which suppliers are the best and how much supplies should be procured from suppliers selected are vitally essential procurement problems. Often, decision makers

determine the best supplier from evaluating suppliers with qualitative supplier selection criteria by way of a decision support system. Supplier Selection enables manufacturing firms such as chemical firms to contain cost associated with the bottom line. It entails the determination of quantitative and qualitative factors imperative for selecting the best possible suppliers (Chan, 2003). The following steps associated with AHP method for decision making are as follows.

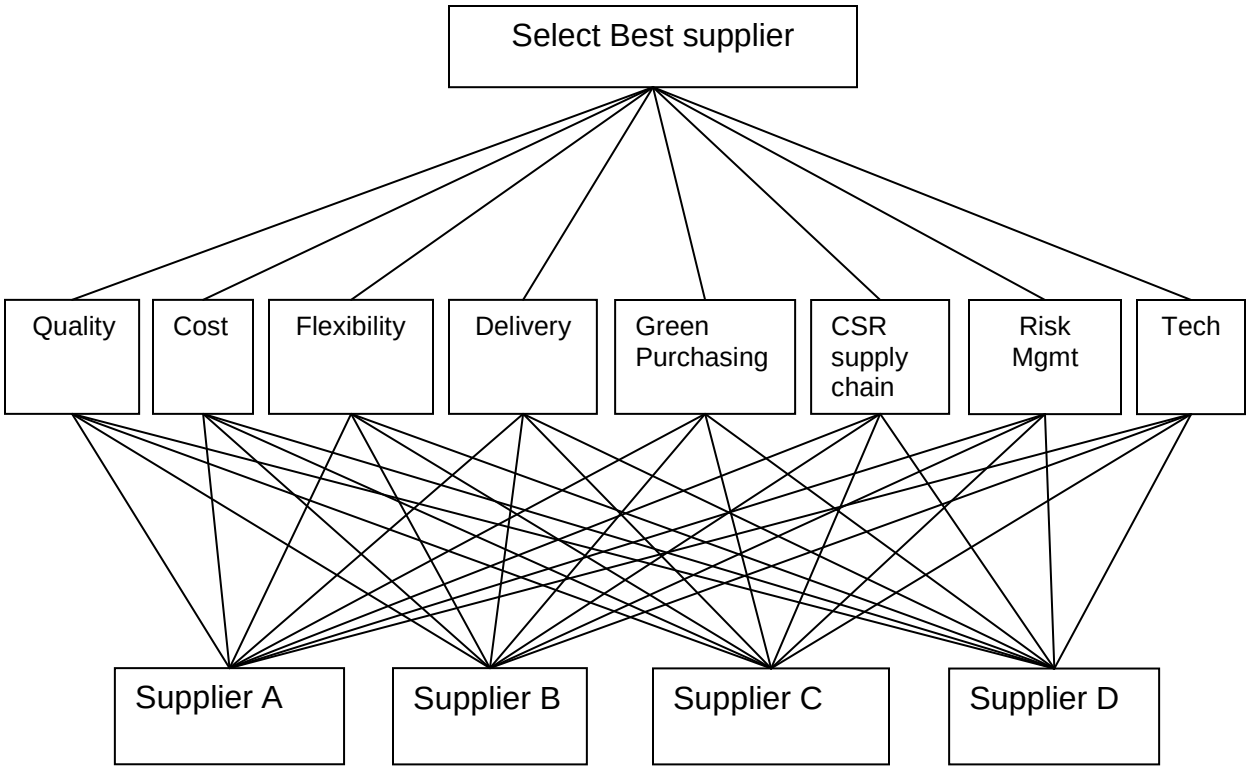
(1) Clearly state the decision problem and the overall goal.

(2) Structure the hierarchy from top through the intermediate levels to the lowest level. In Figure 1, the goal of the problem is located at level 1. Level 2 houses the major attributes. Finally, the alternatives are located at the last level of the hierarchy.

Description of Criteria and Alternative Suppliers. Historically, organizations have primarily considered criteria such as quality, service, price/cost, flexibility, reputation, and financial stability when selecting and evaluating suppliers (e.g. Sarkis and Talluri 2002; Verma and Pullman 1998; Hirakubo and Kublin, 1998). However, in today's competitive environment, ethical and corporate social responsibility supply chain, regulatory compliance mandate, environmental/green supply chain, and post 9/11 safety and security requirements pressure are growing, thus prompting organizations to consider them in supplier selection. Therefore, the identified attributes used for supplier selection for a chemical firm include the following:

Quality. Quality of raw material and component requirements are very essential in the chemical industry. Because customers demand quality products and services from manufacturers, it behooves them to select suppliers with proven record of world-class service and quality raw materials. For example, chemical firms' suppliers are required to provide top-notch commodities as well as services. Lin et al. (2005) note that quality management practices are imperative in supplier selection strategies. Gonzales et al. 2004 found that quality is the most significant attribute in supplier selection.

Figure 1. The Hierarchical Structure of AHP Model for a Chemical Firm



Cost. Cost has traditionally been considered as one of the most important aspects of supplier selection criteria in the purchasing and supply management literature.

Flexibility. It is imperative for a chemical firm to select suppliers with flexibility given that chemicals encompasses many raw materials and components that require large outlay to be spent on converting them into thousands of final products. With proper flexibility, the manufacturers and suppliers could reduce risk associated with predictable and unpredictable surprises. Proper flexibility can reduce unnecessary costs.

Delivery Performance. Ability of suppliers to deliver on-time as promised.

Green Purchasing. The pursuit of green initiative by way of green purchasing can improve firms' environmental as well as financial performance (Zhu and Geng, 2001). Arguably, "Suppliers face increasing pressure from their customers to improve their environmental performance. When firms downstream in the supply chain seek to achieve such improvements themselves, they frequently request … their suppliers adopt greener practices" (Delmas and Montiel, n.d). Industries of all type are requiring their suppliers to achieve international environmental management standard ISO 14001certification. For example, many firms are requiring their suppliers to implement better environmental management practices (Plambeck and Denend 2008; Darnall 2006; Handfield et al. 2002; Walton, Handfield, and Melnyk 1998). According to Handfield et al. (2002), "Dow Chemical only uses suppliers who are part of the voluntary ''Responsible Care'' initiative [RCI]." Similarly, BASF evaluates both potential and

existing suppliers on the basis of environmental protection, occupational safety, and social responsibility standards. (http://www.basf.com/group/corporate/en/sustainability/management-and-instruments/supply-chain).

Corporate Social Responsibility (CSR) Supply Chain. Embracing ethical and CSR supply chain is more than ever seen as crucial to the long term sustainability and profitability of manufacturing firms. In today's global marketplace, consumers are interested in knowing the labor conditions under which the products they purchase are produced and how their operations impacts the environment and economic growth of the host communities along the firms' supply chains (Harrison et al. 2005; Shaw and Clarke 1998; Strong 1996). Carter and Jennings (2004) examined the need for CSR in the purchasing activities. Chemical firms are increasingly under pressure to be ethically and socially responsible in their conduct of global business operations. As a result, they are more than ever requiring suppliers to embrace RCI. Handfield et al. (2002) defines RCI as "… a dedication of responsibility to the community regarding chemicals, chemical transportation and manufacturing, as well as safe disposal and prompt reporting." In accordance with the United Nations' Global Compact Initiative, BASF mandates it suppliers not to either employ children or employ forced or bonded laborers. Also, its procurement requirements specify that suppliers must comply with the International Labor Organization's (ILO) employment standards (http://www.basf.com/group/corporate/en/sustainability/ Management-and-instruments/supply-chain).

Risk Management. This is a disciplined approach to mitigating and managing both predictable and unpredictable surprises. For example, to ensure the safe and secure distribution of its raw materials, intermediates and products worldwide, Dow Chemical developed a comprehensive risk management program. The program includes baseline requirements such as: Compliance with transportation safety and security regulations; global implementation of RCI; development and implementation of uniform Dow supply chain standards which include the use of Most Effective Technology and Loss Prevention Principles (LPP); and a process for conducting reviews, audits and assessments of Dow and supply chain partner operations. Indeed, chemical firms rely on their suppliers to operate and deliver chemical products reliably, safely, securely, and in a sustainable manner (Mathes 2006).

Technology. For the manufacturers, technology is imperative for maintaining and improving product and services. The technological advancement of suppliers is important to the quality of their supplies. There is a direct relationship between technology and the quality of commodities provided by suppliers.

Alternative Suppliers. The suppliers are identified as supplier A, Supplier B, Supplier C, and Supplier D, respectively.

(3) Construct a set of pair-wise comparison matrices for each of the lower levels. The pairwise comparison is made such that the attribute in row *i* (*i = 1,2,3,4…n)* is ranked relative to each of the attribute represented by *n* columns. The pair-wise comparisons are done in terms of which element dominates another (i.e. based on relative importance of the elements). These judgments are then expressed as integer values 1 to 9 in which a_{ij} = 1 means that *i* and *j* are equally important; a_{ij} = 3 signifies that *i* is moderately more important than *j*; a_{ij} = 5 suggests that *i* is strongly more important than *j*; a_{ij} = 7 indicates that *i* is very strongly more important than *j*; a_{ij} = 9 signifies that *i* is extremely more important than *j*;

Establishment of Pairwise Comparison Matrix *A*. Assuming C_1, C_2, C_3, …C_n to be the set of elements and a_{ij} representing a quantified opinion or judgment on a pair of elements C_i, C_j. The relative importance of two elements C_i, C_j is assessed using a preference scale on an integer-valued 1-9 developed by Saaty (2000) for pairwise comparisons. According to Saaty, a value of 1 between two criteria indicates that both equally influence the affected node, while a value of 9 indicates that the influence of one criterion is extremely more important than the other. It allows the transformation of qualitative judgments and/or intangible attributes into preference weights (level of importance) or numerical values. The pairwise comparisons are accomplished in terms of which element dominates or influences the order. AHP is then used to quantify these opinions that can be represented in *n-by-n* matrix as follows:

$$A=[a_{ij}]=w_i/w_j = \begin{bmatrix} w_1/w_2 & w_1/w_2 & \dots & w_1/w_n \\ w_2/w_1 & w_2/w_2 & \dots & w_2/w_n \\ . & . & . & . \\ . & . & . & . \\ . & . & . & . \\ w_n/w_1 & w_n/w_2 & \dots & w_n/w_n \end{bmatrix} = \begin{bmatrix} 1 & a_{12} & \dots & a_{in} \\ 1/a_{12} & 1 & \dots & a_{2n} \\ . & . & . & . \\ . & . & . & . \\ . & . & . & . \\ 1/a_{1n} & 1/a_{2n} & \dots & 1 \end{bmatrix} \quad (1)$$

If c_i, is judged to be of equal importance as c_j, then $(a_{ij}) = 1$
If c_i, is judged to be more important than c_j, then $(a_{ij}) > 1$
If c_i, is judged to be less important than c_j, then $(a_{ij}) < 1$

$(a_{ij}) = 1/a_{ji}$, (i, j = 1, 2, 3, …, n), $a_{ij} \neq 0$.

Where matrix *A* represents a reciprocal matrix, a_{ij} is the inverse of the entry a_{kj} which indicates the relative importance of C_i compared with attribute C_j. As an example, a_{12} = 3 indicates that C_1 is 3 times as important as C_2. In matrix *A*, it becomes the case of assigning the *n* elements C_1, C_2, C_3, … C_n a set of numerical weights W_1, W_2, W_3, …W_n, that represents the recorded experts' judgments. If *A* is a consistency matrix, the links between weights W_i and judgments a_{ij} are given by $W_i/ W_j = a_{ij}$ (for i, j = 1, 2, 3, …, n).

Eigenvalue and Eigenvector. Saaty (1990) recommended that the maximum eigenvalue, λ_{max}, can be determined as

$$\lambda_{max} = \sum_{j=1}^{n} a_{ij} W_j/W_i. \quad (2)$$

Where λ_{max} is the principal or maximum eigenvalue of positive real values in judgment matrix, W_j is the weight of j^{th} factor, and W_i is the weight of i^{th} factor.
If *A* represents consistency matrix, eigenvector X can be determined as

$$(A - \lambda_{max} I)X = 0 \quad (3)$$

Consistency Test. Both AHP and Expert Choice Software does not impose on the pharmaceutical firms to be perfectly consistent, rather a consistency test is performed to examine the extent of consistency as well as each judgment once the priorities are determined. Saaty (1990) recommended using consistency index (CI) and consistency ration (CR) to check for the consistency associated with the comparison matrix. A matrix is assumed to be consistent if and only if $a_{ij} * a_{jk} = a_{jk} \ \forall_{i\,jk}$ (for all *i, j, and k).* When a positive reciprocal matrix of order *n* is consistent, the principal eigenvalue possesses the value *n.* Conversely, when it is inconsistent, the principal eigenvalue is greater than *n* and its difference will serve as a measure of CI. Therefore, to ascertain that the priority of elements is consistent, the maximum eigenvector or relative weights/λ_{max} can be determined. Specifically, CI for each matrix order *n* is determined by using (3):

$$CI = (\lambda_{max} - n)/n - 1 \quad (4)$$

Where n is the matrix size or the number of items that are being compared in the matrix. Based on (3), the consistency ratio (CR) can be determined as:

$$CR = CI/RI = [(\lambda_{max} - n)/n - 1]/RI. \quad (5)$$

Where RI represents average consistency index over a number of random entries of same order reciprocal matrices shown in Table 2. CR is acceptable, if its value is less than or equal to 0.10. If it is greater than 0.10, the judgment matrix will be considered inconsistent. To rectify the judgment matrix that is inconsistent, decision-makers' judgments should be reviewed and improved. However, Byun (2001) suggested that .20 might still be acceptable.

Table 1. The Reference Values of RI for Different Numbers of n

n	2	3	4	5	6	7	8	9	10
RI	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.51

Data Collection and Results. A survey questionnaire approach was used for gathering relational data to assess the order of importance of the supplier selection criteria. Through interview and survey of the purchasing and supply chain managers of a chemical firm, 8 relevant criteria were identified for supplier selection process and evaluation. Base on the

identified criteria and the hierarchy tree, we developed a questionnaire to enable pairwise comparisons between all the selection criteria at each level in the hierarchy. The pairwise comparison process elicits qualitative judgments that indicate the strength of a group of decision makers' preference in a specific comparison according to Saaty's 1-9 scale. A group of purchasing and supply chain managers was requested to respond to several pairwise comparisons where two categories at a time were compared with respect to the goal. The result of the survey questionnaire technique was then used as input for the AHP. The matrix of pairwise comparisons of the criteria or attributes given by the chemical firm in the case study is shown in Table 2. The judgments are entered utilizing the Saaty's pairwise comparison preference scale explained in no. 3.

Table 2. Pairwise Comparison Matrix with respect to Goal

Goal	QPS	Cost	Flex	DP	GP	CSRSS	RM	Tech
Quality of product & service(QPS)	1	1	3	5	1/5	1/7	1/3	1
Cost	1	1	3	1	1/5	1/7	1/7	1/3
Flexibility (Flex)	1/3	1/3	1	1	1/7	1/6	1/5	1/2
Delivery performance (DP)	1/5	1	1	1	1/7	1/7	1/3	1/4
Green purchasing (GP)	5	5	7	7	1	1	1	5
CSR supply chain (CRSS)	7	7	6	7	1	1	1	3
Risk management (RM)	3	7	5	3	1/5	1/3	1	7
Tech	1	3	2	4	1/5	1/3	1/7	1

Employing pairwise comparison matrix as shown above in Table 2, the inconsistency or referred to as CR is 0.07 < 0.10 reported by the Expert Choice Software. This implies that the group decision makers' (purchasing and supply chain managers') evaluation is consistent. The priorities obtained from the group decision makers' judgments are depicted in Figure 2. It shows that corporate social responsibility supply chain is the best supplier selection criterion, followed by green purchasing, risk management, and technology. Thus, suggesting that the decision makers in the case chemical firm should integrate the preceding criteria into supplier selection decision. However, the traditional selection criteria (quality, cost, delivery performance, and flexibility

Figure 2. Priority weights for the major criteria

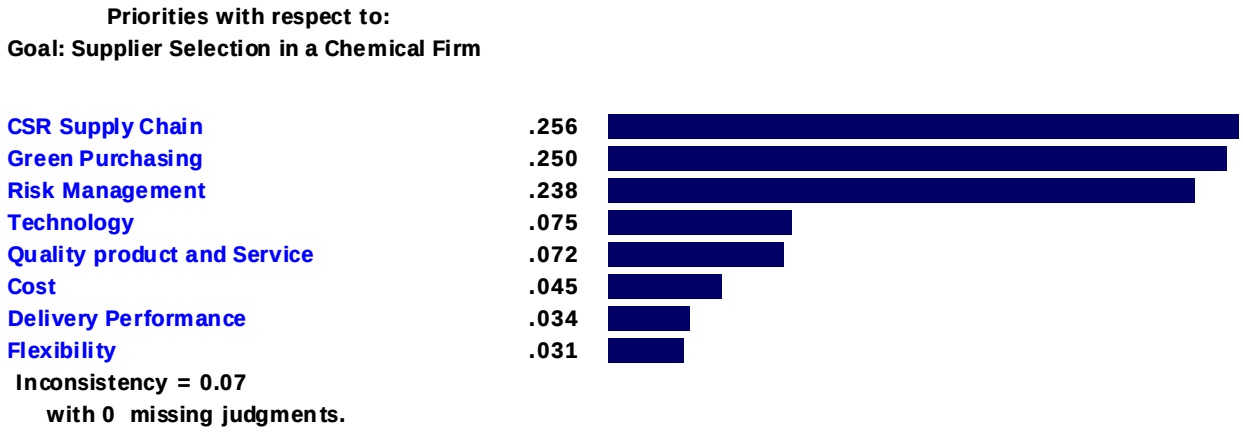


Table 3-10 show the pairwise comparisons associated with the alternative suppliers. There are eight 4 x 4 matrices of judgments. That is, there are seven attributes and four suppliers to be pairwise compared for each attribute. Essentially, Table 3-10 depict the judgments of a group of decision makers regarding the relative importance of the suppliers A, B, C, and D with respect to quality product/service, cost, flexibility, delivery performance, green purchasing, CSR supply chain, risk management, and technology, respectively.

Table 3. Pairwise comparison with respect to quality product/service criterion

Quality Product/Service	A	B	C	D	Priority
A	1	3	3	1/7	0.161
B	1/3	1	1	1/9	0.065
C	1/3	1	1	1/7	0.070
D	7	9	7	1	0.704

Table 4. Pairwise comparison with respect to cost criterion

Cost	A	B	C	D	Priority
A	1	1/3	3	1/7	0.098
B	3	1	5	1/4	0.220
C	1/3	1/5	1	/9	0.047
D	7	4	9	1	0.635

Table 5. Pairwise comparison with respect to Flexibility criterion

Flexibility	A	B	C	D	Priority
A	1	1/3	5	1/4	0.136
B	3	1	7	1/3	0.276
C	1/5	1/7	1	1/9	0.040
D	4	3	9	1	0.548

Table 6. Pairwise comparison with respect to delivery performance criterion

Delivery performance	A	B	C	D	Priority
A	1	3	3	1/5	0.177
B	1/3	1	2	1/9	0.080

C	1/3	½	1	1/9	0.057
D	5	9	9	1	0.686

Table 7. Pairwise comparison with respect to Green purchasing criterion

Green Purchasing	A	B	C	D	Priority
A	1	1	1/5	1/3	0.096
B	1	1	1/7	1/5	0.077
C	5	7	1	1	0.456
D	3	5	1	1	0.371

Table 8. Pairwise comparison with respect to CSR supply chain criterion

CSR Supply Chain	A	B	C	D	Priority
A	1	3	5	1/3	0.243
B	1/3	1	3	1/7	0.101
C	1/5	1/3	1	/9	0.049
D	3	7	9	1	0.607

Table 9. Pairwise comparison with respect to risk management criterion

Risk Management	A	B	C	D	Priority
A	1	1	5	1	0.311
B	1	1	3	1	0.278
C	1/5	1/3	1	1/7	0.067
D	1	1	7	1	0.344

Table 10. Pairwise comparison with respect to technology criterion

Technology	A	B	C	D	Priority
A	1	1	3	1	0.284
B	1	1	5	1	0.321
C	1/3	1/5	1	1/5	0.074
D	1	1	5	1	0.321

Table 11 reports on the priority scores of alternative suppliers. With respect to the overall priority scores of alternative suppliers, supplier D (0.439) is most preferred followed by supplier A (0.219), supplier B (0.186), and accept risk (0.161), respectively.

Table 11. Priority scores of alternative suppliers

Attribute	**Alternatives**	**Priority Scores**	**Ranks**
Quality Product & Service (0.072)			
	Supplier A	0.161	2
	Supplier B	0.065	4
	Supplier C	0.070	3
	Supplier D	0.704	1
CR = 0.05 < .10			
Cost (0.045)			
	Supplier A	0.098	3
	Supplier B	0.220	2

Supplier C	0.047	4
Supplier D	0.635	1
CR = 0.05 < .10		
Flexibility (0.031)		
Supplier A	0.136	3
Supplier B	0.276	2
Supplier C	0.040	4
Supplier D	0.548	1
CR = 0.06 < .10		
Delivery Performance (0.034)		
Supplier A	0.177	2
Supplier B	0.080	3
Supplier C	0.057	4
Supplier D	0.686	1
CR = 0.04 < .10		
Green Purchasing (0.250)		
Supplier A	0.096	3
Supplier B	0.077	4
Supplier C	0.456	1
Supplier D	0.371	2
CR = 0.02 < .10		
CSR Supply Chain (0.256)		
Supplier A	0.243	2
Supplier B	0.101	3
Supplier C	0.049	4
Supplier D	0.607	1
CR = 0.03 < .10		
Risk Management (0.238)		
Supplier A	0.331	2
Supplier B	0.278	3
Supplier C	0.067	4
Supplier D	0.344	1
CR = 0.03 < .10		
Technology (0.075)		
Supplier A	0.284	2
Supplier B	0.321	1
Supplier C	0.074	3
Supplier D	0.321	1
CR = 0.01 < .10		
Overall		
Supplier A	0.219	2
Supplier B	0.182	3
Supplier C	0.161	4
Supplier D	0.439	1

Sensitivity Analysis on the Priority Weights of Criteria. With the aid of Expert Choice Software, AHP-based model provides an opportunity for decision makers to perform the sensitivity analysis (SA) of the decision criteria. If group of decision makers believe that an attribute might be more or less important than originally indicated, they can drag that attribute's bar to the right (increase) or left (decrease) and then observe the impact on alternatives. The objective of the SA is to determine how the small changes (perturbation) in input parameters, including quality, cost, flexibility, delivery performance, green (environmental) purchasing, CSR supply chain, risk management, and technology will impact the ranking of the alternative suppliers. Min (1994) emphasized that "the sensitivity analyses are necessary because changing the importance of criteria requires different levels of resource commitment …" If the global marketplace environmental conditions change, priorities of the chemical firm may change as well. Indeed, SA can enable group of decision makers to assess what may happen if the priority weights of the criteria change. Because of limitation of space we investigated few sensitivity analysis of the impact of changing priority of the criteria on the alternative suppliers' ranking. For performance SA in Figure 3 and dynamic SA in Figure 4, the alternative supplier ranking is as follows: supplier D, supplier A, supplier B, and supplier C.

In Figures 5-6, when the traditional criteria as well as the CSR supply chain, and risk management criteria priority weights were increased, the ranking of suppliers remained insensitive or stable. That is, suppliers D, A, B, and C, respectively However, when green purchasing priority increased from 0.26 (Figure 3) to 0.32 (Figure 5) the supplier ranking became sensitive or unstable. The same was the case when green purchasing priority increased from 25.0 (Figure 4) to 34.2 (Figure 5). That is, the new supplier ranking as follows: suppliers D, A, C, and B, respectively.

Figure 3. Performance sensitivity analysis on supplier selection

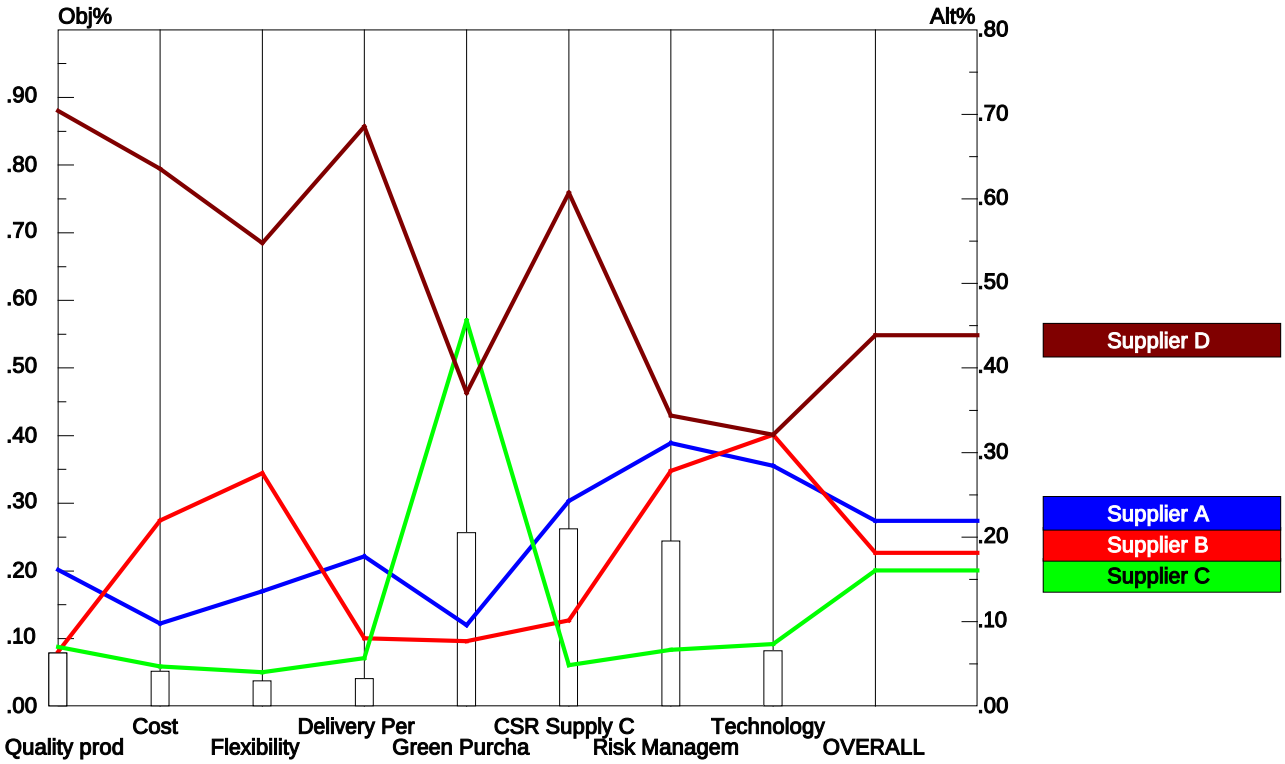


Figure 4. Dynamic sensitivity analysis on supplier selection

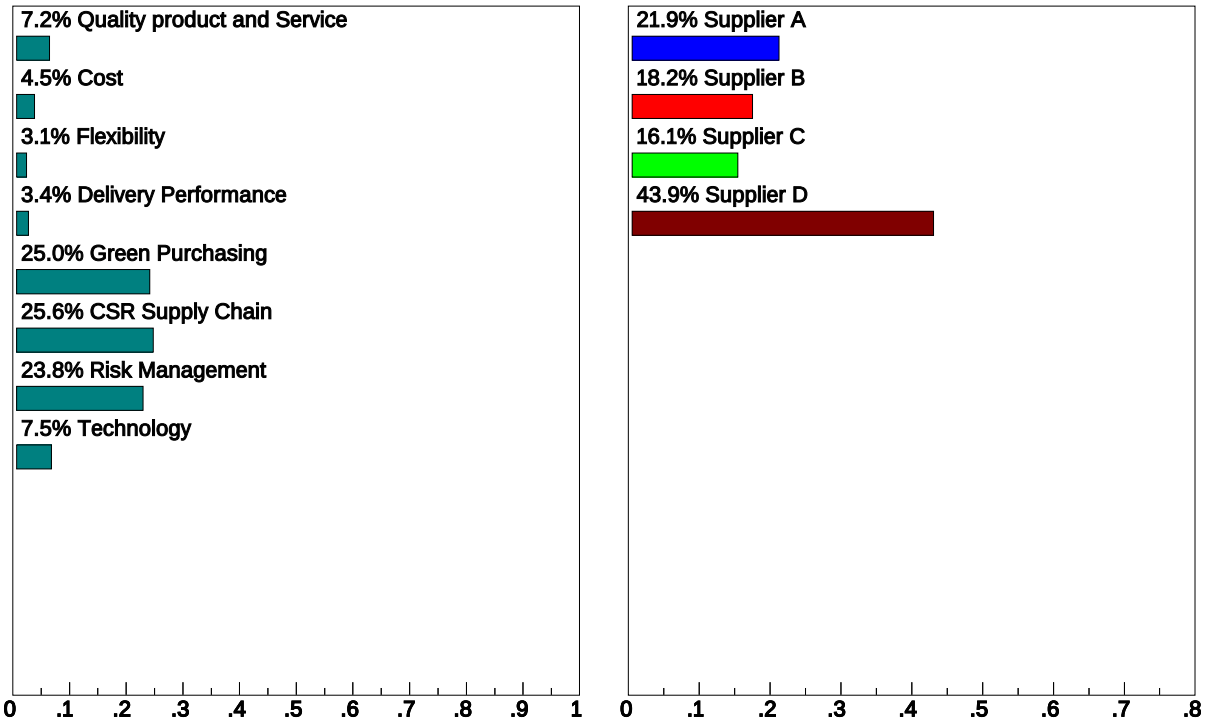


Figure 5. Performance sensitivity analysis on supplier selection

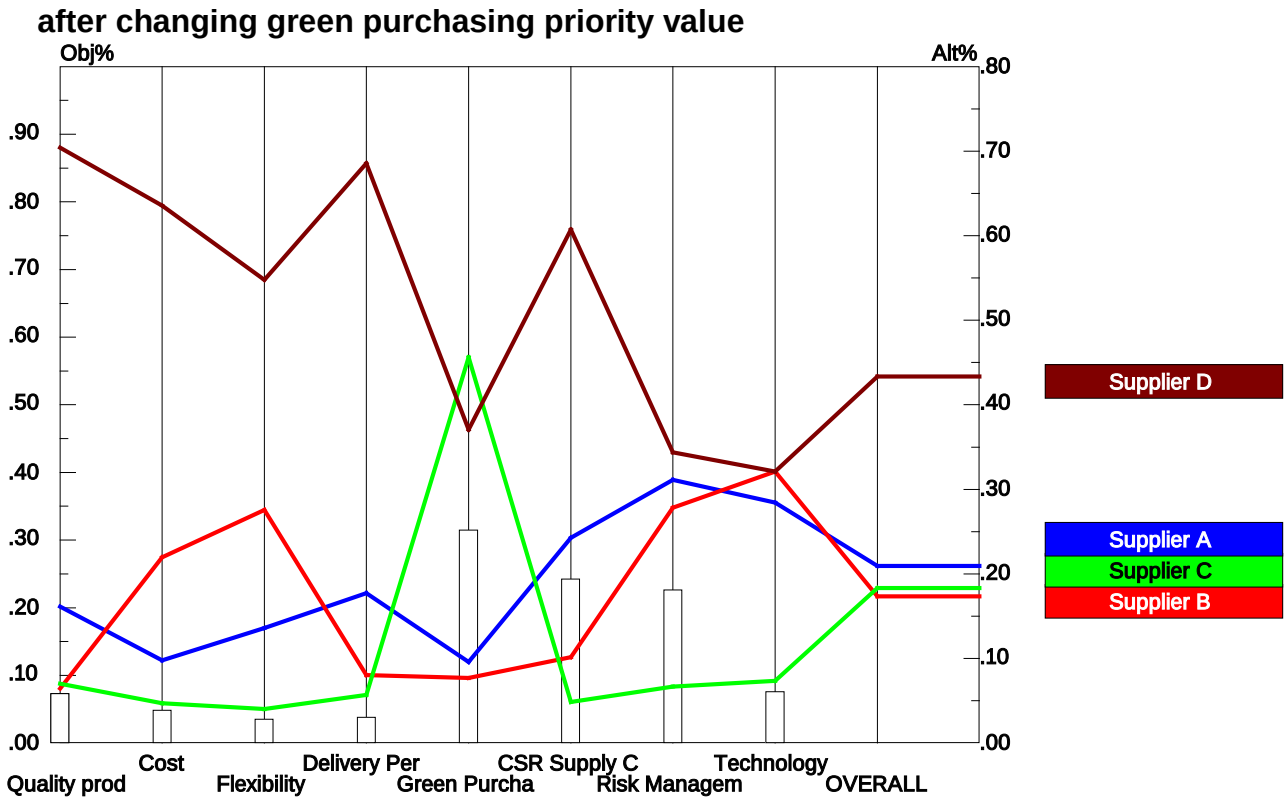
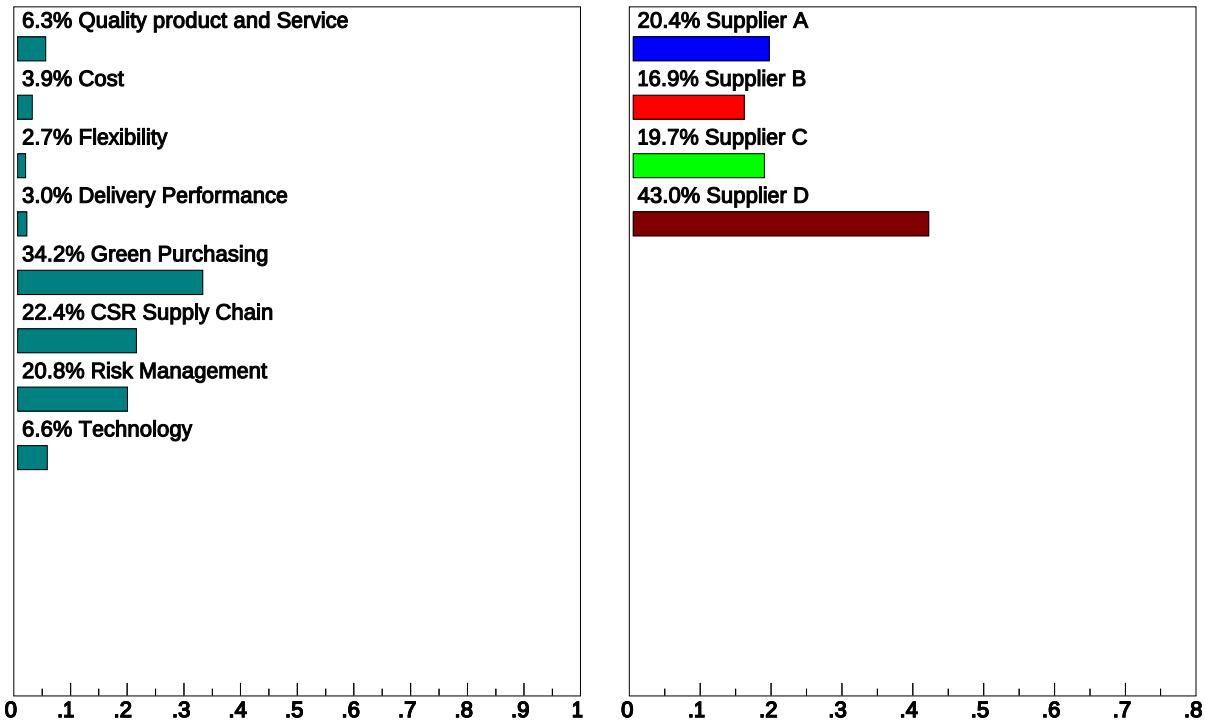


Figure 6. Dynamic sensitivity analysis on supplier selection after changing green Purchasing priority value



Conclusions and Managerial Implications. Supplier selection is an important purchasing function for any firm. However, in today's changing and hypercompetitive global business environment, purchasing and supply chain managers are faced with the daunting challenge of selecting the right suppliers for long-term collaborative and trusting relationship that will supply them with the requisite commodities. Indeed, supplier selection process is an essential problem facing the chemical firm under study as selecting the right suppliers represents a long term investment. A well executed supplier selection process can be the linchpin for achieving supply chain performance and competitive advantage. However, to accomplish these objectives means that "… an efficient supplier selection process needs to be in place and of paramount importance for successful supply chain management (Sonmez 2006).

Selecting the best supplier for a chemical firm can be defined as a multi-attribute decision making problem encompassing quantitative and qualitative attributes. A multi-attribute decision making methodology such as AHP is beneficial in actively involving purchasing and supply chain managers with diverse conflicting objectives to reach a consensus decision. Thus, the AHP-based model is utilized to select the right suppliers since it can handle both quantitative and qualitative attributes.

A group decision-making process can be enhanced by a systematic and logical method to evaluate priorities based on opinions or judgments of purchasing and supply chain managers within the chemical firm. Although the traditional criteria are still relevant in supplier selection process and evaluation decision, this research revealed that CSR supply chain followed by green purchasing, and risk management, are the most important criteria to consider. For example, according to Humpreys (2003), "in the long term, environmental [or green purchasing and CSR supply chain] issues will become important [factors] for a company to consider." This insightful revelation underscores the growing imperative for green or environmental purchasing and CSR supply chain that purchasing and supply chain managers must consider when selecting suppliers for long-term and trusting relationships. It also means that selection of suppliers is not only based on economic criteria. Arguably, those firms that incorporate green purchasing and CSR supply chain criteria into the supplier selection process and evaluation will not only boost their supply chain performance, but they will also sustain and grow supply chain profitability.

Based on the AHP-based methodology, the best supplier selected was supplier D. Thus, the proposed AHP-based supplier selection decision support system was successful in aiding a group of purchasing and supply chain managers to select the best supplier for a chemical firm supply chain. Indeed, the AHP model proved useful in the group decision making and curtailed the time associated with supplier selection process exercise.

Finally, the premier contribution of this research was the identification of new important attributes for supplier selection problem in a chemical firm. The new attributes integrated into supplier selection process include green purchasing, CSR supply chain, and risk management. Another contribution pertains to the extension of a decision support system model for supplier selection in a chemical firm supply chain. The decision support system model for supplier selection process was successfully extended leveraging AHP approach.

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Developing Student Competencies in E-Sourcing Technology Using a Reverse Online Auction Project

Jacqueline A. Williams, Associate Professor of Marketing & Sales
North Carolina A&T State University
336/334-7656 ext. 4020; jacq@ncat.edu

Kathryn Dobie, UPS Professor & Director of the Transportation Institute
North Carolina A&T State University
336/334-7656 ext. 5000; kaydobie@ncat.edu

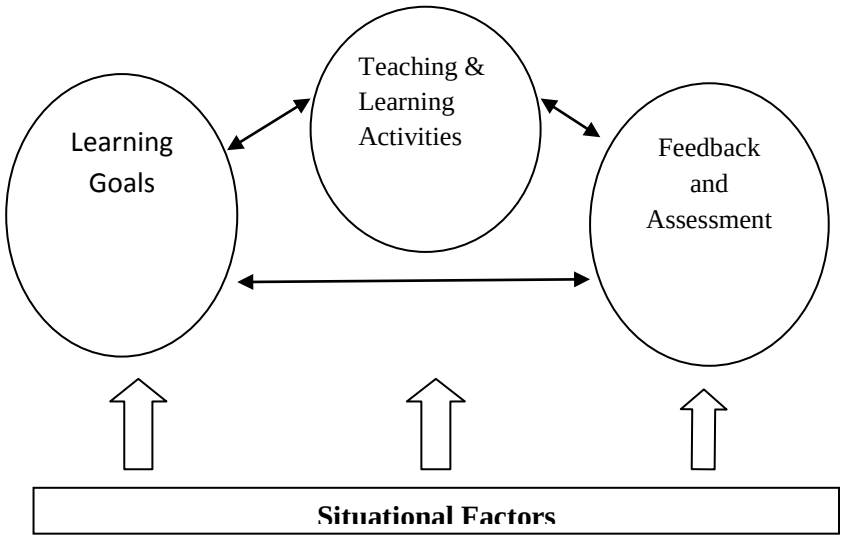
Curtis Wynn, Chief Executive Officer
RFQHosting
252/539-3024; cwynn@roanokeonline.net

Abstract. As companies face the dual tasks of managing an ever expanding supply chain and reducing costs, technology becomes an indispensible tool for sales and supply management professionals. Graduates entering the workforce are expected to have a working knowledge of the enabling technologies that are available to assist in the performance of their professional duties. Electronic auctions are increasingly being used by firms as they seek to improve firm financial and operational performance. Integrating the knowledge and use of online reverse auctions as an e-sourcing tool can enhance the competencies and job performance readiness of business school graduates. However, educators are cautioned that under the pressure to integrate new technology into student coursework, one must avoid rushing through a comprehensive instructional design process. We present the development of a course project using online reverse auctions for sourcing needs. The course project is developed using an established instructional design framework that incorporates identifying important situational factors, establishing learning goals, developing teaching/learning activities, and incorporating feedback and assessment. This paper describes how the project was designed and implemented.

Introduction. Organizations are increasingly utilizing technology to source a variety of goods and services from suppliers (Kaufman and Carter, 2004). Many transactions that could be conducted as traditional face-to-face negotiations are now candidates for online, real-time auctions between buying organizations and two or more invited suppliers. The emerging technology for sourcing, such as an on-line bidding process, is often augmented with traditional face-to-face meetings, teleconferencing, and/or emails. With every major industry using e-sourcing technology (Jap, 2002), the rapid growth of this sourcing effort underscores the need to expose business students (specifically, both professional sales and purchasing students) to its influence --- opportunities, issues, and consequences -- on buyer-seller dynamics. The desired result of this exposure is to enhance the competencies of the graduates as they prepare for the duties and responsibilities assumed as supply chain professionals. Thus, this paper describes a business school curriculum that was updated to include online reverse auctions. The change in the curriculum was made using an established instructional design framework that incorporates identifying important situational factors, establishing learning goals, developing teaching/learning activities, and incorporating feedback and assessment.

Applying Instructional Design to an E-sourcing Project. As a contemporary leader in faculty development focused on teaching and learning, Fink's model (Exhibit 1) is used to develop the e-sourcing project. Fink (2003) argues that a learning-centered approach to designing courses provides the best chance for significant learning experiences to occur. He notes that in contrast to a content-centered approach to learning where the focus is on what to cover or put in a course, the learning-center approach focuses on what students can and should learn in relation to a subject and then how such learning can be facilitated. The distinction is appreciated when one understands that what to put in a course may be controlled by the curriculum committee or administrators of the university. But how to facilitate the instructional event is the responsibility of the faculty member.

Exhibit 1 – Fink (2003) Model of Integrated Course Design



Instructional design focuses on how to best facilitate the instructional event and, as a discipline, is a branch of knowledge concerned with research and theory about instructional strategies and the process for developing and implementing those strategies (Smith and Ragan, 1999). The overall objective of instructional design is to serve the learning needs and success of students through effective presentation of content and fostering of interaction. Andrews and Goodson (1980) provided one of the first comprehensive comparisons of models of instructional design. Today, as instructional design models are adapted for situated learning with technology, the assessment components may be radically different (Young, 1993) however, the basic features of instructional design are stable (Smith and Ragan, 1999). The basic features of all instructional development models include four components: 1) identifying situation factors, 2) learning goals and objectives identification, 3) content and delivery development, and 4) evaluation and redesign. Fink (2003) provides a detailed analysis of theses four basic steps in his book entitled *Creating Significant Learning Experiences: An Integrated Approach to Designing College Courses.*

Step 1: Identifying Situation Factors

In the instructional design process, the situational factors are the setting and audience analysis backdrop in which the learning will occur. The teaching and learning environment is a mid-size, public university in the Southeastern United States. The University is a public, state university with a homogenous student body consisting of eighty percent of its students from the surrounding counties in the state. A majority of the students are first generation college students with the expectation that their college education prepares them for entry level jobs in corporations or the government. The idea that they could apply the learning outcomes from this course was a very relevant factor for these students.

Instructional design theory proposes that the characteristics of the learners should be reviewed as part of the situational analysis (Fink, 2003; Smith and Ragan, 1999). Learners' prior knowledge and experiences relevant to the subject must be considered. In addition, designers need to consider what are the goals and expectations of the students. Given that the courses were undergraduate courses offered to juniors and seniors as major electives, the design of the project could incorporate the prerequisite course work such as basic computer information knowledge as well as the general body of knowledge required for freshman and sophomore students.

Another situational factor that must be addressed is the expectations placed on the course by the university, the college, the department, and other stakeholders of the university like recruiters and alumni. The business school is held to the standards of the accreditation organization to which it belongs. In addition, corporate partners have verbalized an interest in certain skills and competencies of graduates from the college. These general contextual requirements were considered in establishing the expectations and the rigor of the project.

The nature of the subject is another situational component that must be considered in designing effective learning experiences. The project was embedded in two courses, scheduled at the same time and day during the semester – The Purchasing and Supply Management course and the Professional Selling and Sales Management course. The Purchasing and Supply Management course emphasizes the importance of the procurement function for efficient operations, product quality, and supply chain integration. The issues of supplier selection, performance measurement and relationship development/ management, and their impact on the firm and fulfillment of customer expectations are emphasized. The Professional Selling and Sales management course focuses on the functions and skills surrounding the personal selling effort such as developing persuasive communication skills in a buyer- seller context. Given the situation in which the university had dedicated courses for both sides of the buyer-seller dyad, an opportunity to integrate the e-sourcing project into both courses was available and appropriate (Baker and Song 2008; Carter and Stevens 2007).

Given that e-sourcing is an applied science that is becoming more and more central to business strategy, the integration of a technology based e-sourcing project across two applied disciplines (purchasing and sales) added realism to the course work as well as an active learning opportunity. The fact that two courses were available to integrate into an e-sourcing project is an important element in the design of the course. Having only one set of students would simplify some aspects of the learning design yet limit some of the realism of the buyer-seller dyad, and subsequently some of the effectiveness of the learning.

In the business school the undergraduate classes are scheduled to meet either three times a week for fifty minutes or twice a week for one hour and twenty minutes. On rare occasions an undergraduate course may meet once a week for three hours. For the e-sourcing project, a twice a week, one hour and twenty minute schedule was requested. This situational condition was requested because of a desire to bring in practitioners to discuss e-sourcing. The faculty felt that the longer class times would allow for the practitioners to present information for an hour and the session would be augmented with a fifteen minute question and answer session.

Another physical component is the type of classrooms that would work best for the delivery elements. A question of whether to use a computer laboratory, or a traditional classroom that was wired for laptop computers had to be answered. We opted to use a traditional classroom and access the computer laboratory at specific points during the semester. The technology component of the semester-long course encompassed about 25% of the time. Since all of the instruction was not computer based we felt that students would be less distracted in a traditional classroom setting during the days when the technology was not utilized.

The number of students taking the courses also has to be considered. Historically the ratio of students in the purchasing and supply chain course to the number of students in the professional selling course is 1:3. This ratio has been consistent for several years. This ratio was found to be effective for structuring the reverse auction bidding since it allowed each of the students role-playing as a "purchasing agent" to have the opportunity to interact with three students role-playing as a "supplier."

Finally, from an instructional design viewpoint, characteristics of the teacher should be reviewed. Smith (1996) explains that as today's education process pushes students to the center, the teacher's role changes to that of facilitator, guide, and coach – not the primary source for knowledge. A teacher's knowledge and experience related to the course content as well as classroom management is important. Yet, a teacher's ability to help students be active participants in the process of finding, organizing, analyzing, and applying information in novel ways is also significant. The faculty, as a situational factor, like the others can present limitation or opportunities for the learning experience. Given that the faculty for this project had recent significant field interactions is an asset in the instructional design process. The purchasing faculty was certified in purchasing management. The sales faculty had recently completed a faculty internship with a fortune 500 company. During this intensive experience the faculty member interacted with the sales force on a daily basis.

Step 2: Establishing Learning Goals

Instead of learning topics – the focus of traditional content-centered instructional design, our goal was to consider how the course will impact the student as an entry level supply chain professional. As recommended in a learner-centered approach to instructional design, we asked what will distinguish students who have taken this course from those who have not. Our learning goals fell into five major categories: 1) foundational knowledge, 2) learning how to learn, 3) application of knowledge, 4) learning about oneself, and 5) relationship building. A course map is presented in Table 1 to connect learning goals and learning activities.

From a foundational knowledge standpoint we conceded that a major goal was that the e-sourcing project will offer undergraduate students a look at the practices of organizations considering and using reverse auctions as an e-sourcing tool. In addition we wanted the students to gain from the course understanding of the fundamentals of e-sourcing and its impact on the sales and purchasing

functions of the firm. We also wanted students to know the history of reverse auctions and to be familiar with applications of reverse auctions across industries.

For the second learning goal category we wanted students to understand how to inquire about a new subject and how to explore a new technology. We wanted to provide the student the opportunity of conducting independent research and being a self-directed learner. Forman (1995) declares that we live in a world where our body of knowledge is doubling every decade and thousands of scientific articles are published daily. Thus, students need to become an active part of the learning community where they learn how to learn and collaborate with the teacher, peers, and experts to add to their base of knowledge. Smith (1996) argues that innovative classroom approaches coupled with "appropriate technologies" set the stage for flexible learning environments where students understand learning occurs and how to create their own, eclectic learning techniques. In effect, our goal was to foster a customized self-learning environment.

Table 1.
E-sourcing Project Course Map and Planning Guide

Learning Goals for Course/Module	Teaching-Learning Activities	Assessment & Feedback
1) Foundational knowledge – understanding and remembering information and ideas	Lecture-discussion Independent research papers In-class Speakers Negotiation exercise Case analysis Research paper presentations	Pre-test survey Post-project survey Oral presentations Written research papers Final case exam
2) Learning how to learn – becoming a better student through self directed inquiry	Independent research papers Online tutorial assignment	Quality of reference material used for research papers Online tutorial learning assessment
3) Application of knowledge – practicing desired skills	Develop/Respond to RFQ Reverse auction software training "Live" reverse auction bidding	RFQ evaluation Web-statistics of "live" bidding response behavior
4) Personal development - Learning about oneself and/or others	Reflection on Negotiation Style Reflection on Technology Use Reflection on buyer-supplier role	Reflection paper evaluation
5) Relationship building – connecting ideas, people, and different aspects of life	Pre-bid face-to-face meeting Post-bid face-to-face meeting	Video-taped meeting role-play evaluations

In terms of application of knowledge, in our third category of learning outcomes we wanted students to participate in a "Live" Bid day exercise (bidding rounds and tactics). We wanted our students to develop (purchasing students) and respond to (sales students) a request for proposal. In addition, we wanted the students to be familiar with a software program specifically developed for the reverse auction process.

At the undergraduate level, a primary form of competency development within the curriculum is information-based; what Habermas (1970) referred to as technical learning. Pedagogically, technical learning is achieved through identifying the specific set of concepts and behaviors needed to achieve a level of competence. However, Nirenberg (2003) criticizes the technical and mechanistic pedagogies used in business schools. He likens instruction that emphasizes the memorization of concepts to driver education classes that do not place the student behind the wheel of a car. He argues that students will know much descriptively about complicated models but nothing about how to use them. To counter the limitations of mechanistic pedagogies, experiential education is increasingly important pedagogical tool within colleges and schools of business at both the undergraduate and MBA levels (Quay 2004). Thus, it was critical to incorporate an experiential or hands-on component to this project.

For the fourth category of learning goals, learning about oneself, we wanted to add a reflective component. Here we hoped students would address their comfort with technology as well as comfort with the negotiation process. Given that purchasing and professional selling are the jobs that they are preparing for, we wanted students to reflect on their perceived fit with their respective profession. We were striving to develop an innovative classroom approach which positions learning as a continuous process grounded in experience, or more explicitly an iterative process in which internalized reflection follows concrete experience, resulting in an adaptation revealed in further reflection and experience (Quay, 2004).

Building relationships is an important learning goal for students preparing for boundary spanning positions. Specifically we want students to understand the real-world issues related to who gets invited to bid and how to get invited to bid. Here the concern is for a clearer connection of the importance of relationship building even in a technology-oriented interaction. We feel that the students need to understand that beyond the computer hardware and software of the reverse auction technology, one has to connect as people (Carter and Kaufmann, 2007).

Step 3: Teaching /Learning Activities

Learning activities were created that linked to the learning goals to foster significant learning. We used lecture and discussion to present basic terminology and concepts. We invited in practitioners to discuss e-sourcing in general and reverse auctions in particular. At the beginning of the course, from a foundational knowledge standpoint we assigned research papers for the students to gain from the course an understanding of the fundamentals of e-sourcing and its impact on the sales and purchasing functions of the firm (Foster and Lin, 2005). We also wanted students to know the history of reverse auctions as one of the contemporary e-sourcing options. Finally, we wanted students to be familiar with applications of reverse auctions across industries.

For the second learning goal category we wanted students to understand how to inquire about a new subject. We wanted to provide the student the opportunity of conducting independent research and being a self-directed learner. Table 2 is a summary of the assigned research papers.

Table 2 – E-sourcing Project
Assigned Research Papers and Presentations

1. The objective of the first research paper is to become familiar with the broad area of e-business. The topic areas which you will investigate include (10 pages):
    - a clear definition of e-business
    - what are the advantages and disadvantages of using e-business
    - what technologies mat be used
    - the relationship between logistics and e-business
    - other related topics of importance to the success of the firm
2. The objective of the second research paper is to distinguish the differences between (3 pages):
    - RFQ
    - RFP
    - RFI
    - Sealed Bids
3. The objective of the third research paper is to report (8-10 pages):
    - the product/service specifications of the selected product and service
    - the identity of 3 potential suppliers for the product and the service
    - the evaluation of each of the suppliers according to supplier criteria using either the categorical method, the cost-ratio method, or the linear averaging method
4. The objective of the fourth research paper is to distinguish the differences between traditional purchasing methods and "e" purchasing methods (8-10 pages).
    - the differences
    - the advantages and disadvantages of each
    - how would you determine the appropriate application for each
    - integrating traditional and "e" into a comprehensive purchasing strategy

The objective of the first research paper is for students to become familiar with the broad area of e-business. The objective of the second research paper is for students to be able to distinguish the differences between a request for quotes (RFQ), a request for a proposal (RFP), a request for information (RFI), and a sealed bid. The objective of the third research paper is for students to become familiar with evaluation criteria for suppliers. The fourth research paper requires students to distinguish between traditional purchasing methods and "e" purchasing methods (Gattiker, Huang, and Schwarz, 2007).

Along with the assigned research papers, independent analysis and critical thinking was required by students for a business situation reported in the local newspaper (Harrington, 2005) entitled "Three local firms asked to bid for Dell Construction." As part of the final examination administered in the courses, students were asked to analyze the opportunities and challenges for a firm anticipating using a reverse auction bid to choose a supplier. In addition to the case, the final examination included a post assessment of the students' perceptions, attitudes and experience concerning online auctions.

In addition, for the second learning goal category we wanted students to understand how to explore a new technology. We wanted to provide the student the opportunity of being a self-directed learner in the context of a technology-driven learning experience. Thus students were required to complete

an on-line tutorial for the use of the reverse auction program. The online tutorial was assigned prior to hands-on computer training offered by the software manufacturer.

For the third category of learning outcomes, the application of knowledge, we planned a "Live" Bid day exercise. We wanted our students to experience developing (purchasing students) and responding to (sales students) a request for proposal. In addition, we wanted the students to be familiar with software specifically developed for the reverse auction process. A one-year user's license was purchased for RFQHosting (www.rfqhosting.com), a privatized web-based system, developed and hosted by Roanoke Electric, LLC, that enables businesses to purchase products and services using electronic commerce. RFQHosting is designed to connect suppliers (salespeople) with buyers (purchasing agents) via reverse auctions or sealed bidding online, in an easy-to-use electronic format. The RFQHosting bidding process can be augmented with face-to-face meetings and/or emails.

RFQHosting training was facilitated using several venues. First, a one day train-the-trainer session was held for interested Faculty and Staff. Next, an in-class presentation was designed and held early in the semester where an overview of reverse auctions was presented by RFQHosting staff to the combined sales and purchasing class at the start of the semester. After the students completed independent research and article reviews about reverse auctions during the semester, the students were required to access and complete the on-line tutorial. Following the completion of the on-line tutorial, the staff of RFQHosting held another on-site training session with the students.

The sales and purchasing class students were trained separately in computer labs using a "mock" reverse auction bidding session. The independent research and article review assignments completed earlier in the semester were used as preparation for a "live" bidding session. The instructors selected the industry and provided the parameters of the products and services to be open for bid. The purchasing class was required to prepare an RFQ and post it to selected suppliers (sales class students) via RFQHosting. The sales class was required to respond to it over the course of a pre-disclosed window of time in which the bidding session was open.

The students were given the day and time that the bid window would be open. At the top of that hour the students had to post their bids and manage the continuous bidding information being fed to them via real time access to bid decisions. During that hour they had the opportunity to respond to the bidding information, resubmitting lower bids and asking questions of the purchasing agent responsible for the RFQ.

For the fourth category of learning goals, learning about oneself, we wanted to add a reflective component. Here we hoped students would address their comfort with technology as well as comfort with the negotiation process. Given this is the career preparation and an applied project; we also wanted students to reflect on their perceived fit with their respective profession. Students had an exercise in the early part of the course where they were asked to reflect on their negotiation style. Midway through the semester, a technology use reflection was encouraged. Students had an exercise at the end of the course where they were asked to reflect on the reverse auction project as a whole. The students were required to write a final reflections paper to describe the process and outcomes related to participating in the e-sourcing project.

Relationship building is an important competency area for students preparing for boundary spanning roles such as purchasing agents and professional salespeople. In a reverse auction context, specifically we want students to understand the real-world issues related to who gets invited to bid

and how to get invited to bid. Here the concern is for a clearer connection of the importance of relationship building even in a technology-oriented interaction. We feel that the students need to understand that beyond the computer hardware and software of the reverse auction technology, one has to connect as people. Thus students were assigned a face-to-face meeting to obtain feedback from the purchasing agent about the bid process. In part we want students to learn about navigating market dynamics and the balance of power from a relationship perspective. The face-to-face meetings will also be used to demonstrate how to conduct professional needs identification sales calls and bid follow-up meetings.

Step 4: Feedback and Assessment Procedures

Students were given pre- and post-assessments of perceptions, attitudes and experience of online auctions**.** A summary of the results is presented in Table 3. The auction awareness survey was based on an instrument developed by Bosnjak, Obermeier, and Tuten (2006) to assess perceptions of bidding, willingness to bid, and bid behavior. The paper and pencil survey was deliberately scheduled for the first day of class and the last day of class. Responses were measured using a seven point likert scale (1 = strongly disagree to 7 = strongly agree). Students indicated an increase in understanding of the theoretical and practical issues associated with the use of reverse auctions. In addition, students indicated that the course experience was positive and will be useful as they become practicing professionals in today's e-commerce environment.

Table 3 – Pre and Post e-Sourcing Project Assessment
1 (Strongly Disagree) to 7 (Strongly Agree)

Reverse Auction Perceptions	**Pre**	**Post**
1. I understand how the reverse auction bidding process works.	1.70	6.30
2. Non-price attributes (such as quality or delivery terms) can be used in reverse auctions.	3.60	5.50
3. Buyers and Sellers should communicate after the reverse auction process finishes.	3.20	5.00
4. Over time reverse auctions are less effective at making good deals.	2.90	5.50
Course Experience		
5. The experience of participating in a reverse auction is valuable.	3.80	5.70
6. I think learning about reverse auction will be a valuable experience.	4.60	5.90
7. I hope to learn more about the reverse auction after the course ends.	4.70	5.80
8. I am satisfied with the reverse auction being a part of this course.	4.20	5.20
Usefulness		
9. I intend to participate in reverse auctions after this course	3.20	5.60
10. The reverse auction experience will be useful information for me to apply after this course ends.	3.90	4.30
***Results based on 30 Professional Sales and 10 Purchasing Students**		

Limitations and Conclusion. The primary goal of the e-sourcing project was to provide students with an understanding of the motivations, challenges, and experiences of buyers and sellers using online reverse auctions based on a Business-to-Business context. The underlying rationale of asking students to participate in a reverse auction project was to help students acquire the capacity to act as a practicing e-commerce professional in the buyer and/or seller role. The use of a comprehensive instructional design guided the development of learning goals, learning activities, and assessments while accounting for contextual factors. The learning activities were assigned across a 16 week semester timeline.

The development of the e-sourcing project for undergraduate college students was limited by several factors. The make-up of the university's student body, the accreditation status of the business school, and the class size are factors that motivate and in ways constrict the design of the course. In addition, in an effort to restrict the focus to the topic of reverse auction, the faculty team decided from a project perspective to limit the connection of reverse auctions as an e-sourcing strategy with other possible sourcing strategies. However, as professionals the relationship established between buyers and sellers are still an important element in e-sourcing regardless of the technology infused into the process. To further this learning outcome we integrate face-to-face meetings with the e-sourcing bidding process.

In conclusion, as companies face the dual tasks of managing an ever expanding supply chain and reducing costs, technology becomes an indispensible tool for sales and supply management professionals. Electronic reverse auctions are one example of the technology that graduates entering the workforce are expected to have a working knowledge of to assist in the performance of their professional duties. To meet the demands of the workplace we developed an e-sourcing project using a comprehensive instructional design process. Faculty can develop appropriate learning activities in order to create new learning environments that recognize the value of instructional technology in the teaching process and assist firms in their talent management processes as they seek to improve firm financial and operational performance.

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Supply Base Complexity and Sustainability Disruption Risk

Ednilson S. Bernardes, Ph.D.
Georgia Southern University
+1-912-478-5375 ebernardes@georgiasouthern.edu

Marco Habermann, Ph.D.
University of South Carolina
+1-803-777-6495 marco.habermann@moore.sc.edu

Abstract. This working paper presents an overview of our research attempt to examine and integrate risk, sustainability and complexity in supply networks. The propositions developed theoretically in this study contribute a basis for empirical work that would explore the impact of supply base complexity on the level of what we refer to as sustainability disruption risk. The key issue addressed is the relationship between the degree of complexity in the supply base and the level of sustainability supply risk resulting from the association of a focal firm with suppliers. Our focus on sustainability supply risks represents an increasingly important, but relatively unexplored, area of concern for supply chain managers.

Supply base complexity and sustainability disruption risk. The supply chain literature has reflected the emergence of three critical issues that are shaping the way supply chains are managed. These issues are: supply chain sustainability, supply chain disruption risk, and supply chain complexity. The management of each of these individual issues is paramount for supply chain managers. However, in this research, we propose that all three of these key issues maybe interrelated in non-trivial ways and, therefore, should be considered holistically to spur improved development and to facilitate the implementation of effective interventions. The study aims at developing concepts and theoretical propositions that will form the basis for subsequent empirical work to explore the impact of supply base complexity on the level of what we refer to as sustainability disruption risk.

Social and environmental values have become critical competitive requirements for many companies (Hanna and Newman 1994; Berry and Rondinelli 1998; Angell and Klassen 1999; Brio and Junquera 2003). Some proactive firms have implemented sustainable management practices motivated by self-regulation (Hillary and Thorsen 1999), whereas others have responded to pressure from stakeholders including customers, governments, and non-governmental organizations (NGOs). These stakeholders have demanded increasingly higher social and environmental standards (Pagell et al. 2007), wherein sustainable corporate practices and behavior are rewarded, and questionable corporate practices are criticized, particularly by NGOs (Spar and Mure 2003). For instance, surveys report that as many as 75% of customers declare that their purchasing decisions are influenced by a company's reputation with respect to the environment, and 80% of customers declare their willingness to pay more

for products that are environmentally friendly (Drumwright 1994). This marketplace context has brought a new dimension of risk to the forefront of a supply manager's attention.

Supply chain risk and risk management have also become topics of great interest in recent years (Christopher and Lee 2004; Wu et al. 2007). As such, various studies have started to address aspects of supply chain risk; some have focused on the identification of risk sources (Ritchie and Bridley 2007) and risk management techniques (Kleindorfer and Saad 2005; Christopher and Lee 2004; Zsidisin et al. 2004), and others have focused on the negative impact of supply chain disruptions on financial and operational performance measures (Hendricks and Singhal 2005). Several current economic developments have added to the importance of risk management in supply chains: outsourcing, globalization of markets, and increasing reliance on suppliers (Narasimhan and Talluri 2009). These economic developments reflect supply management efforts to improve efficiency and achieve responsiveness. However, the pursuit of efficiency and the growing importance of social and environmental practices add new dimensions to risk management in supply chains and increase the complexity of the supply base.

The same economic developments that are critical for supply chain risk have also led to increasingly complex and dynamic supply networks that consist of more dyads, are more global, and have reduced buffers (reflecting efforts to improve efficiency, such as lean management and JIT inventory). Accordingly, a growing number of studies propose complexity as the main driver of supply chain risk (Choi and Krause 2006; Hoole 2006; Christopher and Lee 2004; Wu et al. 2007; Juettner et al. 2003). This link between complexity and risk highlights the need for a systemic view regarding design decisions on supply chain management, which becomes even more important due to a new type of risk brought by growing social and environmental values – to which we refer as sustainability disruption risk in this study.

Sustainability risk and supply base complexity. The supply base – those suppliers that are actively managed through contracts and the purchase of parts, materials, and services (Choi and Krause 2006) – impacts the focal firm's products, production waste, and disposal (Handfield et al. 2002). The level of this impact has heightened as firms have turned their focus to their core competencies. In doing so, these firms have transferred a significant portion of their value-added activities involved in satisfying the final customer (e.g., manufacturing and design) to the supply base. In turn, operations and supply managers have realized that social and environmental risks can be passed on to their firms through suppliers (Handfield et al. 2005). Along with a concentration on core competencies, the globalization of large companies and their supply networks has led to more firms operating in countries with very different (and many times lower) standards of living than those found in their domestic base (Smith 2003). Therefore, social and environmental pressures in the broader context of the supply network comprise a newly important source of supply risk for a focal firm. As such, safeguarding the firm's reputation and brand image has become crucial (Jennings and Zandbergen 1995; Smith 2003). Thus, globalization and the fragmentation of the supply base have increased its

complexity and the disruption risk in general and disruption risk related to social and environmental aspects surrounding the supply base in particular.

Disruption risk tied to sustainable practices is a critical consideration. The possibility of these disruptions adds to the challenges imposed upon supply managers because, despite all efforts to improve social and environmental performance and to select sustainability-conscious suppliers, a focal firm may still be penalized by customers and other stakeholders for a *supplier's* actions that are not considered socially responsible (Smith 2003). This new dimension of risk is compounded by the increased frequency of interaction with and the nature of the supply base, which presents characteristics of a complex adaptive system.

Complex adaptive systems and dimensions of supply base complexity. Firms are embedded in networks of cooperative and competitive interactions with other organizations (Hakansson 1987). A network consists of nodes (positions occupied by firms) and links (relationships) manifested by the interaction between nodes (Thorelli 1986). A business network is conceptualized as sets of connected interactions among firms (Anderson et al. 1994; Emerson 1981), wherein firms in a single focal dyadic relationship are also involved in other interactions that are connected to the focal relation (Hakansson and Snehota 1995). These connections have further ramifications for indirectly connected dyads (Wilkinson and Young 2002). As such, the relationships maintained by a focal firm originate interconnected webs described as supply networks (Hakansson and Ford 2002) that directly and indirectly impact the activities of a focal firm and that behave as complex adaptive systems (CAS).

The ability of a system to emerge and adapt over time into a coherent form without any singular entity deliberately managing or controlling it is one of the major characteristics of a CAS. For instance, a city is the result of intense and self-organized interactions between various groups of its inhabitants. Thus, one of the major tenets of the CAS perspective is the notion that order is an emergent property of individual interactions between the elements within a system — i.e., complex adaptive systems are self-organized.

In the context of a supply base, each supplier constitutes a system trying to cope with the complexity of its environment in order to either achieve an adequate level of fit with it or to achieve a degree of autonomy with respect to potential constraints that the environment might impose (Varela, Thompson, and Rosh 1991). These dynamics of complexity and its dimensions have consequences for a focal firm. Choi and Krause (2006) define the level of supply base complexity as a function of the following dimensions: the number of suppliers in the supply base, the level of supplier interaction, and the degree of differentiation among suppliers. Each of these dimensions may lead to a different impact on the level of sustainability disruption risk and may interact differently with other characteristics of the supply base of a focal firm.

Conceptual Model. The proposed research is summarized at a high level in the conceptual model seen in Figure 1. Supply base complexity impacts the levels of sustainability risk. In general, complexity makes the management of supply chains more difficult and ambiguous, leading to higher risk levels (Choi and Krause, 2006). In particular, a complex supply base elevates the risk of an event regarding the social or environmental aspects of supply chain sustainability. Sheffi (2006) pointed out that supply chains are only as strong as their weakest link, which is particularly true for supply chain sustainability. Sustainability issues in an individual dyad (even far upstream in the supply chain) have the potential to negatively impact the reputation and performance of a focal firm in the network as whole. However, certain dimensions of complexity may have a counter intuitive effect on the level of sustainability risk. We argue that the aggregate effect of those dimensions impact the supply chain performance. In the empirical framework, we further differentiate between the complexity dimensions, evaluating their individual contributions to sustainability risk and their potential interactions as drivers of sustainability risk.

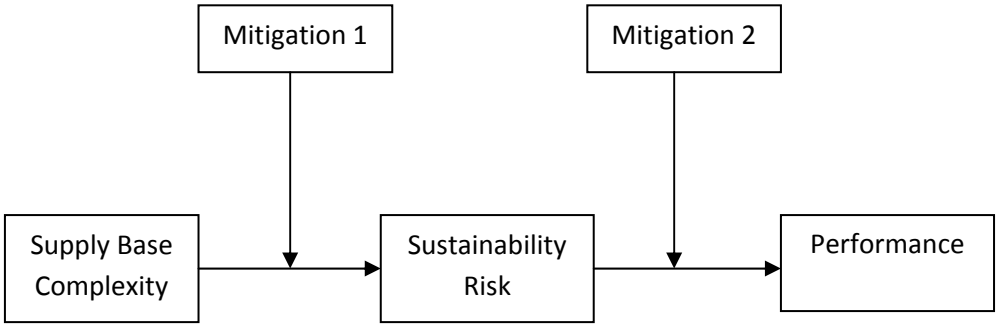

Figure 1: Conceptual Model

The literature points out that sustainability in business has three major aspects: the natural environment, society, and economic performance (Carter and Rogers 1998). These aspects are subsumed on the concept of the triple button line proposed by Elkinton (1998; 2004) and they reflect the challenges faced by supply chain managers. Supply management will be increasingly charged with managing not only short-term financial goals, but also social and environmental risks posed by a focal firm's interactions or associations with the supply network. Thus, the management of sustainability risk should be impacted by the level of complexity of the supply base and this should impact the various measures of supply chain performance. However, different dimensions of complexity and decisions to cope with them may impact the sustainability risk of a supply base differently. The detailed framework and empirical propositions will be presented during the symposium. Our overall propositions derived from our conceptual model are as follows:

Proposition 1: Supply base complexity impacts the level of sustainability risk, but the impact will vary across the different dimensions of complexity.

Proposition 2: Higher levels of sustainability risk are negatively related to supply chain performance.

As part of our framework, we also propose to investigate two separate mitigation areas. First, we focus on the relationship between complexity and sustainability risk. As such, mitigation tools need to focus on the effective management of supply base complexity and are based on systems theory. Second, existing supply chain risk management approaches need to be adjusted to manage the link between sustainability risk and performance. Based on Miller's (1992) work, Juettner et al. (2003) categorize mitigation techniques into four strategies: avoidance, control, co-operation, and flexibility. The avoidance technique involves dropping specific products, suppliers, markets, or geographic areas if the levels of disruptions risk are considered unacceptable by the focal firm. Alternatively, firms may seek to control the contingencies that lead to disruption risk through vertical integration, stockpiling, buffer inventory and capacity, or contractual requirements for suppliers. Co-operation aims to increase supply chain visibility and understanding through the sharing of information. Flexibility, in this context, includes postponement and multi-sourcing strategies. In general, a simplification of the system naturally reduces its complexity (Perrow, 1999). In a supply network context, reducing complexity requires adjustments on its size, heterogeneity, interdependencies or coupling. Importantly, the dimensions of complexity are interrelated and the latent trade-offs between the dimensions need to be considered. The mitigation tools will be examined regarding their ability to overcome the impact of the individual complexity dimensions, resulting in a differentiated assessment of their applicability and effectiveness.

Proposed method. Conceptual theory building is used to develop a framework and propositions representing sustainability management risk. Specifically, we have conducted a content analysis to identify or develop definitions to describe sustainability risk and have reviewed the relevant literature to develop and propose a conceptual framework to examine the interplay between sustainability risk and supply base complexity. To develop the framework, we integrated elements from the literature on risk management, supply base complexity, and sustainable supply chain management by summarizing common elements, contrasting differences and extending existing theory. After refining the conceptual framework, we plan to take testable hypotheses from the framework to perform initial empirical tests. Empirical methodology will be used to test if the proposed relationships hold in the external world. The data is being collected through a large scale survey. Initially we will perform an exploratory data analysis. If the data is deemed appropriate, we will assess the dimensionality, validity, and reliability properties of the measures representing the theoretical concepts used in the portion of the framework on which we are going to focus initially. Once the scales have been purified and the psychometric properties of the scales have been established, we will examine the relationships proposed in the framework through structural equation modeling and other linear statistical models.

Summary. This study aims at contributing to nascent supply base management theory by conceptually integrating it with risk theory and sustainable development studies so we can examine how the different dimensions of complexity affect sustainability disruption risk, what

mitigating strategies are available, and potential outcomes. One important aspect of sustainability disruption risk management is the interplay between the various dimensions of supply network complexity and their potential effects on sustainability disruption. By grasping this topic, managers and researchers can develop effective mitigating strategies. This is timely, as the notion that an organization must manage not only short-term financial results, but also risk factors such as harm resulting from its activities on social and environmental aspects surrounding its supply network is gaining momentum. As corporate critics, social investors, activists, and customers who claim to assess sustainable practices when making purchase decisions pressure firms for enhanced sustainable practices, a framework that frames the interplay between supply base complexity and sustainability disruption risk should assist supply managers and researchers in developing effective interventions.

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Effects of Sales Incentives on Supply Chain Financial Risk

Christian L. Rossetti
Assistant Professor
Department of Business Management
College of Management
North Carolina State University
Campus Box 7229
Raleigh, NC 27695-7229
christian_rossetti@ncsu.edu
919.513.3867 (tel)
919.515.6943 (fax)

Abstract. This research examines the effects of quarterly sales incentives on supply chain and financial risk. Companies frequently incentivize sales employees to reach quarterly and yearly goals. In order to achieve sales goals, sales employees often offer incentives to customers to increase orders. This creates pronounced seasonality in demand, which forces supply chains to choose between chase and level strategies. The operational implications of either strategy fairly well understood; the impact on revenue, costs, profit, and ultimately unit price are not. Using sales, cost, and operational, data from a large computer manufacturer, a stochastic model of the company's supply chain is created for its largest product line. Financial and operational metrics are measured over seventy-five weeks for 10,000 simulations. Results show that cash flow as well as unit price varies widely throughout the year. Perhaps more importantly, if the company is unable to incentivize demand for one period, cash flow is severely disrupted and inventories rise considerably. If one extrapolates these results, the firm's supply chain and balance sheet would be severely impeded.

Introduction. Many companies use monthly and quarterly sales incentives to meet corporate revenue goals. The purpose of these incentives is to ensure that sales efforts result in revenue that meets the expectations of the Wall Street analysts and the company's shareholders. These incentives require sales personnel to reach certain targets or quotas by the end of the prescribed period. Sales personnel that fail to reach goals do not receive bonuses and may be targeted for termination. When the sales department as a whole is having trouble meeting its revenue goals, upper management may authorize price or non-price incentives to stimulate demand.

Stimulating demand through marketing incentives can create several problems. First, the market comes to expect sales incentives around the end of the period. Customers then forestall purchases until the end of the period in expectation that the price will be lower or terms and conditions will be more favorable. This creates seasonality in demand. Demand

spikes at or around maximum incentives and then falls off rapidly. This makes forecasting difficult due to predicting the effectiveness of market stimulants. Second, as more customers purchase with favorable pricing or terms and conditions, the profit margin of the items sold decrease. This makes budgeting particularly difficult since upper management cannot accurately predict unit margins. Third, the company's supply chain must operate under these artificial seasons. Using flexible manufacturing systems or anticipatory inventory, the company must match supply to demand. This creates extra costs due to temporary workers, overtime, subcontracting, or increased inventory holding costs. These three problems have been identified in the research and practitioner literature.

The interaction of these three problems and their combined effects are not well understood for extended supply chains. This research attempts to provide insights into the effects of sales incentives on operating income, cash-flow, and unit profitability when an extended supply chain induces lags in accounts payable and accounts receivable. This leads to three related research questions:

Research Questions.

- What are the effects of sales incentives induced seasonality on income and profitability measures?
- How sensitive is cash-flow to changes in operating expenses, days payable, and days receivable?
- Can sales incentives create a systemic risk to earnings that should be reported per Sarbanes Oxley, given certain supply chain as well as firm specific financial characteristics?

Methodology

Case Description. This research is built on a single case derived from a large computer hardware manufacturer. The company has multiple product and service lines and revenue in excess of $10,000M. Throughout much of its history, sales incentives have been used to manage revenue. These incentives have created regular peaks and troughs throughout the year. Previously, manufacturing managed these peaks and troughs through lead time management – effectively smoothing satisfied demand throughout the quarter. With increased global competition combined with flexible manufacturing practices, lead-time has been reduced to approximately ten days for all customer orders. Due to shortened product lifecycle, building inventory during the trough is very risky. Therefore, the company operates a highly flexible supply chain. Previous internal analysis showed that this flexibility costs the company a fifteen percent premium on operating expenses. Upper management deemed that these costs were acceptable.

Although average costs were acceptable, the previous analysis could not determine the financial risks associated with the current sales and supply chain strategy. After conversations with several high-level supply chain managers and ascertaining data availability, it was decided that a stochastic model employing Monte-Carlo simulation would be best suited to answer the research questions. This case relies on confidential data that containing sales history, cost history, operating strategy / tactics, and relevant managerial

experience. The data has been disguised to maintain confidentiality. A single representative product line is evaluated to ease modeling specification and interpretation of results.

Forecast. Historical data was used to evaluate the degree of seasonality. An autoregressive moving average (ARMA) forecast was used to determine appropriate seasonal factors and trends within the data. Weekly sales data were analyzed to determine the ARMA coefficients. A web:reg MS Excel Add-in written by Kurt Annen (see www.web-reg.de) was used to perform the ARMA analysis.

The following plot and output demonstrate the seasonality of the sales history. Repetition of the seasons occurs at monthly and quarterly intervals. The general level of future sales is best predicted by the fourth and fifth week in the cycle.

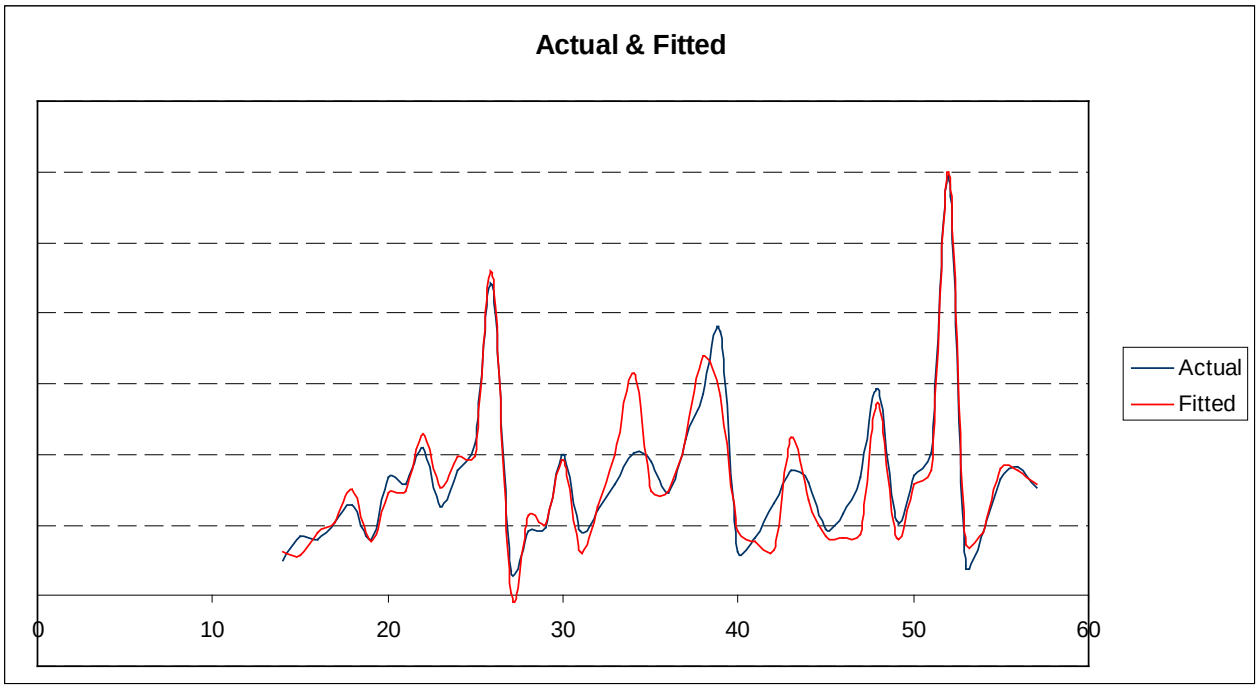


Figure 1. Plot of weekly demand vs. actual sales for a single year

Table 1. Parameters from autoregressive moving average regression

timeseries: y
Method: Nonlinear Least Squares (Levenberg-Marquardt)
date: 07-26-08 time: 13:38
Included observations: 44
p = 13 - q = 6 - constant - manual selection

	Coefficient	Std. Error	t-Statistic	Prob.
c	confidential	confidential	8.01	0.00
AR(1)	-0.04	0.12	-0.30	0.77
AR(2)	0.01	0.12	0.08	0.94
AR(3)	-0.04	0.09	-0.45	0.65
AR(4)	**-0.20**	**0.09**	**-2.24**	**0.03**
AR(5)	-0.06	0.10	-0.57	0.57
AR(6)	-0.01	0.12	-0.04	0.97
AR(7)	**-0.19**	**0.12**	**-1.60**	**0.12**
AR(8)	0.03	0.12	0.23	0.82
AR(9)	-0.05	0.11	-0.44	0.67
AR(10)	-0.11	0.12	-0.91	0.37
AR(11)	-0.05	0.13	-0.38	0.71
AR(12)	0.08	0.12	0.64	0.53
AR(13)	**0.94**	**0.11**	**8.29**	**0.00**
MA(1)	-0.25	0.31	-0.82	0.42
MA(2)	0.02	0.32	0.06	0.96
MA(3)	0.41	0.27	1.49	0.15
MA(4)	**1.01**	**0.27**	**3.77**	**0.00**
MA(5)	**-0.54**	**0.32**	**-1.68**	**0.11**
MA(6)	-0.42	0.35	-1.20	0.24

Model Specification. The model is a simplified version of the company's supply chain. The company subcontracts two major components, mechanical and electrical to Eastern Europe and Asia respectively. These subassemblies are then shipped to final assembly in the company's major market. Final assembly then ships the assembled product directly to customer as well as to intermediaries. Because incentives often push intermediaries to purchase more product then the market will bear, the company experiences a significant return rate. The model uses the following parameters to capture costs and lags within the supply chain.

Table 2: Model Parameters

Demand	Manufacturing Data	Financial
Base Demand Level	Starting Inventory	Costs
Skew Factor	MRP Units Requested	Final Assembly Costs
Forecast Error	Assembly Lead Time	Final Assembly Average Payables (weeks)
Forecasted Demand	Shipping Lead Time	Shipping Payable
Returns	Units Assembled	Shipping Average Payables (weeks)
Returns Threshold	MFG Fixed Cost	Supplier 1 Accounts Payable
Operating Profit Discount	MFG Variable Costs	Supplier 1 Terms (weeks)
Discount Impact Factor	Units Shipped	Supplier 2 Accounts Payable
	Shipping Cost	Supplier 2 Terms (weeks)
	Units Expedited	Returns Accounts Payable
	Expediting Surcharge	Returns Terms (weeks)
	Inventory Safety Factor	Period Unit Costs
	Ending Inventory	52 Week Moving Average Unit Costs
	Holding Costs	
		Revenue
	Items Specific to Final Assembly	Operating Profit
	Percent Returns Resaleable	Accounts Receivable
	Lag of Returns to Ship Date	Net Cash Flow

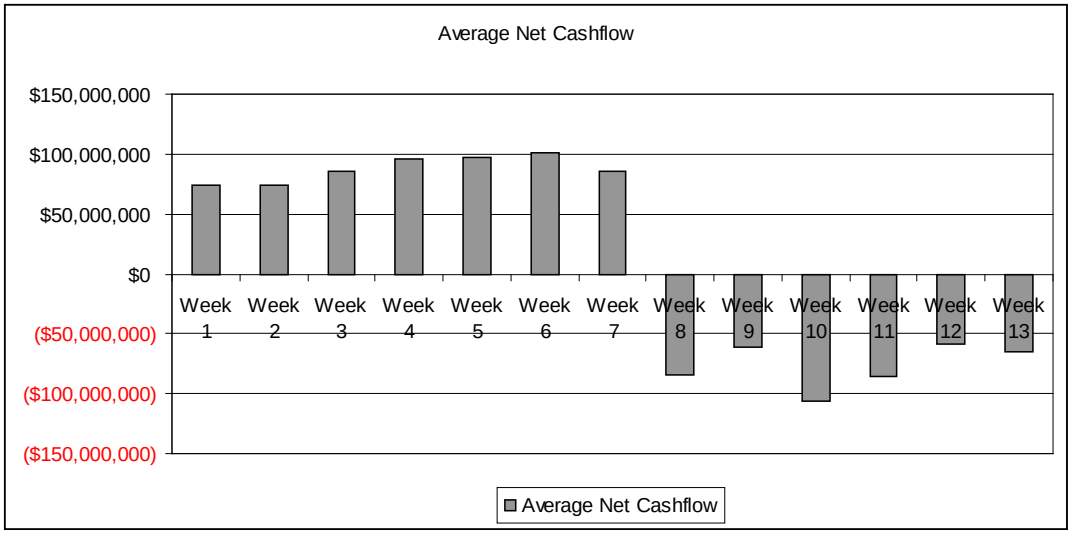
The supply chain was modeled using Monte-Carlo simulation. Monte-Carlo simulation uses multiple repetitions of an analytical model to determine the distribution of key outcome variables. Using historical or estimated values, input variables are assigned stochastic distributions. With each repetition, these variables are altered. Each repetition constitutes an experiment. The output variables can then be analyzed using standard statistical techniques.

The major variables manipulated were the degree of demand seasonality (difference between trough and peak), returns, and demand split between two customer types. The company's supply chain was simulated over five quarters for 10,000 replications.

Results. Preliminary results show that cash flow is highly variable throughout the year and the quarter. This variability is primarily due to the increased sales towards the end of the quarter coupled with lags in receivables, payables and returns. The results show that returns and payables simultaneously hit towards the end of the quarter. Weekly cash flow ranges from +$100M to -$100M. Unit cost varies between $750 and $2000. Over 10,000 simulations, the fifty-two week average unit costs has a standard deviation of one percent. Though a one percent standard deviation in unit costs may appear small, it creates a standard deviation of year end operating profits of approximately $42M.

The results demonstrate that although the company's incentives have allowed it to make its top-line, the incentives have severely impacted its bottom line. The following chart demonstrates the variability of weekly cash flow.

Figure 2. Average Weekly Cash Flow



Discussion and Preliminary Conclusions. The preliminary results show that cash flow, unit costs, and operating profits vary widely. The largest contributor to these is demand variability coupled with lags in receivables and payables. The implication is that if during a specific quarter the company cannot stimulate the market sufficiently, cash flow will be severely impacted.

Since the company relies heavily on sales at the end of the quarter, any decrease in demand is very difficult to predict. This is evident by the ARMA analysis. The company must rely heavily on the previous quarter's data to predict what the future quarter will bring. In high-tech, where sales can shift rapidly, this can create a severe impact on quarterly results. For example, if demand were to precipitously drop the company's earliest indication would be a change in demand's four-week moving average. However, given the standard error of four-week moving average, it is unlikely that this change would be perceptible to forecasters. The earliest perceptible indication would be if month-end numbers declined precipitously. However, given the lead-times, suppliers would already have committed to a significant portion of the MRP schedule.

Given the company's size and its reliance on software, hardware and services, it is difficult to say if this impact on quarterly results represents a material risk. The company could lower this risk through a mixed strategy of decreasing quarterly sales incentives and increasing promised lead-times to customers that order late in the quarter.

Process-Oriented Supply Risk Management: An Analysis of What Constitutes Excellence in Supply Risk Management

Kai Foerstl*
Doctoral Candidate
Supply Chain Management Institute (SMI)
European Business School (EBS)
Soehnleinstrasse 8
65201 Wiesbaden, Germany
T: +49 611 360 18 825
E: foerstl@supplyinstitute.org

Constantin Blome
Professor and Research Director
Supply Chain Management Institute (SMI)
European Business School (EBS)
Soehnleinstrasse 8
65201 Wiesbaden, Germany
T: +49 611 360 18 800
E: blome@supplyinstitute.org

Michael Henke
Professor and Research Director
Supply Chain Management Institute (SMI)
European Business School (EBS)
Soehnleinstrasse 8
65201 Wiesbaden, Germany
T: +49 611 360 18 800
E: henke@supplyinstitute.org

Keywords: Supply Risk Management; Capability Maturity Model; Best Practices; Case Studies

* Corresponding author

Working Paper

Abstract. Supply risk management (SRM) is on the rise as firms face increased risks due to outsourcing and an increasingly dynamic and complex business environment. Besides, supply chain risks and resulting disruptions are not only related to temporarily enhanced cost, but may endanger the existence of a firm. Many firms from different industries intensified their efforts in SRM during the economic crises. But so far – also because of the difficulty to assess the success of risk management approaches – a process standard for SRM has not yet been defined. Hence, different approaches for SRM in terms of scope, resource intensity and formalization exist, bringing different maturity levels of SRM systems to the light.
In this paper, we contribute to prior research by deriving a supply risk management capability maturity model (SRM-CMM). We derive the model based on established literature. The four core SRM processes to be assessed for maturity are risk identification, risk assessment, risk treatment and risk monitoring. Based on this model we explore the status-quo of maturity in SRM and determine best practices across different industries. Based on insights from multiple case studies we elaborate in detail on the best practices in SRM processes and the SRM maturity firms. Providing an overview over the significant spread of SRM processes proficiency we offer guidance to purchasing executives who seek to develop their SRM towards greater maturity.

1. Introduction. In turbulent times of financial crisis not only capital markets are affected, but also supply markets. Therefore, risk management plays an ever more important role in purchasing and supply management (PSM). Supply management professionals find themselves in a challenging environment. They must contribute to corporate performance through cost savings, working capital effects, and additional key performance dimensions such as quality, flexibility, and security of supply, while they are confronted with increasing supply chain risk and resulting disruptions. The consequences do not simply include direct financial losses, but also reputational damage and loss of goodwill with customers due to interruptions of operations from supply shortages as well as reduction in product quality. In many cases the impact of supply chain risks is much higher than that of internal operational risks (Tang, 2006).
As a result of the outlined circumstances and in particular its linking role between external supply markets and the internal customers, the PSM function must take actions to actively manage such organizational risk exposure. In particular, global enterprises which source from a global supply base face these challenges in a notable extent (Wagner and Bode, 2006). Within this context we rely on the definition of Zsidisin et al. (2004) who defined inbound supply risk as “the potential occurrence of an incident associated with inbound supply from individual supplier failures or the supply market, in which its outcomes result in the inability of the purchasing firm to meet customer demand or cause threats to customer life and safety”.
In fact, legal regulations such as the COSO report in the USA, the Turnbull Report in the UK and the German legislation of the KonTraG require firms to identify, communicate, and monitor functional risks (Pausenberger and Nassauer, 2000), yet these legislations overlook inter-firm risks (Lam, 2003). Therefore, these approaches only assure compliance with government legislation, but do not necessarily embrace the growing need to actively manage risks in the supply network. Still the COSO

framework and other European initiatives such as the KontraG are instrumental in transforming the discipline from a finance and engineering paradigm to a more company-wide and inter-company paradigm embracing every function (MacGillivray et al., 2007).

To this point in time there is no standard for supply risk management (SRM) established neither in research nor in practice. Across industries and even within one industry, there is a strong variance in SRM process maturity. Establishing and controlling SRM processes is difficult, thus, PSM executives require guidance how to master the strategic challenges they are facing when developing risk management processes for their global supply management organization.

Therefore, we developed a model that allows comparing SRM processes across companies of different industries in order to sharpen the conception of what distinguishes initial, basic, moderate, capable and superior SRM processes. The two specific research questions to be addressed in this paper read as follows:

1. What constitutes best practices in supply risk management across industries?
2. What is the variance of maturity in supply risk management processes across firms from different industries?

By addressing these research questions, we contribute to the gradual build up and diffusion of knowledge concerning SRM processes and standards. In the model we break down SRM into four subsequent processes (see Figure 1) namely 1. Supply risk identification, 2. Supply risk assessment, 3. Supply risk treatment/ response and 4. Supply risk monitoring.

The model allows exploration of the status-quo in SRM processes across firms of different industries displaying commonalities and differences between them. Based on the results of eight case studies from different industries we seek to provide guidance to purchasing executives who seek to develop their SRM process to enhanced maturity and effectiveness. The findings are valuable to a broad audience since we offer an overview of best practices in SRM across industries providing purchasing executives with a process benchmarking opportunity leading to the disclosure of paths for further improvement of their functions risk management capabilities.

The article is structured as follows: Firstly, the supply risk management literature will be shortly reviewed to develop the scoring grid for the SRM process capability assessment. We shortly elaborate on the multiple case study method enabling us to rate the SRM process maturity of firms along the four dimensions displayed in Figure 1. Afterwards, we will present the results of this investigation focusing on the best practices across firms. After condensing our findings the paper provides implications for management practice.

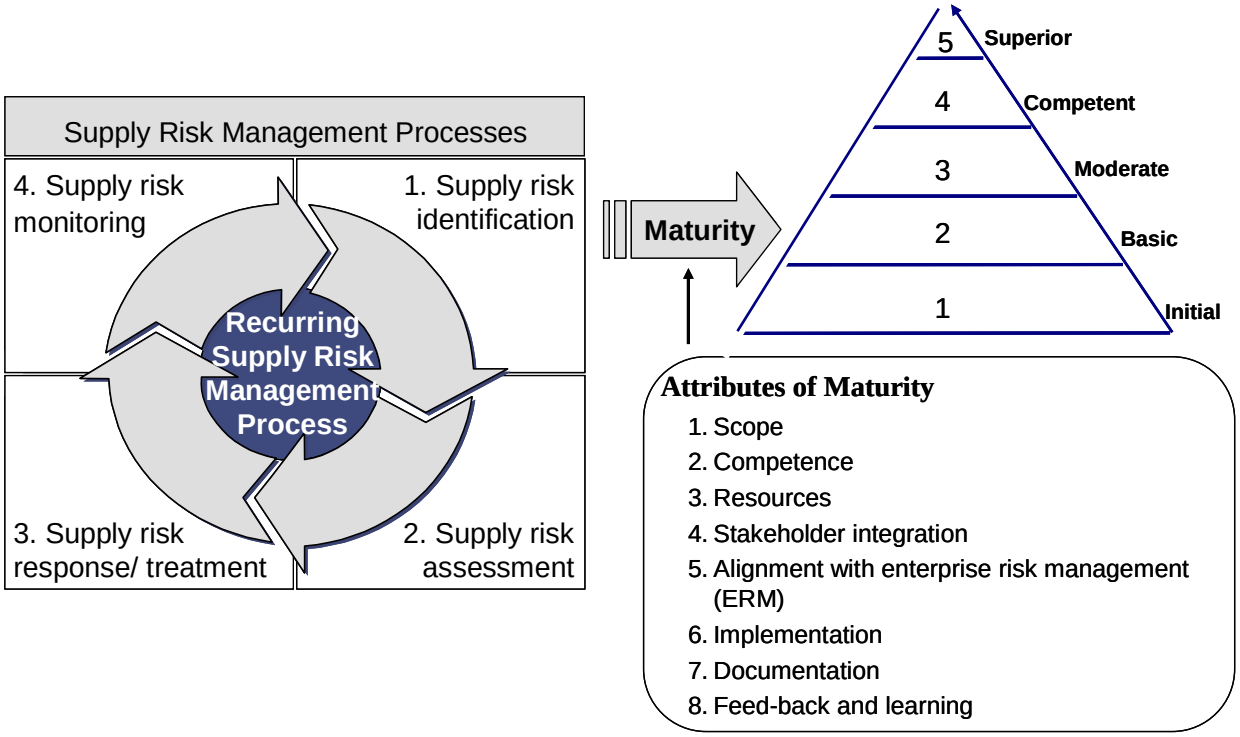
2. A Review of Supply Risk Management Literature. Risk management in supply chains is of growing importance. Essentially, scholars agree on the trends for this development: supply chain risk has grown (Jüttner et al., 2003), not only due to environmental uncertainty (Wagner and Bode, 2006), but also due to increased reliance on supplier production as part of firms' value adding processes (Harland et al., 2003; Christopher and Lee, 2004). However, the separate research stream and discussion on SRM has emerged only recently (Zsidisin and Smith, 2005; Zsidisin and Ellram, 2003;

Kull and Closs, 2008). Following the pioneering contributions of Ritchie and Brindley (2000) and Zsidisin et al. (2000), scholars delivered conceptual frameworks on SRM (e.g. Jüttner et al., 2003; Ritchie and Brindley, 2007).
Recent contributions highlight that firms must enlarge the scope of SRM beyond the risk inherent in direct or first-tier supplier relationships to the risk inherent in the entire supplier network (Hallikas et al., 2004). Despite these valuable contributions, knowledge about best-in class SRM is not well developed for two eminent reasons: (1) Several scholars only discuss specific SRM practices of the recurring SRM process, which provide a valuable, yet scattered and less process-oriented picture of SRM. E.g. Khan et al. (2008) discuss product design as risk mitigation strategy for supply chains. Other contributions focus solitarily on supply risk assessment techniques (Zsidisin et al., 2004), early supplier involvement and risk (Zsidisin and Smith, 2005) or supplier development as a supply risk mitigation strategy (Matook et al., 2009). (2) Only limited qualitative research on SRM emerged presenting detailed cases on how leading companies design their SRM processes. An exception is the contribution of Norrman and Jansson (2004) which elaborated on the whole SRM of the firm Ericsson. Also, Zsidisin, Melnyk and Ragatz (2005) focused on the whole process of business continuity planning with high commonalities to a risk management process.
We recognized that an approach allowing an integrated analysis of SRM core processes prevalent in companies across multiple industrial sectors is missing. To close this research gap we build on the supply chain risk management processes established by Ritchie and Brindley (2007), when defining the SRM processes as displayed in Figure 1. Moreover, we combine insights from the above mentioned contributions and beyond when developing the supply risk management capability maturity model (SRM-CMM).
The concept of maturity or proficiency suggests that organizations follow an identical sequence of changes towards greater maturity, consecutively integrating the achievements of earlier stages. As they pass through these stages, functions and organizations ultimately reach maturity, which is expected to result in enhanced performance effects of the respective processes (Keough, 1993; Rozemeijer, 2008). We relate our work to MacGillivray et al. (2007) who developed a comprehensive benchmarking of enterprise risk management (ERM) capabilities in the water utility industry. It is designed to help managers assess their process maturity, their weaknesses and strengths compared to their peers, identify improvement potential and set priorities to achieve higher maturity (Jokela et al., 2006). Based on the literature review we tailored their approach to the field of PSM as presented in the following section.

3. Development of the Supply Risk Management Capability Maturity Model. In our approach we adopt the notion that a firm which invests in strategies for managing supply risks will do better than firms that do not implement strategies and processes that enable active management of supply risks. While it is important to establish organizational structures and processes, one also needs to specify how core tasks and activities are controlled as a process. Thus, our assessment distils SRM in a process-based framework which enables a firm to establish their current level of maturity and to identify the necessary steps to progress to a higher maturity level. Hence, the

assessment according to our model provides guidance to PSM managers how to better identify and assess supply risks, which lead to more a more informed decision-making which will result in selection of successful risk response strategies and effective monitoring of supply risks across the supplier portfolio. The attributes of the four sub-processes of effective SRM are listed below. We based the attributes of maturity and the maturity stages on the prior works of MacGillivray et al. (2007).

Figure 2: The Supply Risk Management Capability Maturity Model (SRM-CMM)



3.1. Core Supply Risk Management Processes.

3.2.1. Supply Risk Identification. In the supply risk identification process firms work with risk checklists in category management to recurrently identify risks to be assessed closer in the subsequent process. In addition risk identification processes provide staff with the required tools and techniques such as scenario analysis or brainstorming creating awareness for formerly uncovered risks. This process requires stakeholder involvement from functions such as R&D and manufacturing at different stages of the sourcing and procurement process. For instance, in the sourcing of materials and services required to develop a new product purchasing should identify risks in cooperation with R&D whereas in the recurring procurement of components for regular process or serial production it is more important to involve manufacturing in risk identification. The identified risks are documented and disseminated to the respective functions involved in handling supply risk.

3.2.2. Supply Risk Assessment. After identifying supply risks, the next step is to conduct a detailed supply risk assessment. PSM should analyze the assessment process and techniques across purchasing category management and determine responsibilities. Depending on the specific type of supply risk the assessment may require input from other functions in order to determine a valid ranking of supply risks considering tolerability thresholds. This assessment tends to be based on the likelihood of occurrence and the impact of occurrence to determine the damage indicator in a supply risk matrix. The integration in IT tools such as supplier evaluation or supplier relationship management enables the timely assessment, documentation and reporting of supply risks - a success factor for timely development of response strategies

3.2.3. Supply risk response/ treatment. Having derived the supply risk profile, firms must consider ways of responding to the respective risks and their damage potential. Supply risk treatment options are typically tools and techniques from regular supplier and purchasing category management processes, but may also require the involvement of internal clients such as R&D, manufacturing or marketing. Based on the variety of treatment options as well as cost and benefit analysis, PSM management and/ or top management must decide upon a strategy and derive and document an implementation plan that is to be monitored in the subsequent step.

3.2.4. Supply risk monitoring. The PSM function is required to monitor the effectiveness of its responses to assessed supply risks, but also to monitor and trend the developments over time. The response to severe supply risks tend to be managed in a project structure also including project monitoring. Supply risks are to be closely monitored by category management, but may also be part of reporting to the Chief procurement officer or the risk and corporate board, depending on the damage potential analyzed in proceeding steps. Moreover, the greater the damage potential, the closer this particular supply risk must be monitored at the supplier level. Implementation of monitoring is supported by IT integration which enables timely information about the effectiveness of supply risk treatment strategies and the development of supply risk exposure over time.

3.3. Maturity Levels. We differentiate 5 maturity levels, which are applied to determine the maturity of each of the eight SRM processes.

Initial (1). Unstructured and ad-hoc approach of SRM. Limited knowledge prevents processes implementation, thus the process depends strongly upon individuals.

Basic (2). An essential understanding of the risk concept and the necessity of active risk management is established at PSM top-management. Still, basic processes with a narrow scope are in place which are not fully defined and not yet embedded in organizational culture. These processes are repeatable which lead to the possibility of further improvement and provide opportunities to further enhance the system as a whole.

Moderate (3). SRM processes are specific and clear responsibilities are assigned to employees to get actively involved. Clear policies and procedures are available to all staff (also from other functions) promoting controllability of processes. Supply risks are identified, assessed, responded to and monitored, yet the quality of individual processes is still variable. The implementation is verified by defined reporting. At present, continuous improvement is constraint by the enhanced focus on the execution of the relatively young processes. Risk management training and tools are available for designated employees. Verification and feed-back mechanisms are not yet well established.

Competent (4). A structured approach for all relevant SRM processes assures the effective and coherent implementation across category management. SRM processes reaches across functional units if required and involve experts from functional such as R&D and marketing at different stages of the sourcing and procurement processes. Advanced IT integration of SRM fosters the implementation of SRM in regular supplier evaluation processes. Soft factors are grasped in terms of training for SRM which further creates sensibility for supply risks and partial improvements of existing process strategies.

Superior (5). Firm's having attained the final maturity level in the SRM-CMM, are characterized by their ability to simultaneously focus on execution excellence of all SRM processes and the adaptability of these processes to changing conditions such as the financial crisis. The PSM function learns from past experience and adapts their SRM processes accordingly. Processes reach across organizational hierarchy and across functional units throughout the different stages of the sourcing and procurement processes. IT governance enables effective SRM and monitoring of supply risks at supplier level. Continuous improvement also includes the adaptation of incentive structures for employees in order to optimise risk management capabilities. There is a strong risk management culture due to long term investments made into the processes and the staff development to effectively execute these processes.

4. Research Method. A multiple case study approach was selected in order to explore the maturity of SRM processes across firms. The cases were selected to attain insights into SRM practices of firms from different industries. Ultimately, the purchasing executives of 15 European MNCs were approached via email and follow-up telephone calls to ask for their cooperation in the project (Dul and Hak, 2008). Out of these 15 firms 8 agreed to participate in our study and provided access to purchasing executives and archival data on condition of anonymity. With the PSM function as the unit of analysis, this approach enabled us to assess the applicability of the SRM-CMM to a broad range of firms. The profile of the participating companies is provided in Table 1.
We relied on on-site visits, semi-structured interviews with purchasing executives and archival data which allows for within case triangulation and cross case coding. The approach appeared to be most suitable to the purpose of this study, since research on how SRM processes are structured in organizations is still in an exploratory stage. Moreover, SRM involves the coordination of complex organizational processes which sometimes required clarification and follow-up questions. Thus, content validity was

best assured in the course of the personal interviews which proceed between August and November 2009. The interviews with at least one high level purchasing executive responsible for SRM lasted between 1.5 and 2 hours and were conducted by the same author. Notes of answers and on presented documents, such as risk management guidelines, supplier scorecards, were taken during the interviews. Right after the interviews, the notes were written up and rated according to the scoring grid for our SRM-CMM. The authors independently rated the maturity of the respective processes for each company. These observations were compared by the team of authors to assure inter-rater reliability. To further assure reliability a case database was set up in order to store all retrieved information (Gibbert et al., 2008; Yin, 2009).

Table 1: Profile of Respondents' Organization

Company name[a]	Bank-ingCo	Insur-anceCo	Fash-ionCo	Energy Co	Logistics Co	Elec-tronicsCo	Health CareCo	Auto-motiveCo
Number of employees at group level	> 50,000	>10,000	<10,000	>50,000	>200,000	>100,000	>50,000	>200,000
Annual sales revenue in 2007 in €	>20bn	>5bn	>1bn	>5bn	>50bn	>10bn	>10bn	>10bn
Total headcount in PSM	>50	<50	>100	>500	>2,000	>100	>100	>2,000
Purchasing volume in €	>1bn	<1bn	<1bn	>5bn	>10bn	>5bn	>5bn	>10bn

[a] Original company name is disguised. The chosen company name is based on each firm's industry classification.

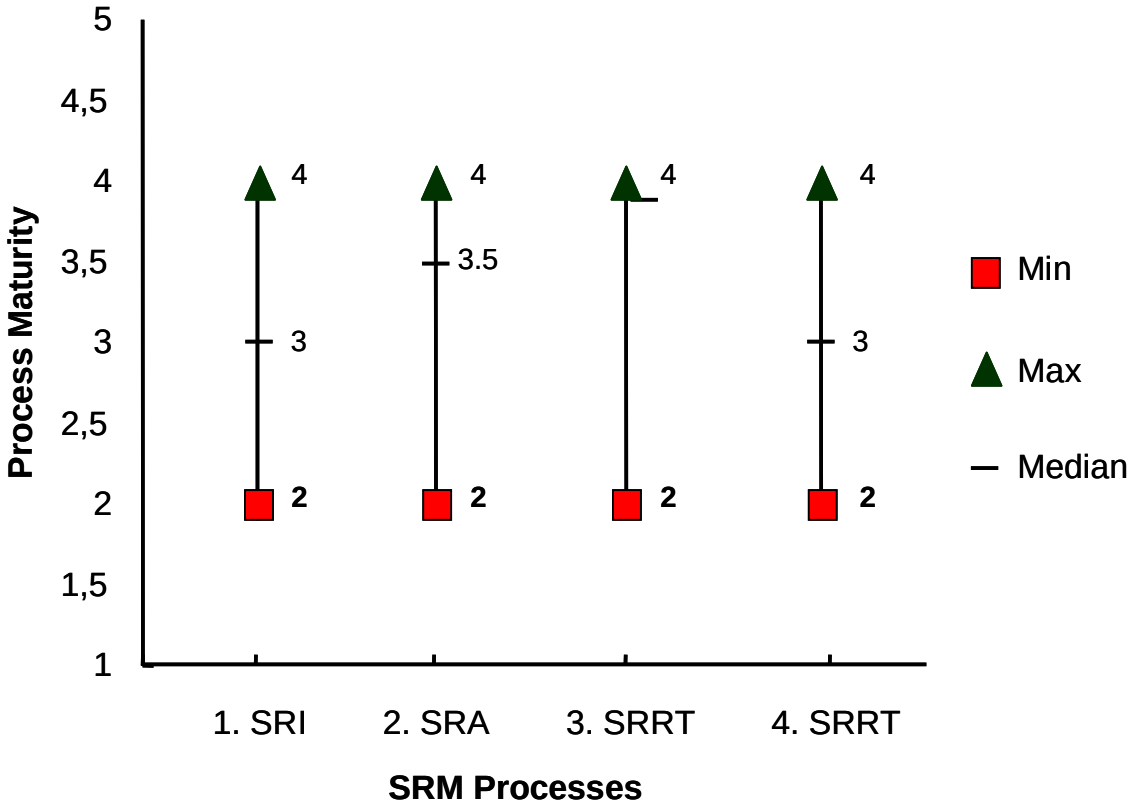
Table 2: Maturity Attributes for Supply Risk Assessment

	Maturity attributes for supply risk assessment				
Attribute	**1. Initial**	**2. Basic**	**3. Moderate**	**4. Competent**	**5. Superior**
Scope	▪ No supply risks to be assessed recurrently defined	▪ Supply risks assessment processes are defined across a limited scope of purchasing categories	▪ Supply risk assessment processes are defined across all purchasing categories	▪ Supply risk assessment processes are implemented in category management and supplier evaluation processes	▪ Controlled supply risk assessment process is initiated automatically as part of periodic supplier assessment across all purchasing categories
Competence	▪ Supply risk assessment is unknown to purchasing employees	▪ Limited knowledge of supply risk assessment methods within purchasing	▪ Knowledge of supply risk assessment methods resides within the purchasing function	▪ Solid knowledge of the selected supply risk assessment methods of all employees involved in risk assessment	▪ Solid knowledge of the selected supply risk assessment methods of all employees involved in risk assessment also beyond purchasing (e.g. production and R&D)
Resources	▪ No resources available for supply risk assessment	▪ Limited resources results in unstructured individual risk assessment by category management	▪ Adequate resources available for the assessment of supply risks	▪ Adequate resources available for the IT based supply risk assessment across categories with interface to other supplier evaluation systems	▪ IT integration with further supplier analytics for supply risk assessment also provides opportunities for the improvement of the supply risk assessment techniques
Alignment with ERM	▪ No alignment with ERM assessment methods	▪ ERM provides risk tolerability thresholds, but lack of compatibility of formal assessment process	▪ Alignment process defines the supply risk tolerability thresholds in line with ERM risk assessment methods	▪ Alignment process defines the tolerability threshold, the escalation hierarchy of supply risks. ERM provides support in risk assessment if required	▪ Aligned and compatible methods for risk assessment allow the transparent communication of risk indicators and thresholds with ERM. Clearly defined escalation hierarchy

Attribute	1. Initial	2. Basic	3. Moderate	4. Competent	5. Superior
Stake-holder integration	▪ No integration with internal stakeholders	▪ Supply risks are assessed by internal clients, but independent of purchasing	▪ Supply risk assessment in purchasing partially demands supply risk assessment from internal clients	▪ Other functions such as R&D and production are actively integrated in the assessment of supply risks	▪ Fully implemented supply risk assessment process involves R&D, internal client and other experts at defined stages of the sourcing process
Implemen-tation	▪ No defined verification of risk assessment process	▪ Irregular verification of supply risk assessment across purchasing	▪ Central control mechanisms to verify the assessment of supply risks	▪ Verification of supply risk assessment is implemented in IT structures	▪ IT governance enables verification of supply risk assessment per supplier relationship
Documen-tation	▪ Individual document-ation	▪ Risk assessments are de-centrally stored	▪ Documentation of supply risk assessment resides within the purchasing function	▪ Centralized storage and dissemination of assessed supply risks to internal clients (e.g. R&D) and ERM	▪ Central storage and dissemination to everyone involved in later processes enable by a formal IT based governing processes
Feed-back and learning	▪ No focus on continuous improvement	▪ Limited receptivity to changing conditions	▪ Learning is partially constraint by focus on execution excellence of existing processes	▪ Supply risk assessment is recurrently questioned and adapted if necessary	▪ Strong risk culture fosters long-term investment into the optimization of assessment techniques and processes

5. Discussion of Firm Cases Based on their Assessment in the SRM-CMM. We assessed each SRM process along the eight maturity attributes described in section 3.2.2 on a discrete integer scale from 1 to 5 described in section 3.2.3. We derived the maturity score for each SRM process based on the modal value of the eight attribute scores per SRM process. In Figure 3, the minimum, the maximum and the median score per SRM process are depicted.

Figure 2: Boxplot of Supply Risk Management Process Maturity



Our preliminary analysis provides evidence that our sample profiles are relatively mature in the strategic, core and enabling processes. The maturity scores range from maturity level (ML) 2 to 4. Thus, all companies have achieved SRM processes beyond the initial maturity level, yet none of these PSM functions has achieved superior SRM processes. For more profound insights at individual case level we discuss the results along the four SRM dimensions in the subsequent sections.

5.1. Core Processes.

5.1.1. Supply risk identification. Here three firms were evaluated at ML2, two firms where evaluated at ML3 and three at ML4. The process of identifying risks is often considered as a basic step in SRM, however competent or superior approaches in risk identification can make the difference. Here it is important to integrate the relevant and not only the most obvious risks in SRM.

AutomotiveCo, the best practice firm, uses a future, present and past oriented supply risk KPI system. Based on this scorecard of 15 risk KPIs, supply risks are recurrently identified. The combination of recurrently assessed early warning indicators with brainstorming workshops beyond the pre-defined risk dimensions enables a truly proactive identification of potentially harmful incidences to the procurement function and the organization as a whole. The strong reliance on just-in-time and just-in-sequence production are drivers of this approach to supply risk identification. At AutomotiveCo, category management allocates time quarterly or even monthly to identify potential threats in supply markets and at specific suppliers. The data are centrally registered and disseminated to all involved parties in the procurement process. Moreover, the risk identification process is cross-functional. In the forward sourcing process procurement is closely cooperating with R&D, whereas in the later global sourcing process just befre the start of serial production, procurement tends to integrate closer with logistics and manufacturing.
A further noteworthy process is established at BankingCo which attained close alignment of supply risk identification with ERM procedures. This is also due to the legal obligations by banks to systematically and recurrently identify risks (Basel II). The identified risks are then centrally stored and must be closely monitored, whereas identified risks with a high operational impact must be actively managed in subsequent processes. So far, the firms of lower ML are mainly characterized by limited documentation and dissemination of identified risks. Basic ML are characterized by a high degree of decentralization and a missing link to ERM or even central supply management.

5.1.2. Supply risk assessment. In the process of supply risk assessment we observed two firms at ML2, two firms at ML3 and four firms at ML4. As we can see from the grading several firms offer interesting approaches, namely LogisticsCo, HealthCareCo, and FashionCo.
At LogisticsCo different parties are involved in the assessment of risks at different stages of the sourcing process. The cross-functional assessment allows a sound assessment as some risks might not appear to procurement professionals, but to internal clients.
A very important question is how firms assess or quantify risks. Most of the investigated firms assess risk or potential damage by the multiplication of probability of occurrence with the potential financial damage caused by the adverse event. The financial impact caused by an adverse event is quantified (or approximated) by the purchasing volume affected by the event. The probability of occurrence of the adverse event is usually rated on an interval scale from one to five or from one to seven. This assessment is usually conducted by the above mentioned experts from the involved departments and functions.
LogisticsCo operates a slightly more sophisticated system that further develops the probability times impact assessment logic by a third measure: the ‘mean-time to repair’ which can be considered as a derivative from the failure-mode-and-effect analysis. It considers how long it will take to reinstall the state prior the adverse event.
Moreover, some of our benchmarking partners also started to look deeper into the bankruptcy probabilities of their suppliers as a result of the financial. In order to detect these insolvencies as early as possible best practice firms rely on a combination of

external data such as the Z-Score, Dun&Bradstreet data as well as bank credit ratings and and internal KPI rating. Especially, FashionCo, ElectronicsCo and AutomotiveCo emphasize the assessment of liquidity and financial strength of their suppliers..
Firms tend to allocate more and more resources to the assessment, because they are aware that risk assessment is necessary to detect the most critical suppliers. Therefore, the assessment covers the entire risk checklist and beyond if new risks are identified or new suppliers are qualified. The firms with high maturity levels demonstrate that the risk assessment has to be integrated in supplier relationship management and evaluation in order to work effectively. At the best-practice firms the risk assessment is integrated in the IT tool for supplier evaluations, such as scorecard or supplier relationship management software. Thus, risk management and in particular assessment becomes part of routine software and processes which fosters acceptance and also improves handability in terms of workload.

5.1.3. Supply risk response/ treatment. Here, we evaluated two firms at ML2, two firms at ML3 and four firms at ML4, thus half the assessed firms show competent level in supply risk treatment of which we would like to highlight the firms AutomotiveCo and ElectronicsCo with ML4. The supply risk response decides whether a risk will be reduced or not. Identified and assessed risks need to be actively managed. It is important to find the right fit of value at risk in case the negative event occurs and the arising costs from the implementation of ex-ante risk treatment strategies, e.g. risk prevention risk minimization or risk transfer).
Both AutomotiveCo and ElectronicsCo rely on pre-defined response and treatment strategies. Even though the detailed measures are decided upon by decentral units, strategies are pre-defined according to the potential damage and the dependence on the supplier. E.g. AutomotiveCo strongly focuses on supplier development in case a high risk crops up. Supplier development may be costly, yet it is a favored strategy due to the difficulties and barriers to switching suppliers once they manufacture for serial production. If financial support in times of supplier financial distress is necessary to keep up production, AutomotiveCo provides help for strategic suppliers. But whenever possible, AutomotiveCo switches to establish back-up suppliers. HealthCareCo desist from providing direct financial support to their suppliers. They prefer to pay the short-term debt of the 1st tier supplier directly to to the 2nd tier in order to keep up the flow of material. Also, ElectronicsCo makes use of a wide range of risk management strategies after engaging in a cost-benefit analysis of the wide range of possible risk management strategies from currency hedging to direct financial support.

5.1.4. Supply risk monitoring. For supply risk monitoring we evaluated two firms at ML2, three firms at ML3 and three firms at ML4. Supply risk monitoring is the final core process guaranteeing that the SRM process is a continuous system. It is necessary to find adequate monitoring cycles in order to have a continuous system in place.
The mature firms show that supply risk monitoring must integrate all relevant categories and all relevant supply risks. Only if a regular check of all risks across purchasing categories is established, the SRM can function as an early warning system, increasing the reaction time in cases of short-term changes in the supply risk portfolio of the firm.
All firms show that the monitoring cycles should be related to the damage potentials. The general monitoring cycle of BankingCo is twice a year, ElectronicsCo and

AutomotiveCo monitors quarterly and AutomotiveCo monthly. In case of high risks the assessments cycles are shorter. In case of BankingCo this is required by regulations (Basel II). AutomotiveCo and BankingCo use traffic light principles in order to make the monitoring intuitive for the users. As in the risk assessment process it is important to integrate internal clients. HealthCareCo has integrated the monitoring and reporting in its supplier evaluation tool. Once a high risk is detected the degree of implementation of the risk response milestones can be a monitored and reported within the IT-tool. In addition to this project-based monitoring a recurrent trending of the supply risks over time is in place. It compares the risk assessments at individual supplier level over time which enables a longitudinal risk performance picture of the supplier

6. Conclusion and Implications for Management Practice. From the investigation it has become clear that SRM decides especially in turbulent times about the ability of the PSM department to consistently contribute to firm performance. We have seen in eight cases from different industries that processes and capabilities vary in terms of proficiency and execution, but that there is a common denominator across industries in terms of SRM that practitioners and researchers should build on.

From prior research we derived the first supply risk management capability maturity model. The SRM-CMM is a detailed reference framework for practitioners to benchmark their own SRM against other firms. Additionally, firms can self-assess their SRM and learn from the richness of the CMM how to attain higher maturity levels in each of the four core risk management processes.

In order to provide the opportunity for practitioners to compare their SRM proficiency to the best-in class we listed best-practices for SRM processes throughout the paper.

In the core processes it is important to recurrently assess suppliers along the different supply risk dimensions that might negatively affect the company. In addition to this recurring process firms should set-up a circle or a committee that seeks to identify potential threats to the company which have not been in the scope of the recurrent risk analysis. It is crucial that the outcome of the preferably cross-functionally conducted risk analysis is disseminated and made available to the entire organization. An it based-governance of risk enables such broad dissemination and links this information to the individual supplier scorecards. This integration further enable the joint involvement of ERM, top-management, and internal client in the risk treatment decision and the in the monitoring of the implementation of the chosen risk treatment strategy. Moreover it is important to trend risk management KPIs available at supplier level to use them as an early warning system of potential risk to the company. It is suggested to look into the past, present and future when managing supply risks.

Since SRM is basically not a tool, but a complex capability, it has to react to changing environments. We've seen that the financial crisis is a major external stimulus forcing firms to rethink their approaches in SRM. Firms can use (our study) the SRM-CMM to think about their own proficiency in SRM and to develop paths for further maturity evolution.

As change is constant, so is risk. Thus, the way to proactively manage supply risks is to have a good understanding about the own firms capability in SRM. This benchmarking enables firms to rate their processes relative to their industry peers and to firms from other industries. From this point managers can set targets to improve or adjust risk

management processes. With the SRM-CMM we provide guidance for practitioners to do so. Moreover, believe that this cross-industry picture of SRM processes supports beginners in the field to in setting-up stable SRM processes, which are receptive to change and are able to effectively detect and manage risk before next crisis strikes.

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Managing Supply Chain Risk that is Beyond Control at the Individual Firm Level: The Logistics Perfect Storm as an Example

Michael E. Smith, Ph.D.
Western Carolina University
828/227-3697; mesmith@wcu.edu

Lee Buddress, Ph.D., C.P.M.
Portland State University
503-725-4769; leeb@sba.pdx.edu

Abstract. Efforts to reduce supply risk often focus on attempts to avoid price increases or prevent supply disruption by working with suppliers. However, substantial risk can accrue from challenges and failures with their roots, not in the supplying firms, but in the broader business environment, such as general economic conditions, socio-political conditions, industry conditions, and risks associated with the linkages between firms. In such cases, traditional approaches to the management of supply chain risk may have little impact on the extent of risk exposure that the firm faces. This proposal focuses on one example of such risk rooted in current challenges found in our transportation networks required to move goods from the suppliers to the purchasing firm. A study of the feasibility of facilities intended to streamline processes within the transportation networks serves to develop themes that can be applied to ameliorating risk in many situations where supply chain risk results from features of the environment outside the control of the focal firm or its individual suppliers.

Introduction. Supply chain risk has generally been defined as the potential occurrence of supply events that may have significant detrimental impact on the purchasing firm (Zsidisin 2003, Ritchie and Brindley 2007). Instability in the world coupled with increasingly sensitive supply chains has caught many organizations off guard. Thus exposed to risk, organizations have shown heightened interest in rethinking supply chain management practices (Wagner and Bode 2008). Risk reduction can be accomplished by actions that either reduce the likelihood of potentially negative events, or reduce the extent of negative impact should such events occur (Zsidisin and Smith 2005). However, a major challenge to instituting such actions may be in finding the means to control events that can actually be implemented by the supply management professional. One can readily see that a supply chain manager can institute internal action or influence the actions of critical suppliers, but if risk is the result of factors beyond the control of the focal firm or its suppliers, supply chain risk management becomes a very challenging proposition.

In characterizing sources of risk, Peck (2005) envisioned supply chain management as interacting along four levels. Of particular importance for the purposes of this paper is that at the highest level, broad environmental factors existing in the macroeconomic and natural realms interact with all other supply chain activities. Thus, broad economic, social, political, technological and natural phenomena interact with our attempts to manage the intra- and inter-firm flows necessary to create value in the business environment. Although forces at this highest level are beyond the control of any given firm, they potentially determine the success of all of the efforts, no matter how well conceptualized or executed, at the lower levels that

include the management of flows within the value stream, the positioning and utilization of assets, and the conduct of business.

Another view highlights a lack of supply chain confidence resulting from increased risk exposure. Having little confidence in such critical events as order cycle time, demand forecasts, supplier delivery capability, quality and transportation reliability all foster risk-averse responses. Safety is sought in increased safety stock, but also by building in safety lead time. Users order substantially sooner than is necessary so that they have confidence in delivery in spite of variable performance within the supply chain (Martin and Lee 2004).

When one considers the critical nature of material flows within the supply chain, it should be clear that effective transportation is critical to the success of many businesses. Recent reports are clear in pointing to increasing logistics costs, and transportation costs have been a major portion of the increased costs. In 2007, according to the Council of Supply Chain Management Professionals (CSCMP), logistics costs increased to 10.1% of the U. S. gross domestic product (GDP, up from 9.5% in 2006), and transportation costs increased to 6.2% (up from 5.9% in 2006) (Burnson 2008b). As readers can readily extract from personal experience, volatility in fuel prices contributes a substantial measure of uncertainty to transportation costs, thus, increasing uncertainty regarding pricing in the supply chain. While the current global economic condition has resulted in a relaxation of the upward pressure on transportation costs, the long term concern remains.

Indeed, failures in transportation networks can lead to non-delivery, increased lead times, uncertain lead times, increased prices for delivered products, damage, and of course, increased inventories as managers invoke buffer strategies to deal with the other challenges. We turn now to a description of three additional forces that are creating challenging situations in our transportation networks.

The Logistics Perfect Storm. The confluence of increasing and shifting demand, capacity constraints and failing infrastructure are leading to what has been called a logistics perfect storm (Buddress and Smith 2008). Growing trade and changing patterns in trade as we experience economic turbulence are having the effect of increasing pressure on logistics assets and making prediction of logistic performance difficult. Projections of freight volumes may vary, but there is one consistent theme; everyone agrees that we will see considerable growth in freight volumes in every mode of transportation. According to U. S. Department of Transportation projections, we may well see doubling of tonnage moved on highways and by rail, and much greater increases in movements through seaports (Schmitt 2006). The Air Cargo Management Group projects that air cargo will triple by 2023 (Thuermer 2006). Even with a slowing economy, growths in population will require substantial movement of goods, and as the economy recovers, we undoubtedly will see the movement of goods increase. With economic turbulence, we have also seen significant reversals in transportation flows, a state of affairs that is fluctuating rapidly as we see dramatic shifts in the monetary markets (Burnson 2008a).

In the face of such growth in demand, constrained capacity across all modes of freight transportation makes effective management of the movement of goods a daunting task. From overwhelmed sea ports (Gallagher 2006) to driver shortages in trucking (Hannon 2006), to constraints in rail capacity (Atkinson 2008), we simply do not have adequate transportation to

meet current and future needs. Further, attempts to address shortages in one mode often result in compounding of the problems faced on another mode as when trucking firms utilize the railroads to address problems in trucking, only to magnify the problems that the railroads face. Finally, it is clear that capacity limitations are not subject to simple remediation, since in each mode of transportation the limitations come from multiple sources, but perhaps the most critical limitation is presented by our failing transportation infrastructure (Engler 2007).

The U. S. faces stiff competition in the global marketplace, and we are undertaking this contest from a disadvantageous position given that our engagement in trade is hampered by inadequate infrastructure (Krohe 2008). We have failed to make the required investments in maintaining our infrastructure, and the result has been that it is simply not satisfactory given our needs. The American Society of Civil Engineers (ASCE) surveys its members periodically (the period between surveys has varied between three and four years) regarding the state of the Nation's infrastructure. For the most recent survey (2009, http://www.infrastructurereportcard.org), the results are dismal. The overall grade was a D. In the transportation realm, roads received a D-, with bridges receiving a C; rail infrastructure received a C-; aviation received a D; navigable waterways received a D-; and over time, the grades have shown continued deterioration. Overall, the ASCE has determined that there is a need for an investment of $2.2 trillion over a five-year period to bring the state of our infrastructure to good condition (in the previous 2005 survey, the amount needed to bring the infrastructure to good condition was $1.6 trillion over a five-year period).

The aforementioned CSCMP Annual State of Logistics report contained the following telling concluding statements that reinforce the ASCE conclusions:

- 2006: "Capacity (workers, infrastructure and equipment) is not keeping pace with growth in volume."
- 2007: "Everybody understands something has to be done about the infrastructure and everybody has to be involved."
- 2008: "Our nation's transportation infrastructure is failing and will not meet our needs in the future."

The composite realization is that we have chronically underfunded our nation's infrastructure for decades, and now the bill is coming due.

These three forces, increasing and shifting demand, capacity constraints, and failing infrastructure are bringing severe turbulence to logistics. When coupled with volatile fuel prices, there can be little doubt that the movement of goods as needed by businesses has become challenging and risky. However, the sheer scale and magnitude of the sources of trouble in this realm are vastly beyond what any single firm can expect to influence. Just what can be done under circumstances where the major forces creating uncertainty are beyond the control of the focal firm or its suppliers? In the next section, we will describe research that seeks to address this concern in the context of transportation.

Feasibility Study for Infrastructure-Based Remediation of Problems Rooted in Transportation Networks. We now turn to description of a study that is examining the feasibility of an inland port to remediate trade disruptions based on challenges present in our transportation networks (Smith 2010). While the study was initially undertaken as part of an

economic development initiative, the results provide themes that are relevant to addressing supply chain risk in many situations where the focal firm and its suppliers are not able to exert significant control over the factors leading to such risk.

While the definition of an inland port varies substantially, for purposes of the study, attention has been directed toward features that impact supply chain risk. In particular, emphasis has been placed upon how a facility can serve to promote handling shipments away from traditional port of entry facilities, the transfer of freight between modes of transportation, and processing international trade. Thus, such a facility can be seen as potentially addressing cost and performance issues in linking firms in a supply chain by addressing constraints in dealing with transportation demand. Further, a well conceptualized facility of this sort should address issues in the infrastructure and fuel prices by promoting efficiency and the selection of transportation modes that are both relatively less impacted by infrastructure challenges within a particular corridor and less costly.

In order to examine the range of issues being addressed by such facilities, the features involved in various implementations, and how well these features address the current and future transportation challenges that impact trade, exploratory visits were conducted to a number of facilities. The facilities studied include both sea ports subject to many of the challenges to be addressed by an inland port, and inland ports, including Virginia Inland Port in Front Royal, VA; inland port facilities as part of the economic development activities in Huntsville, AL; a new rail park in Sommerset, KY; the Smart Port projects in Kansas City, MO; the ports of Los Angeles and Long Beach, CA; the developing Victorville Southern California Logistics Airport in Victorville, CA; the port of Stockton, CA; the San Joaquin Valley Inland Port in CA; and the port of Savannah, GA. Additionally, information was gathered from five facilities with varying levels of success in order to create a profile of the differences between successful and unsuccessful facilities. Finally, a number of meetings with local business groups served to highlight alternatives to facilities in dealing with transportation challenges.

From the data gathered, themes were extracted relating to placement, demographics, transportation requirements, freight flows, workforce development, infrastructure requirements, and a number of specific requirements for public and private engagement in order to support potential success for an inland port. However, with respect to risk management, a number of themes emerged. We now turn to describing how these findings can be applied to general considerations of how to mange supply risk from sources beyond the control of the firm, such as supply risk resulting from within our transportation networks.

Traditional Approaches Fail when Managing Supply Risk that is Beyond Our Control. With challenges as great as those present in the current state of transportation, traditional supply risk management efforts are destined to fail. Behavior-based management (Zsidisin and Ellram 2003) may work very well in dealing with risk that is based in a supplier or in its management of its suppliers. However, we would not expect such efforts to be effective when the risk was not essentially independent (i.e., not shared with other organizations). Note that problems such as those present in transportation networks are shared, much as is the case for industry risk and other situations where the risk affects the entire supply base or major segments thereof. Managing instances of such risk as if they were isolated circumstances will prove ineffective and wasteful of management resources.

The other major form of supply risk management, the buffer-oriented approach (Zsidisin & Ellram, 2003) may indeed protect the firm by limiting the extent of damage. Note that when inventory is increased either with the supplier or the focal firm, the reduction in damage may be substantially offset by the costs associated with increased inventories. Another limitation to buffer-based risk management approaches can be found in recognizing that for the class of large, multifaceted risks being addressed in this paper, the risk is shared, and advantage may not accrue to using multiple sources except in the very limited condition where differential exposure can be found to the general risk. This limiting condition is addressed, for example, when a firm uses local suppliers to limit the extent of transportation-based risk.

Managerial Implications. Managing the class of supply chain risk that is present in the logistics perfect storm requires coordinated efforts beyond the level of the individual firm. Therefore, collaboration is essential in the face of a significant portion of the supply chain risk that firms face today. In many cases, this collaboration may involve parties that today's businesses tend to shun.

In logistics, the required aggregated action may include coordinating shipments with other businesses and even competitors. Consortia or alliances may be an essential part of such efforts. For example, the Asheville (NC) Area Chamber of Commerce (2010) has worked with manufacturers in the western North Carolina region to facilitate the establishment of the Western North Carolina Transportation Alliance (WNCTA) that functions to promote exchange of shipping information between member businesses. This exchange of information has led to cooperation that has begun to see success in ensuring full utilization of transportation assets, as well as emerging approaches to dealing with other challenges associated with the movement of freight today.

For efforts such as those described above to work, collaboration has to function across traditional boundaries, including local political boundaries in many cases. Note also that there is a real need for facilitation, and governmental bodies are often well positioned to provide resources if we can move toward public-private partnerships. Such partnerships may be particularly critical given limitations in capital resources. In today's environment, public initiatives will require private investment if they are to have any realistic chance of coming to fruition.

Another aspect of collaboration to address problems that cross boundaries is that such collaboration does not always require infrastructure. In an era of tight resources, better coordination may be much more likely if we can facilitate the coordination through virtual means. Thus, in the case of the logistics issues, if a virtual freight coordinating effort can be established, it is far more likely that the resources for a few staff to manage such an effort can be obtained than is the massive infusion of capital required for a facilities-based effort.

Finally, since most of the shared sources of risk can only be addressed by efforts that extend beyond the constraints imposed by business, political and geographical borders, it is critical that we engage resources beyond the local level. Almost all solutions require at least a regional focus, and many require national attention (and we may really need to look for international solutions in many cases). In seeking resources to extend our efforts beyond immediate boundaries, we will need to effectively bring pressure to bear at the highest levels. Business interests must begin to band together to influence governmental processes. For

example, with respect to the infrastructure issues involved in the logistics perfect storm, if the tendency to lobby federal legislatures from the perspective of a particular industry could be eschewed in favor of a concerted effort to gain investments in improving our infrastructure generally, we would be much more likely to see meaningful investments to support future national success in competing in global trade. Likewise, in seeking regional solutions to transportation challenges, most efforts must include interests in surrounding states.

Ultimately, supply chain risk management is substantially about solving or ameliorating those really big problems that extend well beyond our immediate control. Thus, making progress toward effectively managing the largest sources of supply chain risk will require that we begin to think beyond immediate actions and evoking collaboration beyond the confines of our immediate supplier relationships.

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Understanding Logistics Services through a Factor-Market Rivalry Lens

Wendy L. Tate*
Assistant Professor of Logistics
University of Tennessee
(865) 974-1648
Wendy.Tate@utk.edu

Lisa M. Ellram
James Evans Rees Distinguished Professor of Distribution
Miami University
(513) 529-3270
ellramlm@muohio.edu

Edward G. Feitzinger
Principal
End-To-End Analytics
(650) 331-9659 x702
ed@e2analytics.com

Giddeon Markman
Associate Professor of Strategy, Innovation, & Entrepreneurship
Colorado State University
(970) 491-7154
Gid.Markman@gmail.com

Abstract

In recent years there have been shortages in a variety of resources required to effectively support offshore outsourcing and offshoring that have caught many firms and individuals by surprise. This includes shortages of skilled labor, shortages of factory workers, and shortages of logistics capacity. These shortages however are driven by competition from diverse companies from unrelated industries creating unanticipated conditions of scarcity for inputs that are generally considered non-strategic. Firms tend to monitor activities and markets for strategic inputs, or inputs that directly contribute to the firms' unique advantage. However, these firms largely ignore the more non-strategic inputs. The purpose of this research is to examine competition among diverse and unexpected industries in factor-markets using the example of logistics services and the lens of factor-market rivalry theory. Factor-markets are defined as markets where firms buy inputs that are used in the creation or distribution of products or services. As organizations become aware of growing competition and demand for resources in geographical regions in which they operate, they should assess the impact on logistics resources, and develop a plan for addressing potential resource constraints thereby improving cost and on-time delivery performance.

Keywords: Factor-Market Rivalry, Logistics, Strategy, Organizational Issues

Companies continue to outsource and offshore services and move production overseas to lower cost production centers, even in the face of financial and market contraction (Baily and Farrell, 2004). In manufacturing, the primary focus of offshoring, and possibly outsourcing is the make or buy decision. If the firm chooses to buy, the focus shifts to selecting the right supplier. This includes considerations of supplier price, capability, capacity and quality (Kannan and Tan, 2002). However, in recent years, there have been shortages in a variety of resources required to effectively support offshore outsourcing and offshoring in general that have caught many firms and individuals by surprise. This includes shortages of skilled labor in India (Khadria, 2002), sporadic shortages of factory workers in coastal China (Barboza, 2006) and shortages of various types of logistics capacity in India, China, Vietnam, and the United States (Goldstein, Pinaud, Reisen, 2006; Kopczak, 1997; Yusuf, Nabeshima, and Perkins, nd).

All of these shortages have been in part driven by competition for the same resources. The surprising thing about this competition and the ensuing resource scarcity is that diverse companies from unrelated industries are becoming competitors in factor-markets. This is creating unanticipated conditions of scarcity for inputs that generally are considered non-strategic. Whereas firms tend to closely monitor activities and markets for strategic inputs, or those inputs considered to directly contribute to the firms' unique advantage (Porter, 1996), they do not have sophisticated tracking mechanisms in place for non-strategic inputs.

The purpose of this research is to examine competition among diverse and unexpected industries in factor-markets using the example of logistics services. Factor-markets are defined here as markets where firms buy inputs that they use in the creation or distribution of products or services to their customer base. This paper will use the lens of factor-market rivalry theory, a relatively new theory (Markman, Gianiodis, and Buchholtz, 2009), to explore how firms may overlook potential competitors for input resources. Due to this oversight, these firms may experience higher prices and scarcity of supply chain resources that they take for granted as readily available.

The types of input resources studied in factor-market rivalry theory are different than the scarce resources traditionally studied by strategy scholars. The resources analyzed are those that are somewhat generic in nature and therefore often seem to be ubiquitous, thus creating a potential blind spot. Resources that are versatile (multifunctional) and mobile (transferable, tradeable, and maneuverable) are the focus of factor-market rivalry (Markman et al., 2009). Further, factor-market rivalry focuses on competition for resources at any stage in the supply chain, not just in product markets, as is the attention of most rivalry research (Markman et al., 2009).

Using the example of transportation and logistics services, the goal of this research is to demonstrate that logistics and transportation are subject to factor-market rivalry, particularly in light of mass movements of production to low cost regions. Specifically, secondary data is analyzed relative to air cargo capacity in China, port capacity in South Vietnam, and the U.S. port and rail system. Due to paper length constraints, the data analysis will be presented in detail during the March symposium. The rivalry being discussed occurs in markets where diverse firms are competing, generally to their surprise, for the same input resources. The scarcity of these input resources reaches a level of criticality in cases where they are essential and assumed to be available at a competitive price and in unlimited, or at least sufficient supply. In reality, logistics resources that support offshore outsourcing of manufacturing, may be subject to limited supply with increasing costs. This research expands the lens of market rivalry theory by filling in some of the gaps, and broadening the application of this theory to logistics services.

Conceptual Development of Factor-Market rivalry

Most of the research to date in market rivalry focuses on rivalry in the product markets. Even the research that considers rivalry in factor-markets tends to focus on rivalry in factor-markets among firms who also compete in product markets (Barney, 1986; Capron and Chatain, 2008; Chen, 1996). While this previous research is interesting and informative, it does not facilitate firms' insight and anticipation of rivalry that occurs when non-competitive industries enter into their factor resource markets. These entries can be domestic, as in the case when Honda of America opened its automotive manufacturing facility in Marysville, OH, in 1982, and competed with the local businesses in a fairly small town for literally hundreds of employees. Chrysler Corporation also met an unexpected competitor in the factor-market for clay used to manufacture prototypes: a kitty litter company (Fine, 1998). This competition can be global, as in American Express facing unexpected competition for labor used in its call centers and back-office operations from companies like Hewlett-Packard, who offshore outsourced its employee benefits desk. Rivalry for input factors occurs for both services and goods. An example on the goods side involves the unanticipated production delays of fryers being produced for Burger King. These fryers ended up competing for air capacity out of Hong Kong with a supplier of automotive parts and a supplier of printers and consumer electronics. The lack of space was not anticipated by any of the companies and the competition for the space drove up the price of the capacity.

Factor-market rivalry is a management theory that focuses specifically on inputs, also referred to as *resources, factors and factors of production* (Markman et al., 2009). The issue that distinguishes factor-market rivalry from other approaches in the management literature is that it views factor-market rivalry in terms of competition over *any resources by any entity at any stage in the supply chain* (Markman et al., 2009). Competition can include very unexpected scenarios, such as Amazon surprising Wal-Mart by poaching some of its key logistics personnel (Markman et al., 2009). This is a departure from other management research which focuses on strategic assets: those that are difficult to transport and utilize in other settings, and those that are important to the firm's success (Barney, 1991; Barney, 2001).

There are three general scenarios associated with factor-market rivalry. The first case is where firms may use different types of resources to compete in the same markets, as is the case with EBay versus live auctions (Markman et al., 2009). Rivalry can move from factor-markets to product markets, as one firm expands and changes it offerings based on perceived opportunities (Markman et al., 2009). The final scenario is where firms use similar resources but do not compete in similar markets or create similar products. This type of rivalry is very difficult to anticipate. This is the example of Wal-Mart hiring Amazon's key logistics personnel. Table 1 summarizes the factors contributing to factor and product market rivalry and provides some examples for clarification.

The focus of this paper is on factor-market rivalry that is restricted to factor-markets where rivals use overlapping resources, but do not compete in product markets. We are interested in this area because of the significant void in the current research. As noted by Michael Porter, "The essence of strategy formulation is coping with competition. Yet it is easy to view competition too narrowly or pessimistically (1979, p 93)." Column 3 in Table 1 is not considered a strategic area and until recently has experienced limited rivalry. This area is the purview of those at the operating level rather than those who are at the more strategic levels or "managing the business." It is this column that is the focus of the research. Columns 1 and 2 in the above table have been the core of strategy research: focusing mainly on areas where there is current (column 1) or potential (column 2) product market rivalry. In increasingly global factor-markets, competition can come from numerous, unanticipated sources.

TABLE 1
Factors contributing to factor and product market rivalry

		Compete in product markets	**Pose a threat of competing in product markets**	**Do not compete in product markets; unrelated**
Use unrelated inputs		Product market rivalry only	Potential for product market rivalry if change product offering.	No product market rivalry.
	Example	Ebay and Live auctions	A new company entering an industry, competing using a different technology, such as a company that makes scar fading cream that discovers it removes tattoos, competing w/ laser tattoo removal.	Any two unrelated firms.
Use common inputs (versatile, mobile resources)		Very strong rivalry due to the presence of both product market rivalry and factor market rivalry.	Factor market rivalry; rivalry could be heightened if there is an awareness that the factor market rival poses a product market threat.	Factor market rivalry only
	Example	John Deere and Caterpillar competing for capacity at a high quality punch press metal shop in Brazil.	Two auto parts companies that both compete for steel in times of shortage. One serves the OEMs only, the other only the aftermarket. If either decided to expand into the other's market, product market rivalry would also exist.	American Express and Honeywell both competing for the same information technology employees in India or on the goods side a disk drive manufacturer and automotive manufacturer competing for capacity at a plastic parts manufacturer.

The fiercest competition is *not* confined solely, or even primarily, to firms that compete in the same market or industry. Rivalry actually flares up at any level or link within a firm's value chain—from upstream and primary activities to downstream and support activities—and even over generic resources. In fact, wherever firms overlap, coexist, or co-occupy the same space rivalry could follow. Further, because each activity in a firm's value chain could trigger rivalry with a unique set of competitors, an incumbent's rivals in factor markets (rivalry over resources) might not resemble competitors in product markets.

Recognizing that some firms compete over resources without overlapping in product markets helps managers to counteract a tendency to examine only the usual suspects—players with similar product-market profiles. Broadening managers' appreciation of competition beyond product markets is important because it helps to explain how hazardous blind spots occur in competition for secondary resources. Indeed, the most formidable threats are often the least recognized. Increasingly, with globalization and outsourcing, unexpected competition can arise from many sources. How can firms anticipate this competition, especially when it comes from completely different product markets and industries? How can firms plan for such competition and not be caught by surprise, facing severe shortages, extreme cost increases, or both? The answers lie in understanding rivalry over resources.

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Gender Differences, Competitiveness and Integrity in Negotiation

Carl R. Templin, Ph.D.
Dean, Professor of Management
School of Business
Southern Utah University
351 W. University Boulevard
Cedar City, UT 84720
Tel: (435) 586-5401
FAX: (435) 865-8153
templin@suu.edu

Gender Differences, Competitiveness and Integrity in Negotiation

Abstract

Men and women approach negotiation differently. Men's competitiveness and aggressiveness tend to give them an edge during distributive negotiations. Previous research indicates women tend to negotiate less than men; however, they are less contentious, show more concern for others and are better communicators. These traits are advantageous in identifying common interest and integrative opportunities. This exploratory study examines the impact of gender, competitiveness and integrity on three negotiation outcomes (1) individual gains from a one-issue distributive negotiation, (2) a four-issue mixed-motive negotiation with integrative potential and (3) an eight issue mixed-motive negotiation with integrative potential, all of which were conducted in graduate negotiation classes at two different institutions. Gender did not play a statistically significant role in the outcomes, although women did score higher results than men in all three negotiations. Competitiveness was also not statistically significant even though high competitive individuals scored better in each negotiation. High-integrity individuals scored lower in the distributive negotiation but scored higher in the integrative negotiations; however, this was statistically significant only in the eight-issue mixed motive negotiation.

Key words: negotiation, gender differences, integrative, distributive

Introduction

Men and women tend to have different negotiation styles (Briles 1996) and approaches (Babcock and Laschever, 2003). The literature review also suggests there are gender differences in negotiation outcomes. This paper explores the impact of gender, competitiveness and integrity on negotiation results in distributive and integrative negotiations. It is an extension of a previous study that examined gender differences and determinants of success in a mixed motive negotiation. This study is primarily pedagogical in nature, in that its objective is to help students understand their own behavior and that of others during mock negotiations conducted as part of a graduate negotiation class.

Literature Review

There is a growing body of evidence that men and women approach negotiation in very difference ways which might impact negotiation success. Men and women tend to have different attitudes toward negotiation resulting in varying levels of engagement. Babcock et al (2003) found that 57 percent of the male graduate students they studied negotiated their job offer compared to just 7 percent of the women, which resulted in the men achieving 7.6 percent higher average starting salary. They also found that men tend to perceive greater opportunities for negotiation and initiate negotiation more than women do. Small et al. (2007) found that framing plays a significant role. Situations framed as negotiation opportunities, as opposed to asking opportunities, intimidate women and lead to ongoing gender differences in negotiation persistence. When

framed as asking opportunities the gender differences disappear. Babcock and Laschever (2003) found women of all ages tended to avoid negotiation. However, older women did not perceive as many negotiation opportunities as did men of their same age or younger women. Younger women recognized opportunities for negotiation at the same rate as their male counterparts.

There are also gender differences in terms of strategies and tactics (Kimmel et al 1980, Kaman and Hartel 1994). Women are less contentious and engage in less hostile language, such as put downs, threats, and arguments (Kimmel et al. 1980). Calhoun and Smith
(1999) found that women use laughter twice as often as men during the negotiation and also
focus more on feelings. Women tend to disclose more information while men tend to be more direct and interrupt more than women (Briles, 1999). Women display more concern for others' welfare, while men are more independent and dominant (Eagly, 1995). Women perceive others as more cooperative, friendly and trustworthy than do men and see themselves as more friendly or trustworthy (Calhoun and Smith, 1999). Bowles et al (2005) raise the possibility that gender effects are simply situational. Ball and Eckel (1996) suggest gender does affect behavior.

Research is mixed as to whether there are gender differences in terms of negotiation outcomes. Some have found men achieve better results than women in distributive type negotiations (Pinkley and Northcraft 2000; Gerhart and Rynes 1991; Neu, Graham and Gilly 1998; Stevens, Bavetta and Gist 1993; King and Hinson 1994). Some found no difference (Pradel et al. 2005 and Kimmel et al 1980). Meta-analysis suggests gender differences exist but are small and their significance may be part of the bargaining situation (Stuhlmacher & Walters, 1999). Pradel et al. (2005) found that men perform better in competitive negotiations, in which payoffs are determined by comparing relative performance. Women perform better when playing the role of an agent, negotiating on behalf of someone else (Pradel et al. 1993, Bowles et al. 2005). Ball and Eckel (1996) found that people with higher perceived status receive better offers than do those with lower perceived status. They also found that both men and women made more generous offers to males than to females. Thus, it appears that men may have an advantage in zero-sum distributive negotiations.

It is now common to differentiate between distributive and integrative negotiation situations. Distributive negotiations involve an issue in which the parties have opposing interests and must divide a fixed sum where one gains at the other's expense. Integrative negotiations involve multiple issues where the parties can explore differences in priorities and values, making tradeoffs that create value for the parties and maximize the joint outcome. Fisher and Ury (1991) use the term "principled negotiation" to differentiate between positional (traditional) negotiation and interest-based negotiations. Principled negotiation resolves personal conflicts prior to focusing on the substantive problems, looks beyond positions to discover and meet the interests of the parties, invents solutions that are mutually beneficial in meeting those interests and uses objective criteria as a measure of fairness for distributive issues. According to

Lewicki et al. (2006) integrative negotiations require the exchange of information and ideas to discover common interests, address needs/interests, meet the needs of the relevant parties, discover options for mutual gains and use objective criteria.

Research has begun to identify the best strategies for achieving integrative solutions. Weingart et al. (1987: 287) found that during negotiations with integrative possibilities, "showing concern for the opponent and providing information was positively related to joint performance." However, Calhoun and Smith (1999: 206) wrote, "Without motivation to resist making early concessions, a tendency to cooperate or look out for the needs of others may mitigate against the discovery of the integrative potential in the conflict." Calhoun and Smith (1999: 218) concluded "women engaged in problem solving and obtained high joint benefit when they were externally motivated to harbor concern for their own outcomes and resist yielding." They found that without this external concern, women obtained poorer joint outcomes because they tended to yield earlier. They found that men obtained high-joint outcomes when they were given high self-concern, but obtained poorer joint outcomes when they were given low self-concern. Patterson et al (2007) examined same-gender pairs engaging in a mixed-motive negotiation with integrative potential to determine if there existed gender differences in joint outcomes and explored the roles that competitiveness, integrity and empathy play in those outcomes. Subjects included undergraduate students without any formal negotiation training, in order to determine if inherent characteristics, as opposed to training, would improve negotiation results. That study found that gender, empathy or integrity were not significant factors in explaining variance in a mixed-motive negotiation. Competitiveness was a significant factor with more competitive individuals yielding higher results than cooperative individuals. This was a small study with only 40 men and 36 women participants and the lack of negotiation training likely converted the exercise into primarily a purely distributive negotiation due to the fixed-pie perception or bias.

Description of Study and Methodology

This study expands on the Patterson study. Subjects in this study are graduate students taking an elective negotiation class in one of two institutions. The objective of the study is to examine the impact of gender, competitiveness and integrity in terms of the following three negotiation measures, each increasing in complexity and breadth.

Distributive Gain is the gain that individuals achieved on a one-issue distributive negotiation concerning the price of a house. The variable is the gain over each person's reservation point (the worst each is willing to accept), which was given in the negotiation scenario.

Mixed Motive 1 is the individual gain achieved in a four-issue mixed motive negotiation consisting of a distributive issue, two issues with integrative tradeoff potential and a common interest item. This is the same scenario used in the Patterson (2007) study.

Mixed Motive 2. This is the individual gain achieved in a more complex eight-issue mixed motive negotiation with two distributive issues, four issues with integrative tradeoff potential, and two common interest items.

The predictor variables are gender, competitiveness and integrity. The last two variables are measured using questions from the Brown and Berkowitz Personal Bargaining Inventory (Lewicki et al., 2003) which is used in class as an exercise to help students explore their own personal bargaining characteristics. The questionnaire consists of fifty statements, 23 of which are statements about their own behavior using a seven point scale ranging from 1=strongly uncharacteristic to 7= strongly characteristic. The remaining 27 statements involve rating people's behavior in general and students rate each statement using a seven point scale of 1= strongly disagree to 7= strongly agree. The variables are defined as follows:

Gender: Gender is an indicator variable with 1=male and 0 = female.

Competitiveness: An indicator variable (1=high and 0=low) drawn from the average of two survey questions regarding competitiveness.

- Statement 21: "In any competitive situation I like to win. Not just win, but win by the biggest margin possible."
- Statement 39: "In bargaining, winning is the most important consideration." The intent here is to measure one's own competitive nature as well as the belief of how competitive other people are.

Average scores of five or above are indicative of high levels of competitiveness while those below five are less competitive.

Integrity: This indicator variable (1=high and 0=low) was measured by averaging three statements:

- Statement 1: "I am sincere and trustworthy at all times. I will not lie, for whatever ends."
- Statement 7: "I pride myself on being highly principled. I am willing to stand by those principles no matter what the cost."
- Statement 23: "The only way I could engage conscionably in bargaining would be by dealing honestly and openly with my opponents."

Average scores of five or more are indicative of having higher integrity than those with scores below five.

Role: This is an indicator variable controlling for role (buyer or seller), in each of the exercises.

Since the subjects used in this study consist of students taking a graduate negotiation class, the sample is of necessity a sample of convenience. Students are randomly assigned roles. Students learn about appropriate strategies for distributive and integrative negotiations through reading the text and class discussion. Then the students engage in the negotiation and report the results to the professor who then presents the results to the entire class.

Expectations are that men will outperform women in terms of distributive gain. It is the third exercise in the course. The literature suggests that men tend to outperform women in such competitive situations. High levels of competitiveness should achieve higher results as well. Low levels of Integrity could also score higher if deceit is used. As integrative opportunities are introduced the need to cooperate and share information becomes critical to identifying both joint outcomes and integrative tradeoffs. One would expect that male advantages diminish given that all parties have received instruction in appropriate strategies and tactics for distributive and integrative negotiations. Competiveness should be a negative factor in the integrative scenarios. Given the need to share information to discover integrative tradeoffs and joint issues, integrity should play a significantly positive role in integrative negotiations.

The hypotheses of interest are as follows:

Dependant Variable	Gender (Men=1, else, 0)	Competitiveness (High=1, else 0)	Integrity (High=1, else 0)
Distributive Gain	Men will score higher than women	High competitiveness will score higher than low	Ho: High $\leq$ Low Ha: High > Low
Mixed Motive 1	No gender effect	High competitiveness will have a negative effect	High integrity will yield higher results
Mixed Motive 2	No gender effect	High competitiveness will have a negative effect	High integrity will yield higher results

The study used data gathered from 221 students that participated in at least one of the exercises. Data were analyzed using SPSS PASW statistics 17.0. The design is an analysis of variance using three indicator variables (gender, competitiveness and integrity) plus a control for role using the univariate general linear module. First, all independent variables were included in the model and then a stepwise regression built a corrected model with only statistically significant variables. The Levene test was used to determine homogeneity of variance with the Welch test used if the assumption was not met. One-way ANOVAs were used to test the independent variables separately.

Findings and Results

While all students engaged in a distributive exercise and two mixed motive exercises, the exercises were not always the same in every class. The exercises selected for review represent those with the most students. Therefore, the mix of students is not the same for each exercise. The following table provides the descriptive statistics for the three exercises and significance levels for the multiple regression/analysis of variance with all treatments included:

Variables		Distributive Gain		Mixed Motive 1		Mixed Motive 2	
		n	$ Gain	n	$ Gain	n	Pt. Gain
Gender	Male	102	7971	87	247,874	125	5977
	Female	33	8545	42	250,357	38	6132
Competitiveness	High	46	9366	41	254,146	47	6072
	Low	88	7463	86	245,465	115	6007
Integrity	High	123	**7631**	114	250,921	150	**6099**
	Low	12	**13042**	15	234,062	13	**5015**
Role	Buyer	68	7712	62	251,048	81	**5689**
	Seller	67	8517	66	246,838	81	**6322**
Overall model significance level with all entered			.016		423		.067
Corrected model			.003		N/A		**.015**

Note: Bold indicates differences significant at p value<.05.

Only one of the analysis of variance models was statistically significant, that for Distriibutive Gain. Only the variable Integrity was significant (p-value of .003). However, the Mixed Motive 2 model was close and a stepwise regression brought two variables into the model, Integrity and Role and it was significant with a p-value of .015.

In all three scenarios, women actually outscored men, although the differences were not statistically significant. Based on the literature, the expectations were than men would score higher than women in the distributive situation. The expectation that men would not dominate in mixed motive negotiations was supported by the data.

Competitiveness was not a statistically significant factor in any of the models and competitive individuals actually scored higher in each scenario. The expectation that competitiveness would inhibit the discovery of integrative solutions was not supported by the data. Since students were provided with strategies for achieving integrative solutions, that may have overcome the force of competitiveness. The fact that there were more low competitive individuals than highly competitive ones might have also played a role.

Integrity was statistically significant in the distributive exercise. Individuals with low levels of integrity scored much higher than did those with high levels of integrity. In both of the mixed motive negotiations, high levels of integrity proved to be of value, scoring higher in both exercises. Only in the second case was the difference statistically significant, suggesting perhaps that as mixed motive negotiations increase in complexity, integrity becomes even more important since the exchange of accurate information is crucial to make integrative tradeoffs.

Conclusions and Suggestions for Future Research

Before drawing any major conclusions, it is important to recognize the limitations of this research. Because the participants of this study are samples of convenience arising from two institutions, the findings may be limited to graduate students at those institutions. The fact that men did not outdo women in the distributive exercise is counter to previous findings. It is possible that self-selection of women into the negotiation class is a factor. Another reason might also be that prior to these exercises, students would have completed two exercises and had instruction on appropriate strategies and tactics that work for distributive and integrative negotiations. Such instruction might combat the disadvantage that women may face due to their dislike of negotiation and unwillingness to engage. If that is true, then it is possible that negotiation education can serve to greatly improve women's negotiation performance and that certainly may be true well beyond the walls of the two institutions in question.

That competitive individuals might do better in distributive zero-sum negotiations is not a surprise. Competitiveness did not serve to be a disadvantage in the integrative negotiations and, in fact, competitive individuals did score higher in them than non competitive individuals, though the differences were not statistically significant. Part of the thrust of Fisher and Ury's Principled Negotiation (1991) stresses that competitive individuals can focus their competitive natures on solving the problem and that could certainly overcome the fixed pie perception that seems to go along with competitiveness.

The mixed role of integrity is interesting. Low-integrity individuals had the advantage in a one-issue distributive negotiation. Lies and misrepresentation can certainly lead to advantage if the opponents believe them. The distributive negotiation always occurs early in the class, before students have time to come to know each other and make a judgment as to the trustworthiness of their classmates. The fact that high levels of integrity seemed to help in both mixed- motive negotiations underscores what the author has observed over a long period of years, that one of the biggest obstacles to achieving Pareto-optimal results in integrative negotiations is misinformation, given either by accident or on purpose. At least for the eight-issue negotiation, high integrity seems to be a major contributor to achieving integrative solutions. That is encouraging. One major limitation to this study is that it only focused on the competitiveness and integrity of one of the parties to the negotiation. A suggestion for future research is to identify the levels of integrity and competitiveness of both parties and see if the different combinations (high-high, low-high and low-low) might better explain the negotiation results. A better way to screen competitiveness and integrity would also be highly desirable as would be greatly increasing the sample size and thus, the power of the statistical tests.

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The Effects of Power and Sourcing Philosophy on Supplier Performance

Regis Terpend, Ph.D.
Assistant Professor of Supply Chain Management
Department of Information Technology and Supply Chain Management
College of Business & Economics
Boise State University
1910 University Drive, MS 1615
Boise, ID 83725-1615
Tel: 208-426-2949
Email: registerpend@boisestate.edu

Bryan Ashenbaum, Ph.D.
Assistant Professor of Supply Chain Management
Department of Management
The Richard T. Farmer School of Business
Miami University
501 East High Street
Oxford, OH 45056
Tel: 513-529-8013
Email: ashenbb@muohio.edu

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THE EFFECTS OF POWER AND SOURCING PHILOSOPHY ON SUPPLIER PERFORMANCE

Abstract. In this paper, we propose to study the direct and moderating effects of selecting a single sourcing strategy as opposed to a multiple sourcing strategy. More particularly, we investigate how the single vs. multiple sourcing decision may affect various sources of power used by buyers to extract performance from their suppliers.

Introduction. Empirical research in supply chain management places considerable emphasis on buyer-supplier relationships and the ways in which various relationship configurations translate into improved performance. Interestingly, relatively little empirical research has been conducted to study how the size of the supply base, more specifically whether a particular good or service is single or multi-sourced, might contribute to performance. The academic literature that exists essentially parallels the practitioner and educational material in debating the advantages and disadvantages of single vs. multiple sourcing strategies. There seems to be a sharp divide in opinion on the matter, with strong advocates on either side.

This paper attempts to address this issue by empirically investigating what potential impact the single or multiple-sourcing decision may have on a buyer's ability to extract supplier performance. Particularly, we propose to study how a single versus a multiple sourcing strategy may moderate the relationship between the exercise of various types of power and the performance extracted from a supplier. A better understanding of that moderating effect would be useful for companies in deciding what type of power to adopt in relation to what sourcing approach (i.e., single sourcing vs. multiple sourcing) in order to maximize the value extracted from a supplier.

The first research question motivating this study is: does the choice of a single-sourcing strategy (as opposed to a multiple-sourcing strategy) affect supplier performance, *ceteris paribus*? Given that buyer are interested in extracting performance from their supply base, and that power relationships are by definition included among the factors influencing buyer-supplier relationships, the second research question motivating this research is: does the choice of a single-sourcing strategy (as opposed to a multiple-sourcing strategy) influence the way in which sources of power are leveraged to extract performance from suppliers?

To address these questions, we chose to focus on six sources of power: French and Raven's (1959) classic five sources of power and manipulative power (Gaski, 1984). We collected and analyzed data to understand how these six forms of power affect supplier performance, and more precisely to study the direct and moderating effects of a single-sourcing strategy versus a multiple-sourcing strategy.

Literature Background: Single vs. Multiple Sourcing. Practitioner sources and educational materials place considerable emphasis on the importance of a key component of the supplier selection process: the decision to single or multiple source (in this manuscript, we differentiate between single sourcing, which implies choice, and *sole* sourcing, which indicates the use of one supplier due to the fact that no feasible alternatives exist, per Trevelen and Schweikhart, 1988). "Pro" single-sourcing practitioner authors tend to argue that its implementation results in greater cost savings, improved supplier performance and enhancement of the buyer-supplier relationship, particularly when considered along with total quality management (TQM) or just-

in-time (JIT) policies (see Cooke, 2004; Morgan, 2004; and Stork, 1999a; 1999b as typical in this regard). Those that are more "pro multiple sourcing" suggest that disruption of supply and increased dependence upon a complacent or opportunistic supplier are good reasons to approach single sourcing with great caution, if at all (Porter, 1999; Treece and Rechtin, 1997). Textbooks for purchasing/supply chain classes also lay out the advantages of each, and by and large come to similar conclusions. Two of these texts (Monczka et al., 2008; Benton, 2006) lay out the "pros and cons" of single vs. multiple sourcing in a few brief paragraphs, while the others (Burt et al.; Leenders et al.,) provide extensive "laundry lists" of the advantages of each.

Given the importance placed upon the single vs. multiple sourcing decision in practitioner sources and student educational materials, the academic literature is somewhat sparse. Among purely conceptual work, Hahn et al. (1986) argue that maintaining supplier competition does not (contra conventional wisdom) lead to reduced input costs. Ramsay (1990), in contrast, suggests that single sourcing should only be used when a buyer enjoys a large power advantage, and even then with caution. Newman (1989) offers a more balanced perspective, arguing that single sourcing contains the seeds of stifled innovation and increased buyer dependence. Trevelen and Schweikhart (1988) suggest a risk/benefit analysis model which can be used to determine which approach is best for specific situations. To some extent, the debate can be traced to the "giants" of quality and strategy, W. Edwards Deming and Micheal Porter, respectively. The fourth of Deming's fourteen points calls for a "move toward a single supplier for any one item, on a long-term relationship of loyalty and trust" (Deming, 1986, p.23). Alternative, Porter (1980) warns that single-sourcing cedes too much power to the supplier in question.

The empirical literature has attempted to establish the extent to which a single or multiple sourcing approach yields gains in supplier performance. Segal (1989) found that firms which tended towards the use of single sourcing placed greater emphasis on supplier price competitiveness, sales force helpfulness and delivery performance than did those favoring the use of multiple sourcing. Swift (1995) found that purchasing managers who favored single sourcing rated technical support, product reliability and total cost as more important than their counterparts who favored multiple sourcing, whereas the latter rated low price more important than did their counterparts. Larson and Kulchitsky (1998) found evidence that single sourcing was positively correlated with improved quality, reduced total buyer cost and increased buyer-supplier cooperation.

Research relying on mathematical modeling and simulation methods has helped to clarify the conditions under which single or multiple sourcing might be more efficacious. Yu et al. (2009) put forth a model suggesting when single or dual sourcing should be used, provided that profitability and the probability of a major supply disruption can be reasonably estimated. Hong and Hayya (1992) propose a just-in-time purchasing model to estimate an optimal number of suppliers (for multiple sourcing) or an optimal deliver number (in the case of single sourcing). Inderst (2008) examines a reverse auction model, suggesting that single sourcing is only advantageous in conditions where the buyer is relatively large vis-à-vis the supplier market. Richardson and Roumasset (1995) employ an agency modeling approach, and suggest that "parallel sourcing" (a form of multiple sourcing in which similar components are purchased from competing suppliers) is generally superior to single sourcing, given certain assumptions

regarding the tradeoffs between switching costs, monitoring costs and the credible threat of moving the business to a competing supplier.

Hypothesis Development. Beginning in the 1970s, the marketing literature began to focus upon the effect of power in distribution channels, but few articles have attempted to measure the direct effects of various sources of power on performance in the supply chain. Gaski and Nevin (1985) found no significant relationship between exercised reward or coercive power and dealer sales. Brown et al. (1995) found evidence that mediated and non-mediated power were influential on two different types of supplier performance (demand stimulation and support activities), as well as retailer's financial performance.

In contrast, the bulk of the power literature has emphasized effects of various sources of power on other relevant aspects of the buyer-supplier relationship, including conflict level (e.g., Lusch 1976; Gaski and Nevin, 1985); Frazier and Rody, 1991; Maloni and Benton 2000), trust (e.g., Busch and Wilson, 1976; Maloni and Benton 2000;), collaboration (e.g., Benton and Maloni 2005), commitment (e.g., Maloni and Benton, 2000) and satisfaction (e.g., Hunt and Nevin, 1974; Gaski and Nevin, 1985). In general, the power literature assumes that the relationship between various sources of power and performance is indirect and mediated by the factors previously mentioned.

The different sources of power can be classified into two sub-categories: mediated and non-mediated power. *Mediated* sources of power (*coercive* and *reward* sources of power) implies that the source of power deliberately controls the reinforcements that change the behavior of the target (Brown et al., 1995). *Non-mediated* sources of power include *expert*, *referent* and *legitimate* (Maloni and Benton, 2000). Overall, empirical research findings suggest that mediated forms of power tend to have a negative effect on performance, while non-mediated forms of power have a positive effect on performance. These results have been confirmed by measuring both the direct and indirect effects of mediated and non-mediated forms of power. For instance, Maloni and Benton (2000) found that mediated forms of power have a negative effect on trust and commitment while non-mediated forms of power have a positive effect on trust and commitment. In turn, trust and commitment have a positive effect on supply chain performance (Brown et al., 1995; Maloni and Benton, 2000; Benton and Maloni, 2005).

The study of performance in the power literature has also tended to focus on generic or aggregate measurements of performance rather than more specific types of performance. For instance Maloni and Benton (2000) used aggregate measures for supplier performance, buyer performance and supply chain performance. In this paper, we segregate performance into the five dimensions of purchasing performance proposed by Krause, Pagell and Curkovic (2001): delivery, quality, cost, innovation, and flexibility. In the absence of prior research linking mediated and non-mediated power to these specific measures of performance, we posit that the effect of mediated and non-mediated power will be similar for all five dimensions of supplier performance:

H1: Non-mediated sources of power have a significant and positive effect on delivery, quality, cost, innovation and flexibility performance extracted from that supplier.

H2: Mediated sources of power have a significant and negative effect on delivery, quality, cost, innovation and flexibility performance extracted from that supplier.

When it comes to foster quality and innovation, the literature makes a compelling argument in favor of single sourcing. Treleven and Schweikhart (1988) note that reaching a high standard of quality often requires a deep involvement of buyers with suppliers, and is therefore easier to achieve with fewer suppliers. They suggest that single-sourcing permits suppliers to better understand buyer needs and to enable them to continuously improve processes and reduce variation. Over time, buyers and suppliers are able to share quality systems and learn from one another. For a buyer, choosing multiple suppliers would of necessity create weaker links than would be possible with a single supplier, and in addition discrepancies among multiple suppliers would create another potential source of problems. Larson and Kulchitsky (1998) found evidence suggesting that single-sourcing leads to higher supplier quality.

Single sourcing also favors innovation. Suppliers in a single-sourcing situation are more likely to share information about new product development with a partner buyer. Moreover, suppliers are more willing to invest more in new technology because of a higher likelihood to recover their development costs. Single sourcing also allows the buyer to work with a supplier from the early stages of product development and work on developing product and processes.

Single sourcing promotes delivery reliability because it is much easier for a buyer to coordinate delivery from a single supplier than it is from multiple suppliers (Treleven and Schweikhart, 1988). Segal (1989) found evidence that firms pursuing single-sourcing strategies placed higher emphasis on a suppliers ability to deliver shipments promptly. In the long-term, single-sourcing provides a better opportunity for buyers and suppliers to coordinate their production schedules and improve delivery schedules.

The ability of one supplier to provide flexibility would imply a high level of assets specificity of that supplier with the buyer's product and would probably require costly investment. It is unlikely that a supplier would invest in a flexible process if it does not have the assurance of receiving orders from a customer. Therefore, we posit that single sourcing would increase the propensity of one particular supplier to improve flexibility.

The literature is somewhat more ambivalent about whether single sourcing or multiple sourcing is the best approach for cost reduction. Segal (1989) found that firms following a single-sourcing strategy were more concerned with price competitiveness than were those following a multiple-sourcing strategy, but Swift(1995) found that purchasing managers who preferred multiple-sourcing focused on low prices to a greater extent than their counterparts:

> *$H3_a$: Single sourcing has a significant and positive effect on delivery, quality, innovation and flexibility performance extracted from one particular supplier compared to purchasing from the same supplier in a multiple sourcing context.*
>
> *$H3_b$: Single sourcing has no significant effect on cost performance extracted from a supplier compared to purchasing from the same supplier in a multiple sourcing context.*

In a single-sourcing context, the buyer's dependence upon the supplier increases its vulnerability (Ramsay, 1990). The supplier may well be aware of the advantage afforded by this situation, and is likely in good position to "rebel" if it feels uncomfortable with the level of pressure the buyer exerts. Since mediated power can be thought of as the most offensive form

of power (from the standpoint of the party against whom the power is exercised), its use has considerable potential to negatively affect the buyer-supplier relationship. Indeed, mediated power has been shown to increase the level of conflict (Lusch, 1976; Gaski and Nevin 1985; Maloni and Benton, 2000), which in turn has a negative impact on performance (Maloni and Benton, 2000). Mediated power essentially relies on positive and negative reinforcement which results in the "infantilization" of the supplier vis-à-vis the buyer. Conversely, research indicates that non-mediated power tends to promote collaboration (Maloni and Benton, 2000). We expect that the effect of mediated power on performance will be exacerbated in a negative way in a single sourcing context because the supplier has more power and may choose not to comply with it. On the other hand, we hypothesize that non-mediated power will have a stronger influence on supplier performance in a multiple sourcing context because non-meditated power will be more meaningful to suppliers than in a single sourcing context. In a single-sourcing context, the act of selecting a single source already sends a strong signal to the supplier that it has a special relationship with the buyer, which will decrease to impact of additional non-mediated power that would come on top of it.

$H4_a$: Single sourcing has a negative moderating effect on the relationship between mediated sources of power and supplier performance compared to multiple sourcing.

$H4_b$: Single sourcing has a negative moderating effect on the relationship between non-mediated sources of power and supplier performance compared to multiple sourcing.

Methodology. We collected survey data from 226 buyers in a sample of US industrial firms and analyzed the results via a hierarchical multiple regression.

Results. Results will be presented in a later version of the paper.

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The Effect of Operations Strategy on Supplier-Customer Relationships and Suppliers' Financial Performance

Yoon Hee Kim, PhD Student
University of Wisconsin-Madison
(608) 770-6343; ykim@bus.wisc.edu

Urban Wemmerlöv, Professor
University of Wisconsin-Madison
(608) 262-0305; uwemmerlov@bus.wisc.edu

Abstract. Effective relationship management, as a key to a firm's success, has received much attention in the growing field of supply chain management. As a part of relationship management, leading OEMs have reduced their supplier base and reportedly developed closer relations with fewer suppliers. It has been argued that close relationships enhance the financial performance of the *buyer firms* through reduced costs and increased revenues. Yet, the benefits of close relationships (financial or non-financial) accruing to *supplier firms* have not been well documented. In this study, we empirically assess the strategic, financial, and power-based issues associated with supplier-manufacturer relationships *from the supplier's perspective.* Specifically, we investigate how the supplier's choices of operations strategy affect its relationship closeness with, and profitability from, the customer as mediated by the power-dependence relation. Using cross-sectional data collected from 158 suppliers in the manufacturing industry, we tested the direct and mediated relationships among the operations strategy, the power-dependence relation, the supplier-manufacturer closeness, and the supplier's financial performance.

Introduction: For more than a decade there has been a large and growing interest, among academics and practitioners alike, in the value of effective supply chain management (SCM) practices. The literature suggests that a move towards to close relationships between suppliers and customers is mutually beneficial for both parties. This notion has been widely accepted among original equipment manufacturers (OEMs) in the U.S (*Economist* 2006). As a result, leading OEMs have reduced their supplier base in recent years and reportedly developed closer relationships with a selected few suppliers (Johnston et al. 2004).

It has been argued that close relationships enhance the financial performance of the *buyer firms* through reduced costs and increased revenues (Noordewier et al. 1990; Cannon and Homburg 2001). Yet, the benefits of close supplier-buyer relationships accruing to *supplier firms* are seldom explicitly stated (New 2004, p.81) nor empirically demonstrated in the large body of research on SCM (one exception is Kalwani and Narayandas 1995). This gap in the literature is the starting point of this research.

Unlike a common belief on the mutual benefits of close relationships, there are many reports in the press about suppliers' complaining about their customers' opportunistic behaviors. These behaviors include forced and excessive price concessions (Bunkley 2006), punitive actions (Hingley 2005) and broken long term contracts (Velocci 1999). Anecdotal evidence suggests that unprofitable customer relationships may not be uncommon among suppliers (Helm et al. 2006), possibly due to power unbalances in the relationships (Bunkley 2006).

In this study, we investigate strategic, financial, and power-based issues associated with supplier-customer relationships *from the supplier's perspective*. Our purpose is to understand what a supplier firm can do to maintain and enhance its profitability relative to individual customers. Specifically, we investigate whether and how a supplier's strategic choices in the operations area affect its relationship with a customer and help balance risks and rewards in the exchange.

Literature Review and Hypotheses: Resource dependence theory views a business relationship to be a social exchange of critical resources with mutual dependency among the exchange partners. Thus, the survival and growth of organizations largely depend on the ability to secure critical resources from the external environment (Pfeffer and Salancik 1978; Casciaro and Piskorski 2005). Yet, transaction cost analysis (TCA) suggests that every transaction has costs. These costs are incurred for adaptation, performance evaluation and safeguarding, and are associated with uncertainty, opportunism, and transaction specific assets (TSAs)[1] invested in the relationship (Williamson 1996). Specifically, TCA identifies opportunism as the hazard of behavioral uncertainty and argues that TSAs raise the cost of safeguarding against opportunistic behaviors where one party may exploit the other for unilateral benefits (Heide and John 1990; Heide 1994; Bensaou and Anderson 1999; Ghosh and John 1999, 2005).

While resource dependence theory focuses on mutual dependence between exchange partners even before the initiation of a relationship (*ex ante)* due to critical resources, TCA assumes that two parties are initially independent but develop bilateral dependence after the initiation of a relationship (*ex post)* due to investments in TSAs over the course of the relationship (Heide 1994, p. 73; Casciaro and Piskorski 2005, p. 174). Although resource dependence theory and TCA originate from different point of view (sociology and new institutional economics, respectively), both theories recognize the existence of interdependency between exchange partners and the importance of safeguarding valued resources from environmental and behavioral uncertainty (Heide 1994).

[1] Transaction specific assets refer to specialized assets used to service the particular needs of the exchange parties (Williamson 1996). Firms invest in TSAs in order to create additional values above what standard product and service offerings can do (Ghosh and John 1999). Examples of TSAs include the development of idiosyncratic knowledge, the provision of dedicated human resources and training, and capital investment in specialized equipment and facility improvement (Williamson 1996). Being unique to a relationship, and possessing little or no value upon the relationship termination, TSAs are often viewed as "valuable but vulnerable" investments (Ghosh and John 1999, 2005; Wathne and Heide 2004).

Ghosh and John (2005) argue that a firm aligns with its exchange partners (i.e., a supplier and a customer) to jointly create values in the market, through cost reductions and/or value additions, based on firm-specific resources and investment in TSAs. From the customer's perspective, they argue that the buying firm needs to take different approaches to the supplier relationship management depending on its strategic goals (e.g., cost reduction or product enhancement) in order to safeguard valued resources (i.e., joint values created and TSAs) from behavioral uncertainty of the supplier. *From the supplier's perspective*, this suggests that the supplier contributes to the joint creation of values by providing the critical resources (products and services) and/or making investment in TSAs. Thus, the criticality of the supplier's products/services and the level of its TSAs invested in the relationship will largely influence the customer's dependence on the supplier.

To improve the values of products and services, supplier firms develop and strengthen operations capabilities by implementing various operational practices and processes (Ittner and Larcker 1997a). Given the limited resources, the operations' task within organization is to match a firm's internal resources to competitive priorities so as to achieve advantages relative to the competitors in the market (Wheelwright 1984). A firm's competitive priorities can be supported by operations capabilities developed through the adoption of practices and processes. There are five dimensions of capabilities frequently mentioned in the literature: *cost efficiency, conformance quality, delivery dependability, flexible responsiveness* and *innovative product development* (Noble 1995; Ward and Duray 2000). By implementing any of these capabilities either individually or collectively, a firm can improve the values of its products and services.

In sum, *ex ante* mutual dependence exists due to critical resources and *ex post* mutual dependence is increased by TSAs in addition to critical resources (Heide and John 1988; Heide 1994; Casciaro and Piskorski 2005). This suggests that mutual dependence would increase over time as the level of investment in TSAs increases and/or the value of critical resources exchanged increases. From the supplier's perspective, *mutual dependence* increases and *power imbalance* decreases as a customer's dependence on the supplier increases. A customer's dependence – given any level of its investment in TSAs – will increase as the value of critical resources (products and services) from the supplier increases. The value of a supplier's product and services to a customer will presumably improve through the development and strengthening of its capabilities. In this regard, a supplier's capabilities should increase its customer's dependence on the supplier and, in turn, decrease the *power imbalance* while increasing the *mutual dependence*. Thus, our first hypothesis is as follows:

> Hypothesis 1: As the degree to which a supplier implements capabilities increases, the *power imbalance* in a customer relationship decreases while the *mutual dependence* increases.

Some capabilities are believe to be complementary (Ferdows and De Meyer 1990) while some need a trade-off due to the different resource requirements (Boyer and Lewis 2002). Based on

these characteristics, capabilities can be grouped into two broad strategic focuses: *improvement* and *innovation* (Cole 2001; Peng et al. 2008). *Improvement* can be defined as a focus on refinement of existing products/processes and internal operations efficiency (Peng et al. 2008), and is associated with three capabilities: *conformance quality, delivery dependability* and *cost efficiency* (Noble 1995). *Innovation* as a strategic focus can be defined as an emphasis on assisting customers through flexible and innovative operations (Cole 2001), and associated with two capabilities: *flexible responsiveness* and *innovative product development* (Hayes et al. 2005). Due to resource limitation, firms often develop capabilities skewed to either improvement or innovation depending on resources and industry conditions, although some may pursue both types (Cole 2001).

Capabilities contribute to business performance either individually or collectively (Noble 1995; White 1996). Thus, both strategic focuses can help firms to compete on operational excellence in the market (Peng et al. 2008). Yet, each strategy creates a different path to superior business performance through different earning mechanisms, different levels of closeness in customer relationships, and different levels of investments in TSAs. The *improvement* strategy, for example, may enable firms to enhance profitability through an increase in sales volume at low margins without developing a close relationship with the customer. Customers may have intentions to expand future business volumes with suppliers that offer a cost advantage (Cannon and Homburg 2001). However, they may not necessarily be motivated to invest in TSAs, nor to develop closer relationships with those suppliers, because the products and/or services can usually be delivered through standard procedures (Bensaou and Anderson 1999). Similarly, suppliers focusing on an *improvement* strategy may not be motivated to invest in TSAs nor to develop close relationships by increasing customer involvement because they can achieve cost savings through internal operations efficiencies. Rather, such suppliers often attempt to increase sales by offering low prices to customers (Kalwani and Narayandas 1995; Cannon and Homburg 2001).

In contrast, an *innovation* strategy may enable firms to increase profitability through increased market shares and premium pricing at high margins, while promoting close relationships with customers. Customers seeking a product-enhancement advantage from suppliers, on the other hand, need to build close relationships with them in order to reduce the risks of uncertainty in downstream markets (Ghosh and John 2005). In the presence of downstream uncertainty, the ability of customers to respond to demand changes is highly contingent on their suppliers' ability and willingness to cope with change requests (Wathne and Heide 2004; Ghosh and John 2005). Thus, customers often use qualification programs to assure that suppliers' operating capabilities can accommodate such needs. They can also make investments in TSAs to increase suppliers' willingness to cooperate while urging the suppliers to do the same to reduce their opportunism (Wathne and Heide 2004). High level of TSAs is believed to increase *mutual dependence* (Heide and John 1990) and expand cooperation between exchange partners (Heide and Miner 1992). More specifically, customers tend to invest in TSAs to support non-standardized tasks such as the development of highly customized or new products (Bensaou and Anderson 1999). They are also likely to be involved in their supplier's product development process by partaking in cross-functional teams and/or various design

practices, such as quality function deployment, design of experiments, and failure mode and effects analysis (Ittner and Larcker 1997b).

Similarly, suppliers pursuing an *innovation* strategy are likely to make investments in TSAs, such as engineer training and custom design tools (Bensaou and Anderson 1999), and develop close relationships with customers by cooperating in the product development process (Ittner and Larcker 1997b). Thus, innovation-oriented suppliers not only have a higher dependence on customers than those focusing on improvement, but they also increase the customers' dependence on them to a greater extent. As a result, suppliers focusing on an *innovation* strategy are likely to show a lower *power imbalance* and a higher *mutual dependence* than those focusing on an *improvement* strategy. As such, the criticality of the supplier's resources and the level of the customer's investments in TSAs may vary depending on the supplier's operations strategy. Thus, our second hypothesis is as follow:

> Hypothesis 2: Capabilities associated with an *innovation* strategy have a more favorable impact on a supplier's power imbalance and mutual dependence than do capabilities associated with an *improvement* strategy.

Mutual dependence and *power imbalance* may have different effects on the closeness of a supplier-customer relationship and the supplier's ability to claim its share of jointly created value. As *power imbalance* increases in a relationship, for example, the parties may have more conflicts (Gundlach and Cadotte 1994; Kumar et al. 1995) and less commitment due to a high potential for opportunism and a lack of trust between the firms (Kumar et al. 1995). As a result, a high *power imbalance* may reduce cooperation between the exchange partners (Heide 1994) and impede the weak party's ability to achieve its desired outcomes (Buchanan 1992). High *mutual dependence*, on the other hand, may reduce conflicts while increasing commitment and trust between the exchange partners (Gundlach and Cadotte 1994; Kumar et al. 1995). As *mutual dependence* increases, the parties will be engaged in more frequent exchanges with each other (Piskorski and Casciaro 2006) and adjust to the needs of the other party under a low risk of opportunism (Heide 1994). Thus, *mutual dependence* improves cooperation between parties and can result in greater joint value (Jap 1999).

From the supplier's perspective, this suggests that as its *power imbalance* decreases the supplier can develop a closer relationship with the customer through increased cooperative activities such as information sharing and joint decisions, and can jointly create higher values in the market. Furthermore, a supplier's increased relative power can improve its financial gains from the relationship because the supplier will have greater bargaining power with the customer when it comes to dividing the value created in the relationship. Similarly, in the presence of high *mutual dependence,* suppliers can develop closer relationships with customers and create greater joint value. In return, suppliers can financially benefit from the relationships due to frequent exchanges and low opportunism in sharing created values with the customers. So, our third and fourth hypotheses are as follow:

Hypothesis 3a: As a supplier's *power imbalance* reduces, the supplier-customer relationship becomes closer through expanded information sharing and more joint decisions.

Hypothesis 3b: As *mutual dependence* increases, the supplier-customer relationship becomes closer through expanded information sharing and more joint decisions.

Hypothesis 4a: As a supplier's *power imbalance* reduces, the supplier's profitability from the relationship with the customer increases.

Hypothesis 4b: As *mutual dependence* increases, the supplier's profitability from the relationship with customer increases.

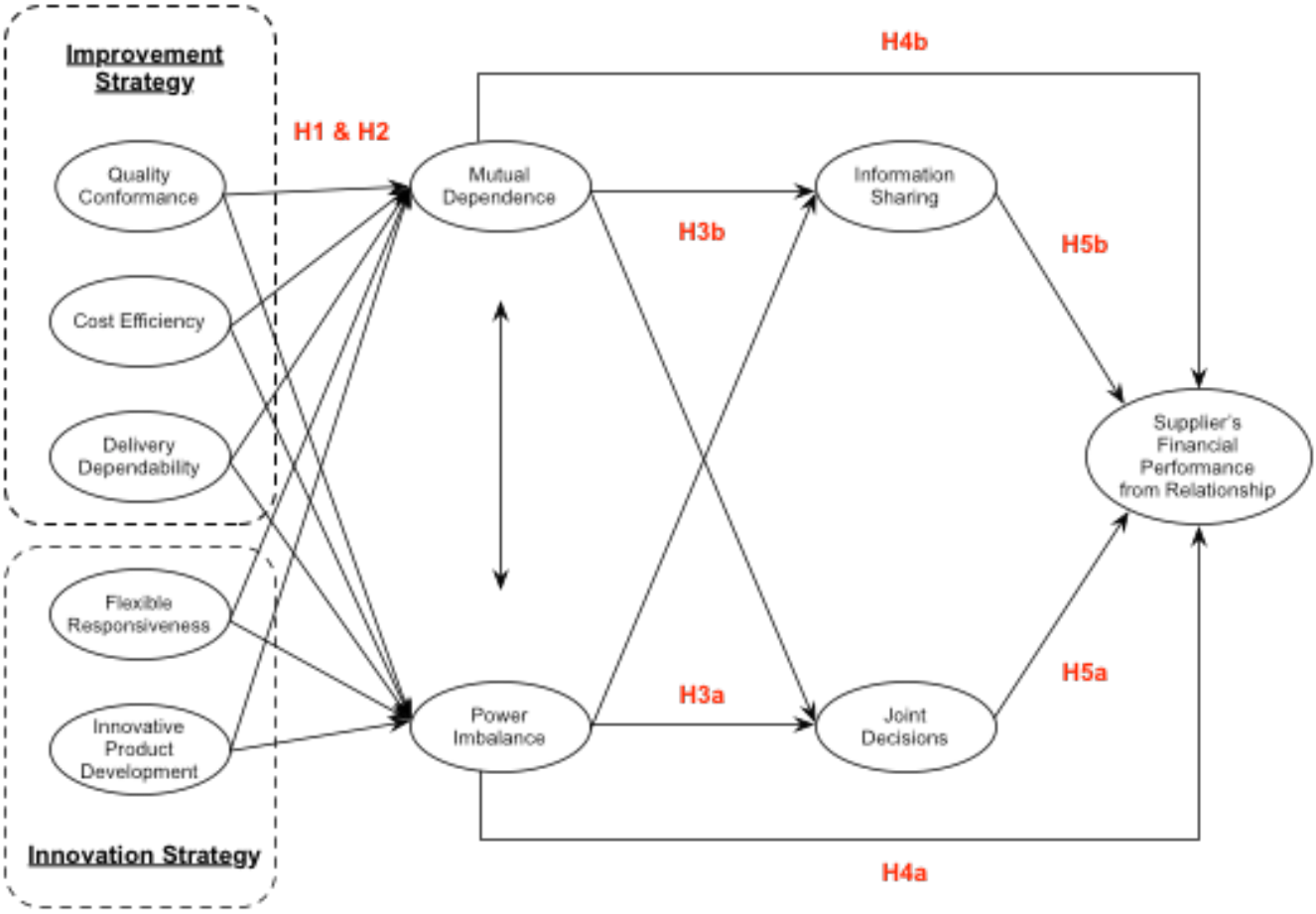
The literature views the ideal relationships between supplier and customer firms as cooperative for mutual benefits. Cooperative activities can bring the parties closer to each other and generate benefits for suppliers. For example, suppliers can increase revenues by selling more of existing products and/or by offering new products and services to the incumbent customers through information sharing and/or joint decisions (Lyons et al. 1990; Kalwani and Narayandas 1995). Suppliers can also save money on the selling, administrative and general expenses by servicing return customers (Kalwani and Narayandas 1995) and reduce inventory and manufacturing costs by improving demand forecasts and manufacturability through information sharing and/or joint decisions (Lyons et al. 1990; Kalwani and Narayandas 1995; Hayes et al. 2005). Yet, the parties may incur higher costs of information sharing, activity coordination, and investments in TSAs as they develop closer relationships (Lyons et al. 1990). Thus, there are both costs and benefits associated with close relationships between suppliers and customers (Lyons et al. 1990). We believe, however, that supplier firms will receive net gains from close relationships with customers because, without sufficient returns, suppliers eventually have to disassociate themselves from cooperation (Kalwani and Narayandas 1995; Helm et al. 2006). Thus, our last hypothesis is as follow:

Hypothesis 5a: As the degree to which joint decisions increase in a supplier-customer relationship, the supplier's profitability from the relationship improves.

Hypothesis 5b: As the degree to which information sharing increases in a supplier-customer relationship, the supplier's profitability from the relationship improves.

The relationships referred to in the five hypotheses are illustrated in Figure 1.

Figure 1: Conceptual Framework of the Effects of Operations Strategy on the Supplier-Customer Relationship and Suppliers' Profitability from the Relationship



Data Collection: Cross-sectional data were collected by survey from 158 suppliers in the U.S. manufacturing industry through an extensive data collection process. Firstly, we conducted interviews with regional supplier firms in manufacturing industry to confirm whether the research topic is relevant to practice and interesting to managers. Based on the literature review and interviews, we developed a self-administered questionnaire available both online and by mail, and refined it through a Q-sort exercise, an expert review and a pre-test with professionals. Before distributing the questionnaire, we randomly drew a sampling frame of 3,107 manufacturing firms operating in SIC 34–38 with an employee base between 100 and 1000 from a commercial database (www.OneSource.com). We then contacted all of them by phone (1) to identify a manufacture supplying to other manufacturing companies and (2) to recruit a key informant who is knowledgeable about the topics of our research interests. We made the questionnaire available (via mail and online) to 1,334 firms and received 158 usable responses with the effective response rate of 14.6%.

Data Analysis: We assessed non-response bias (Groves et al. 2004) by comparing responding firms (n = 158) with non-responding firms (n = 150) on key demographic characteristics such as SIC code, number of employees, and annual sales revenues. There was no sign of non-response bias. We also assessed two types of response bias by the response method (i.e., online vs. mail) and the response time (i.e., early vs. late) (Dillman 2007). Following Johnston et al. (2004), we considered early responses to be those who responded to the survey prior to the first reminder (n = 63). The *t*-test was performed to investigate the mean differences in responses to 50 scale items between online and mail responses and between early and late responses, respectively. The results suggested no significant differences at alpha of 0.05 for 92% and 94% of the items, respectively.

Operations strategy is defined as a pattern of decisions regarding the selection and development of capabilities – with the latter accomplished through a variety of strategic choices of operational practices and processes. To measure the capabilities-based concept of operations strategy in this relatively new perspective (Ketokivi and Schroeder 2004; Peng et al. 2008), we created a number of new items in addition to existing items adapted or adopted from the literature. For content validity, the 28 items measuring operating practices/processes were reviewed by four academic experts who associated each item with a specific capability. Through the Q-sort exercise, it was suggested that certain practices and processes are related to more than one capability. Therefore, we performed exploratory analysis to identify the dimensional structure of capabilities – the number of distinctive capabilities and the unique practices associated with each capability – prior to confirmatory analysis.

We randomly split the total sample (n = 158) into equal halves (n = 79) to be used for calibration and validation, respectively. In the first stage, we used the calibration sample to define a measurement model through exploratory and confirmatory analysis. For exploratory analysis, we first evaluated a Corrected Item to Total Correlation (CITC) for item reliability (Netemeyer et al. 2003) and then performed exploratory factor analysis (EFA) to identify the structure underlying the capabilities. EFA was conducted with CF-Varimax oblique rotation and the maximum likelihood (ML) estimation method using M-plus 5.0 (Muthén and Muthén 2007). From this iterative analysis with two to seven factors in multiple steps, a 6-factor solution was chosen based on interpretability and goodness of fit.

Although five dimensions of capability were adopted for our analysis based on the literature (see Figure 1), two distinctive dimensions of *innovative product development* were suggested by the EFA. One dimension is manifested by practices such as the use of design of experiment (DOE), quality function deployment (QFD) and failure mode of effects analysis (FMEA). The other dimension is manifested by practices such as the involvement of engineers, the use of cross-functional teams and design for ease of manufacturing. According to Flynn et al. (1999), the former group of practices focuses on product design to shorten lead time by developing right product specifications for both the customer and the producer while the latter group of practices focuses on minimizing ramp-up time into full production by avoiding over-specifications of products. To separate the two, we labeled the former dimension as *innovative product design* and the latter dimension as *innovative product development*.

After EFA, we performed a confirmatory factor analysis (CFA) to evaluate the adequacy of the dimensional structure extracted during EFA and to assess the construct validity of the measurement model. CFA was conducted with LISREL 8.80 using ML estimation with a covariance matrix extracted from the raw data. The result suggested convergent validity, item-level reliability and unidimensionality of the measurement model. Although we assessed the validity and reliability of all measures separately with calibration, validation and whole samples, we present the results only for the whole sample in Table 1 to avoid redundancy. Overall, 50 scale items were reduced to 34 during calibration.

Table 1: Validity and Reliability of the Measurement Model for the Whole Sample (n = 158)

Item		Latent Variable	λ_i (*t*-value) [a]	R^2	Cronbach's α	Composite Reliability	AVE
QUAL1	←	Conformance Quality [QUAL]	0.72 (8.05)	0.51	0.68	0.69	0.52
QUAL2	←	Conformance Quality [QUAL]	0.73 (8.18)	0.53			
EFF1	←	Cost Efficiency [EFF]	0.68 (8.14)	0.46	0.69	0.70	0.42
EFF2	←	Cost Efficiency [EFF]	0.61 (7.22)	0.37			
EFF3	←	Cost Efficiency [EFF]	0.65 (7.78)	0.43			
EFF4	←	Cost Efficiency [EFF]	0.49 (5.62)	0.24			
DEL1	←	Delivery Dependability [DEL]	0.54 (5.10)	0.30	0.46	0.49	0.33
DEL2	←	Delivery Dependability [DEL]	0.59 (5.33)	0.35			
FLEX1	←	Flexible Responsiveness [FLEX]	0.63 (5.72)	0.40	0.62	0.63	0.46
FLEX2	←	Flexible Responsiveness [FLEX]	0.72 (6.13)	0.52			
IPD1	←	Innovative Product Development [IPD]	0.79 (9.64)	0.62	0.72	0.74	0.50
IPD2	←	Innovative Product Development [IPD]	0.83 (10.18)	0.69			
IPD3	←	Innovative Product Development [IPD]	0.45 (5.39)	0.20			
IPDS1	←	Innovative Product Design [IPDS]	0.77 (10.01)	0.59	0.80	0.80	0.57
IPDS2	←	Innovative Product Design [IPDS]	0.75 (9.74)	0.57			
IPDS3	←	Innovative Product Design [IPDS]	0.74 (9.59)	0.55			
SDP1	←	Supplier's Dependence [SDP]	0.66 (7.44)	0.43	0.68	0.72	0.46
SDP2	←	Supplier's Dependence [SDP]	0.62 (7.05)	0.38			
SDP3	←	Supplier's Dependence [SDP]	0.76 (8.35)	0.58			
CDP1	←	Customer's Dependence [CDP]	0.65 (7.74)	0.42	0.75	0.76	0.52
CDP2	←	Customer's Dependence [CDP]	0.63 (7.57)	0.40			
CDP3	←	Customer's Dependence [CDP]	0.89 (10.05)	0.75			
INF1	←	Information Sharing [INF]	0.76 (10.54)	0.58	0.84	0.84	0.58
INF2	←	Information Sharing [INF]	0.81 (11.40)	0.65			
INF3	←	Information Sharing [INF]	0.67 (8.86)	0.45			
INF4	←	Information Sharing [INF]	0.79 (11.16)	0.63			
JD1	←	Joint Decisions [JD]	0.52 (6.41)	0.27	0.79	0.80	0.45
JD2	←	Joint Decisions [JD]	0.68 (8.80)	0.46			
JD3	←	Joint Decisions [JD]	0.67 (8.68)	0.45			
JD4	←	Joint Decisions [JD]	0.80 (10.88)	0.63			
JD5	←	Joint Decisions [JD]	0.65 (8.36)	0.42			
PERF1	←	Supplier's Performance [PERF]	0.54 (7.06)	0.29	0.82	0.84	0.65
PERF2	←	Supplier's Performance [PERF]	0.98 (14.73)	0.96			
PERF3	←	Supplier's Performance [PERF]	0.84 (12.01)	0.71			

[a]Standardized factor loading (*t*-value).

In the second stage, we cross-validated the measurement model – specified *a priori* – with the validation sample to evaluate the generalizability of the measures (Anderson and Gerbing 1988; Netemeyer et al. 2003). The results showed the similar pattern and size of factor

loadings in the calibration and validation samples, suggesting invariance of form across samples (Netemeyer et al. 2003).

In the last stage, we tested validity, reliability and unidimensionality of all measures for the whole sample and presented the results in Table 1 and 2. The overall fit indices suggested that the *a priori* specification of the measurement model is a good fit to the data (chi-square = 588.55, d.f. = 472, RMSEA = 0.04, Standardized RMR = 0.065, CFI = 0.92, NNFI = 0.91). Reliability was assessed by Cronbach's Alpha, composite reliability, and average variance extracted (AVE) (Fornell and Larcker 1981; Bollen 1989; Netemeyer et al. 2003; Hair et al. 2006). Cronbach's Alpha exceeded the threshold value of 0.60 for 5 of 6 newly constructed or adapted latent variables (LV) and exceeded the threshold value of 0.70 for 4 of 5 existing latent variables (Robinson et al. 1991; Hair et al. 2006). Composite reliability exceeded the recommended value of 0.70 for 8 out of 11 latent variables (Hair et al. 2006). AVE exceeded the recommended value of 0.50 for 6 out of 11 latent variables (Fornell and Larcker 1981). Since the reliability measures are largely influenced by the number of items (Bollen 1989; Netemeyer et al. 2003; Hair et al. 2006), the latent variables with two indicators (i.e., QUAL, DEL, and FLEX) showed lower reliability than those latent variables with three or more indicators. However, only DEL failed to exceed the reliability threshold values for all three tests. Therefore, DEL was removed from further analysis. Discriminant validity was assessed by the chi-square difference between the constrained and unconstrained models for all possible pairs of latent variables. As reported in Table 2, the chi-square difference tests suggest discriminant validity for all latent constructs.

Table 2: Correlations and Discriminant Validity for Whole Sample (n = 158)

	LV	Mean	S.D.	1	2	3	4	5	6	7	8	9	10
1	QUAL	5.96	1.18		27.50	27.86	36.19	44.50	41.75	42.31	47.99	38.27	42.82
2	EFF	4.81	1.37	0.54**		26.70	97.49	109.34	128.03	116.88	126.12	119.40	179.25
3	FLEX	5.20	1.46	0.34**	0.27*		26.61	35.80	32.98	31.33	28.24	24.82	30.91
4	IPD	5.38	1.23	0.39**	0.38**	0.35**		103.82	100.30	108.41	98.27	97.66	99.48
5	IPDS	4.13	1.77	0.10	0.31**	-0.14	0.20*		96.53	121.09	148.33	153.67	172.18
6	SDP	5.05	1.02	-0.08	0.02	-0.27*	0.06	0.14		95.08	88.40	98.31	94.04
7	CDP	4.47	1.20	0.04	-0.03	0.15	-0.005	0.16	0.16		125.31	127.69	119.93
8	INF	5.26	1.00	0.27**	0.04	0.33**	0.09	-0.001	0.20*	0.03		130.52	156.27
9	JD	4.67	1.08	0.33**	0.14	0.33**	0.29**	0.16	0.19	0.10	0.63**		177.24
10	PERF	3.87	1.09	-0.05	0.008	0.29**	0.01	-0.07	-0.30**	-0.03	0.30**	0.16	

The lower triangle shows correlations with * $p < 0.05$ and ** $p < 0.01$ (two-tailed *t*-test). The upper triangle shows the difference in χ^2-test statistic between the constrained and unconstrained CFA models; all χ^2 differences are significant at $p < 0.01$

Lastly, we assessed common method bias by Harmon's single-factor test and the marker-variable technique (Lindell and Whitney 2001; Malhotra et al. 2006). Firstly, we used CFA to test Harmon's single-factor model as Malhotra et al. (2006) did. The result showed a poor fit to the data, suggesting no evidence for substantial common method bias (chi-square = 1922.70, d.f. = 527, RMSEA = 0.130, SRMR = 0.347, CFI = 0.53, NNFI = 0.50). Secondly, we used a marker-variable to estimate common method variance (CMV) as suggested by Lindell and Whitney (2001). The results suggested that CMV is unaccountable for the statistical significance of the correlations observed in Table 2. Hence, common method bias should not be a problem in this study.

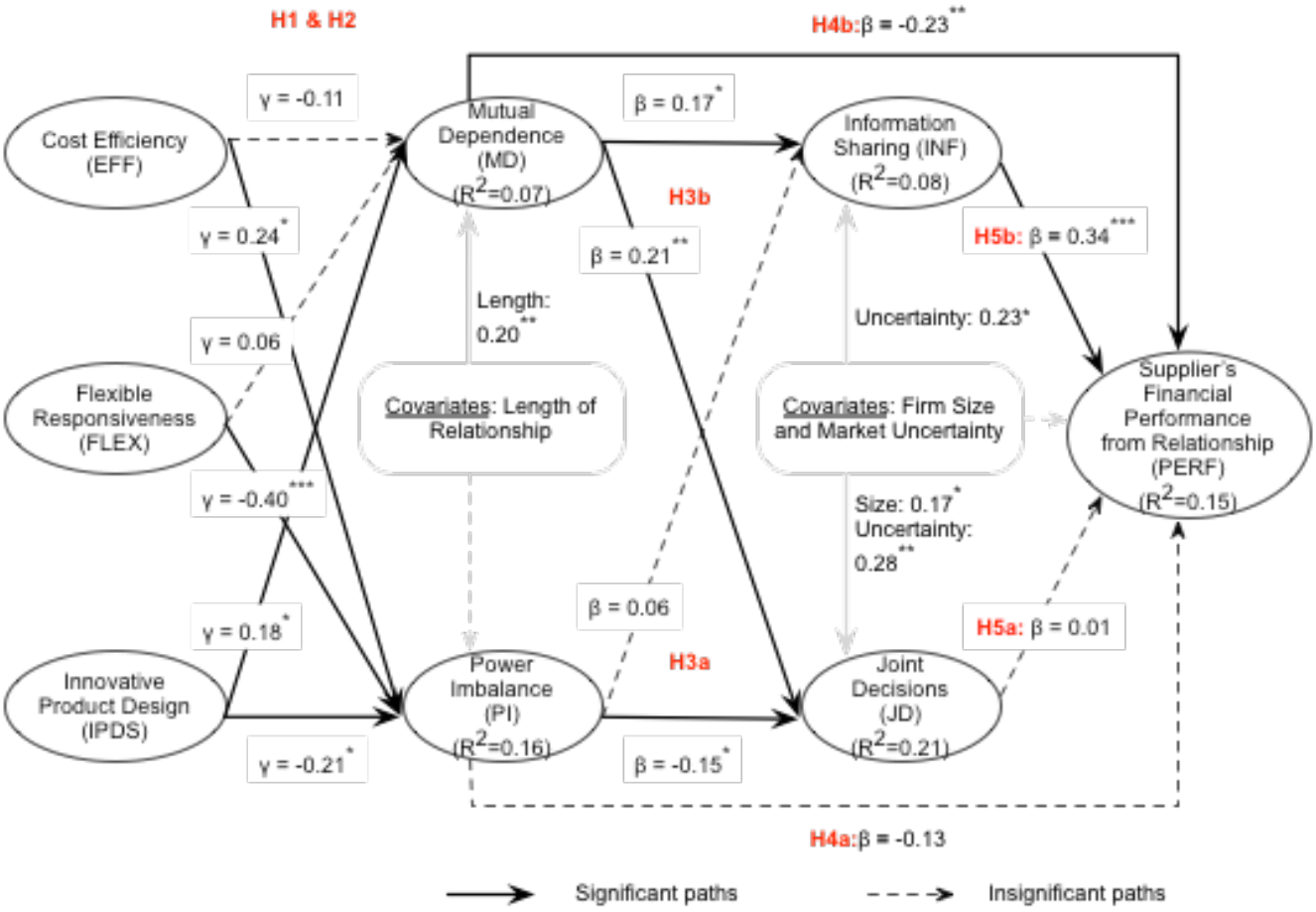
Results: Overall, our analysis indicates that our conceptual framework is supported by the data (Figure 2). As for the hypotheses testing, the results are mixed. In H1, we expected that strategic capabilities – regardless of whether associated with an improvement or an innovation strategy – would be positively associated with MD and negatively associated with PI. The results show that two capabilities (FLEX and IPDS) are negatively associated with PI (γ = -0.40, p = 0.000 and γ = -0.21, p = 0.019, respectively), one capability (EFF) is positively associated with PI (γ = 0.24, p = 0.016), and two capabilities (QUAL and IPD) have no associations with PI. On the other hand, only one capability (IPDS) shows a positive association with MD (γ = 0.18, p = 0.038) while other capabilities have no statistically significant associations with MD. Thus, H1 is supported only in part.

In H2, we hypothesized differential effects on MD and PI depending on the strategy. Specifically, we expected capabilities associated with an innovation strategy to decrease PI and increase MD to a greater degree than capabilities associated with an improvement strategy. The results show that the capabilities associated with an innovation strategy (FLEX and IPDS) decrease PI while the capability associated with an improvement strategy (EFF) increases it. IPDS also increases MD while EFF does not. This suggests that certain capabilities associated with an innovation strategy have a more favorable impact on a supplier's PI and MD than capabilities associated with an improvement strategy. Thus, H2 is also partly supported.

In H3a, we expected PI to be negatively associated with INF and JD. The results show that PI has a significant negative association with JD (β = -0.15, p = 0.038) while having no significant association with INF (β = 0.06, p = 0.226). This suggests that as a supplier's PI reduces, the supplier-customer relationship becomes closer through more joint decisions. Thus, H3a is partly supported. In H3b, MD was expected to be positively associated with INF and JD. The results show that MD is positively associated with both variables (β = 0.17, p = 0.022 and β = 0.21, p = 0.008, respectively). This suggests that as MD increases the supplier-customer relationship becomes closer through expanded information sharing and more joint decisions. Thus, H3b is supported.

In H4a, we expected a negative relationship between PI and PERF. The results show that PI has a negative but insignificant association with PERF (β = -0.13, p = 0.063). This suggests that a reduction in a supplier's PI does not lead to an improvement of the supplier's performance from the customer relationship in terms of gross margin, sales revenue, and sales growth. Thus, H4a is not supported. In H4b, we expected a positive relationship between MD and PERF. The results show that MD is negatively associated with PERF (β = -0.23, p = 0.005). This suggests that as MD increases the supplier's performance in terms of gross margin, sales revenues, and sales growth decreases rather than increases. Thus, H4b is not supported.

Figure 2: Structural Model



Chi-square = 481.201/ d.f. = 345, CFI = 0.93, NNFI = 0.92, RMSEA = 0.042, Standardized RMR = 0.093
Standardized estimates are reported with * p < 0.05, ** p < 0.01, *** p < 0.001 (one-tailed)

In H5a and H5b, we expected INF and JD to be positively associated with PERF. The results show that INF has a strong positive significant association with PERF ($\beta = 0.34$, $p = 0.000$) while JD has no significant association with PERF ($\beta = 0.01$, $p = 0.45$). Thus, H5a is supported while H5b is not.

In addition, we included six control variables in the model (i.e., industry membership, firm size, holding status, market uncertainty, the length of a relationship, and the percentage of sales accounted by a customer). The results suggest a positive association between MD and the length of a relationship. This indicates that the longer a relationship lasts, the more the parties become dependent on each other. The results also show that INF is positively associated with market uncertainty while JD is positively associated with market uncertainty and the size of the supplier firm. The positive association of INF and JD with market uncertainty suggests that as

markets become more unpredictable, the parties tend to develop closer relationships through expanded information and more joint decisions. The positive association between JD and the size of a firm suggests that the larger the supplier firm, the more it is involved with customers in joint decision-making. Other control variables were not statistically significant.

Discussion: The main purpose of this study is to understand what a supplier firm can do to maintain or enhance the financial gains derived from exchanges with its customers. Firstly, we investigated whether and how a supplier's choices and implementation of capabilities associated with operations strategy affect its power-dependence relation with a customer. It is often believed that excellence in any capability area will enhance the value of the supplier's products or services to a customer and, in turn, increase the customer's dependence on the supplier due to high switching costs. Unlike the conventional belief in the virtue of operational capabilities of any kind, our findings suggest that not all supplier capabilities have a favorable impact on the power-dependence relation with a customer. Instead, we found that there exist differential effects among the capabilities.

Contrary to expectations, for instance, *cost efficiency* tends to increase rather than reduce a supplier's power imbalance. This is probably because *cost efficiency* is mainly achieved through internal practices, such as lean manufacturing and value stream mapping, without requiring a customer's involvement or investment in TSAs. The customer can benefit from the supplier's improved *cost efficiency* without increasing its dependence on the supplier. Given any level of the supplier's dependence on the customer, the customer's lower dependence on the supplier would increase the supplier's power imbalance. On the other hand, *flexible responsiveness* and *innovative product design* are likely to reduce a supplier's power imbalance by increasing a customer's dependence either because there are fewer suppliers who can deliver in these regards and/or because these capabilities require the customer's investment in TSAs to some extent. Although both capabilities increase a customer's dependence, our findings show that *innovative product design* alone promotes mutual dependence while *flexible responsiveness* has no impact. This might be because a supplier achieves *flexible responsiveness* mainly through the internal training of engineers and production workers, a skill investment whose impact can readily transfer outside a specific relationship while making a customer more dependent on the enhanced capabilities. On the other hand, a supplier achieves *innovative product design* through the practices such as DOE, QFD and FMEA. These practices require the involvement of a supplier and a customer, and cannot easily transfer outside a specific relationship. Thus, *innovative product design* increases mutual dependence while *flexible responsiveness* does not.

Secondly, we investigated whether and how power-dependence is related to the suppliers' profitability from the relationship. Surprisingly, our findings indicate that *mutual dependence* hurts a supplier's profitability while *power imbalance* has no impact. Thirdly, we investigated whether and how power-dependence is related to the supplier-customer relationships. Our findings suggest that mutual dependence leads to a close relationship through information sharing and joint decisions while a supplier's power imbalance impedes joint decision-making.

Lastly, we investigated whether getting closer to the customers is beneficial for suppliers. Our findings show that expanded information sharing improves a supplier's financial outcomes from a customer relationship in terms of meeting its goals for gross margin, sales revenues and sales growth, while joint decision-making has no impact. Thus, our findings suggest that a supplier can benefit from a customer relationship through expanded information sharing that can help a supplier create value for both its customer and itself.

Contributions: The theoretical contributions of our study are three-fold. First, we proposed a conceptual framework that integrates a supplier's operations strategy, the supplier-customer power-dependency, the supplier-customer relationship closeness, and the supplier's financial performance from the relationship. In this framework, we introduced operations strategy – viewed as a group of capabilities developed by the supplier – as a mean to improve the supplier's stance in the power-dependence relation with a customer. To the best of our knowledge, our study is the first inter-disciplinary attempt to investigate the interrelations between operations strategy and power-dependence between suppliers and customers. Second, our study fills a gap in the supply chain literature by studying supplier-manufacturer relationships *from the suppliers' perspective*. This begins by mapping out the critical elements of a relationship with a customer as seen by the supplier: the power-dependence structure (i.e., mutual dependence and power imbalance), cooperation as a measure of the relationship closeness (as evidenced by joint decision-making and information sharing), and the supplier's financial performance from the relationship (the supplier's goal achievement with respect to sales revenues, sales growth, and gross margin). Our findings *from the suppliers' perspective* show the importance of power-dependence in the supplier-manufacturer relationships and the different behaviors of customers and suppliers depending on their role. Third, the study assessed whether there are economic benefits accruing to suppliers from "close" supplier-manufacturer relationships. There is documented evidence that *customer firms* benefit from close relationships with suppliers through reduced costs and increased revenues (Noordewier et al. 1990; Cannon and Homburg 2001), but the benefits of close relationships accruing to *supplier firms* are not adequately documented in the literature. Our study contributes to this void.

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Suppliers´ Reactions to ERAs – A Systematisation and Empirical Examination

Extended Abstract for a Working Paper

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Professor Dr. Dr. h.c. Ulli Arnold
Chair of Industrial Marketing and Procurement
University of Stuttgart
0049 711 685 83161
ulli.arnold@bwi.uni-stuttgart.de

Wolfgang Schnellbaecher
Chair of Industrial Marketing and Procurement
University of Stuttgart
0049 711 685 83127
wolfgang.schnellbaecher@bwi.uni-stuttgart.de

Abstract

The introduction of electronic reverse auctions [eRAs] has been one of the heaviest discussed developments in business-to-business commerce over the last decade. Numerous research- often times triggered by buying companies- has been conducted on how to achieve the highest price reductions and how to conduct most efficient eRAs. Response opportunities of supplying companies however have been examined only rarely. A fact even more surprising considering that these opportunities are of great relevance for selling as well as for buying companies. The following article delivers a systematisation of these opportunities, examines their spreading in practice and tests how these reactions are linked to the suppliers´ perception of eRAs.

Introduction And Purpose Of The Study: Electronic sourcing tools promise various cost saving opportunities in the field of procurement. Additionally they enable procurement managers to design new processes and new ways to influence sourcing markets. One of these tools is the electronic reverse auction [eRA]. In general “an auction is a market institution with an explicit set of rules determining resource allocation and prices on the basis of bids from market participants” [McAfee and McMillan, 1987, p. 701]. A reverse auction is initiated by the buyer who describes demanded objects and potential sellers try to underprice each other in order to get the contract. Is the eRA conducted as an English auction a high price is the starting level and suppliers bid each other down till no one is willing to submit a lower offer [Kaufmann [2003a] S. 201, Jochen/Resch, 2007, p. 311]. An eRA conducted as a dutch auction starts with a low price that is raised in fixed rates and time frames until one supplier accepts the contract [Jochen/Resch, 2007, p. 311, Katok/Roth, 2004, p. 1045]. In 2004 Wagner/Schwab categorised the existing literature about eRAs into three groups [Wagner/Schwab, 2004, p. 15]: The first group examines purchasing management-related conditions favouring or opposing eRAs. The second one

deals with a best suited auction design and the third group analysis the eRA supported procuring process [Arnold/Schnabel, 2008]. Research papers published after that classification for example examined perceptions of opportunism among suppliers and effects of these perceptions on supplier performance [Carter/Kaufmann, 2007], the relation of weak bidding behaviour and a suppliers willingness to invest into a business relationship [Jap/Haruvy, 2008] or what groups of suppliers like or dislike reverse auctions [Caniëls/Raaij, 2008]. These works show that the research focus is no more solely on most efficient ways to achieve short term price reductions but also on long-term consequences of the auction. In that regard the response possibilities of suppliers and their application in practice are unknown. The following article targets that research gap by systemising the different reaction options suppliers have, illustrating their spreading in practice and identifying their conjunction to suppliers` perception of eRAs.

According to the Structure-Conduct-Performance Paradigm market conduct results from companies attempts to adapt to a given market structure [Bain, 1968, p. 7 and p. 9; Kaysen/Turner, 1959, p. 59]. Therefore, in a first step we introduce market structure changes caused by eRAs and the eRA-perception by suppliers. In a second step a systematisation of possible supplier reactions is derived out of these changes. Based on this theoretical framework an empirical study reveals the spread of these reactions in practice and the assignment to suppliers´ attitudes towards the procurement tool. As a last step implications for science and practice are conveyed from the results.

Market-Structure-Changes Through ERAs: *[a] Price reductions:* Achieving lower prices can be seen as the main motivation for buying firms to use eRAs [Arnold et al., 2005, p. 117]. Consequently purchasing managers measure an eRAs success in terms of price savings compared with traditional sourcing activities [Beall et al., 2003, p. 48]. Empirical

examinations of price reductions revealed different results [Arnold et al., 2005, p.117: 5-12%; Beall et al., 2003, p. 26: 10-20%; Emiliani, 2003, p. 66: 10-30%]. Generally the findings indicate that prices dropped and that these reductions were significant. The results consequently are heavily reduced margins on the supplier side [Emiliani/Stec, 2004 and 2005].

[b] Increased number of competitors: Authors argue that eRAs are enabling buyers to broaden the geographical reach of their tender procedures [Beall et al., 2003, p. 53]. Since eRAs are mostly conducted over the internet, suppliers from all over the world may theoretically participate without significant negotiation costs [Beall et al., 2003, p. 27]. In that context it is also believed that cultural boundaries during price negotiations are reduced through eRAs [Kaufmann, 2003a, p. 213]. Besides the integration of distant suppliers the simultaneity of the negotiation should allow a general rise of competitors. Previous empirical research on the purchase side showed however, that buyers mainly fall back to already known suppliers when conducting an eRA [Arnold et al., 2005, p. 122]. The costs that evolve from conducting an eRA might result in higher concentrated purchasing volumes [Beall et al., 2003, p. 53], which means higher attractiveness of the contract favouring an additional increase of competing suppliers.

[c] Switch of knowledge advantage: In traditional sourcing processes selling companies often posses a more detailed market-knowledge regarding a specific product than the buying company [Beall et al., 2003, p. 54]. Through eRAs buyers can develop detailed market knowledge on items, bottom prices and price elasticitys´ of their suppliers [Beall et al., 2003, p. 27]. This enforces a switch of market knowledge advance from the selling to the buying side [Giampietro/Emiliani [2007] S. 81; Beall et al., 2003, p. 27-28]. On the long run that switch of market knowledge and power might be reversed if some suppliers are

driven out of business and market power is concentrated on only few [Kwak, 2002, p. 18]. It depends on the auctions design and the information policy of the auction conducting institution [the procuring company itself or an external provider] whether sellers may also profit from the aggregated knowledge. The auction can be designed in a way that all bids are visible to bidders or suppliers could be informed in a post event analysis about their competitive performance [Beall et al., 2003, p. 29]. In some cases the sole motivation to participate in an eRA for suppliers could be the potential gain of market knowledge [Kirchner, 2001, p. 35].

[d] Modification of required products: In a face-to-face negotiation there are various opportunities of highlighting special features and benefits of products offered. Those opportunities are omitted through eRAs [Jap, 2003]. The price becomes the only measure to outpace a rival.

[e] Modification of sales processes: Previous research has shown that the negotiation through eRAs has led to many changes in the purchasing process of the buyer [Arnold/Schnabel, 2008]. The modification of the suppliers` sales processes has not been examined yet. It is possible, that the reduced cycle times from the first tender for offers till the contract will be awarded [empirical findings estimate decreases in cycle time of up to 50% [Smeltzer/Carr, 2003, p. 483] will lead to a decrease in process costs]. On the other hand it could also be that sales employees are working more intense in those decreased time frames and that process costs remain the same level or even rise.

Figure 1 illustrates the impact on these market structure changes on the market conduct of supplying companies.

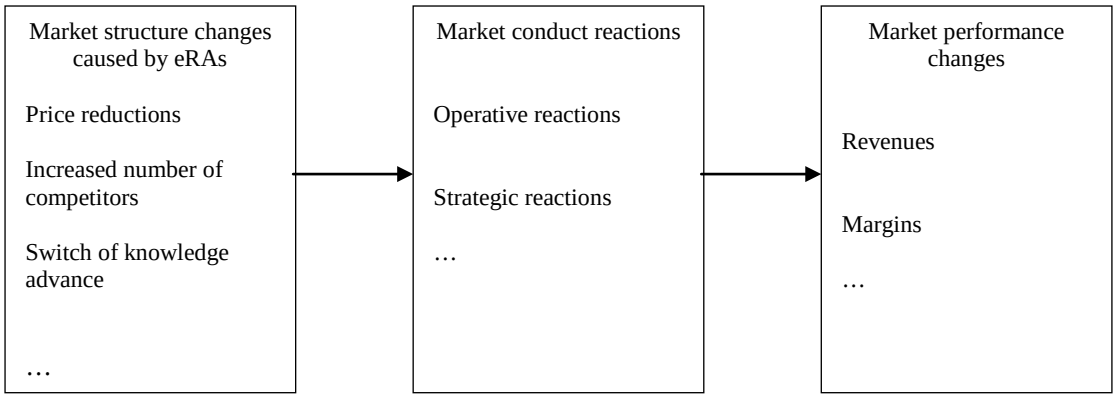

Figure 1: Market-Structure-Conduct-Performance Paradigma applied to eRAs

Suppliers´ ERA-perceptions: Considering these market structure changes it is of interest whether eRAs are viewed as a fair or an unfair sourcing tool. Previous research has shown that suppliers view eRAs as an opportunistic, unfair measure by purchasing firms [Emiliani/Stec, 2004, p. 68; Jap 2003]. Especially previous suppliers feel treated unfair [Jap, 2000]. This is not really surprising considering that for incumbent suppliers' margins and business relationships are at stake and new suppliers take part in a free lottery for additional business [Tassabehij et al., 2006].

More crucial than the fairness perception of the auctions is the impact on quality of the business relationship which suppliers perceive if they get involved in eRAs. The current literature shows two different points of view on that question. Loesch/Lambert believe that the suppliers` perception on the business relationship remains unchanged despite the eRA-usage [Loesch/Lambert, 2007]. Indeed there are good arguments supporting that opinion. One is that eRAs disable the buyers ability to make wrong or fake statements regarding offers of other competitors [Germer/Kaufmann, 2004, p. 62], since every bid is visible for all suppliers involved. The whole bidding process can be transparent for each supplier [Carter et al., 2004]. This effect however requires that the auction is credible and that suppliers do not believe in opportunistic behaviour by the buyer. A concern which is appears quite frequent among suppliers [Jap, 2002]. Such unreliable behaviour would be caused if a

buyer would insert bids by himself to stimulate price dynamics. Another supporting argument is that eRAs force buyers to make exact specifications of their demands. All relevant parameters of the product or service have to be defined ahead of the eRA [Arnold/Schnabel, 2008, p. 67]. Suppliers get a clear view of requirements and specifications they have to fulfil and later adjustments/modifications occur less often [Kaufmann, 2003b, p. 32; Smeltzer/Carr, 2003, p. 485]. This and a less time consuming negotiation phase should lead to a more efficient bidding process than face-to-face negotiations [Smeltzer/Carr, 2003]. The majority of authors however hold a different point of view. Pearcy et al./Jap argue that suppliers confronted with eRAs lower their willingness to cooperate with the buyer [Pearcy et al., 2002; Jap, 2003]. Jap/Haruvy discovered that aggressive bidders [who are most likely to win the contract] do not have the willingness to commit themselves into a long lasting or sustainable business relationship [Jap/Haruvy, 2008, p. 558]. Carter et al. discovered a negative impact of eRAs on the suppliers perception of the business relationship [Carter et al., 2004]. Some authors even argue that eRAs will damage the purchasing firm because of decreased trust by incumbent suppliers [Jap, 2000; Emiliani, 2004; Emiliani/Stec, 2004].

Suppliers´ reactions to eRAs: *a] Negotiation related behaviour:* In 1968 Albert O. Hirschmann described three alternative responses of individuals confronted with a declining market performance of an organisation or a system: Voice, Exit and Loyality [Hirschmann, 1970, p. 4]. They can complain [voice] and enable the management of an organisation to countervail to the decline [Hirschmann, 1974, p. 4]. They can leave the organisation [exit]; [Hirschmann, 1970, p. 37] or remain within the organisational frame despite the negative development [loyality] [Hirschmann, 1974, p. 66-67]. Considering the direct effects which the introduction of eRAs develops on the suppliers´ transaction system with the customer- price reductions, higher number of competitors, loss of market transparency- there is

evidence that the eRA-introduction will be perceived as a negative development by suppliers. Besides the three general possibilities described by Hirschmann suppliers also have economic options like the reduction of product quality or a higher charging of additional services. The reaction options can be differentiated according to their time frame and considering this we found two operative reaction fields and one strategic.

First of all suppliers can show reactions that affect the direct negotiations and their results. One option in this operative approach is a simple complaint at the buyer about his way to use and practice eRAs. Suppliers conducting that step can choose between two strategies: The first one is to highlight negative effects that emerge for buyers from the eRA usage. Indeed one might argue that the lower prices of some suppliers [who probably will win the eRA] lead to reduced margins of purchasing companies caused by lower quality levels and less additional services that have to be compensated [Beall et al., 2003, p. 25]. Choosing the second, more offensive strategy the supplier in addition to his complaint threatens the buyer not to participate in future eRAs and other biddings. In that case the voice option is combined with a menace of the exit option which increases the success chances of a complaint [Hirschmann, 1974, p. 70]. Another option concerning an eRA supported negotiation is not to participate in the auction. Three nuances of that step can be differentiated. The first one [ii] is that suppliers officially participate in the auction but refuse to hand in any bids- or only bids on a high price level [Millet et al., 2004, p. 176; Emiliani, 2005, p. 528]. Suppliers choosing that option could try to gain valuable knowledge about the competitive situation and price elasticitys´ in the market “bird watching” [Sashi/O`Leary, 2002, p. 109; Beall et al., 2003, p. 29; Carter et al., 2004]. They could also try to disrupt the auction. The next nuance of the step [iii] is the refusal to participate in any auctions conducted by the buyer. Analyzing the motivation of suppliers to participate in eRAs one gets similar results like those revealed in analyzing the fairness perception of suppliers.

While incumbent suppliers participate unwillingly and out of fear of loosing business relationships, new suppliers appreciate the additional sales opportunities [Beall et al., 2003, p. 9]. An incumbent supplier refusing the eRA participation will not ultimately loose the business. Especially Emiliani and Emiliani/Stec highlighted that supplier changes through eRAs are often times reversed because of discontent on the buying side [Emiliani, 2004; Emiliani/Stec, 2004]. The general willingness to participate probably is also highly dependent on the overall economic situation. In boom phases with capacity constraints suppliers should react more dismissive to eRAs than in economic downturns. The last nuance of the exit option [iv] is a complete ending of the business relationship. In that case suppliers lose all future contracts assigned by the purchasing firm. An enragement on the supplier side leading that fare should be rare. The buyer however could severely suffer from that consequence. Under certain circumstances not only an eRA bidder is lost but also a strategic supplier. Even though strategic items are not part of eRA negotiations [Kaufmann, 2003a, p. 205] it can happen that the same supplier delivers strategic and non-strategic items.

Last but not least suppliers could react with collusive behaviour. In that case eRA participants align in order to influence the auctions result. Not all bidders have to participate in order for the collusion to work. Theoretically it is sufficient if the two most competitive suppliers negotiate a price higher than both of their bargain prices to manipulate the auctions result. In general there are two possibilities for collusive behaviour: [i] The suppliers can decide to collectively refuse the eRA participation trying to enforce a traditional negotiation procedure or [ii] they can agree on a weak bidding behaviour. In that case eRA participants align in order to prevent the competition of an auction and to influence the auctions results. Not all eRA bidders have to participate in order for a collusion to work. Theoretically it is sufficient if the most competitive suppliers negotiate a

price higher than one of their bargain prices and the auctions result is manipulated. In that case a “winner” of the auction has to be nominated before the event. That winner can alternate within the group or pay a compensation fee to the auctions losers. An analysis of existing literature on collusions in eRA supported negotiations reveals a mixed picture. Some authors believe in a rise of the number of collusions through eRAs [Kaufmann/Carter, 2004, p. 20], some in a lower number of collusions [Sashi/O`Leary, 2002, p. 105] and some argue that collusions are impossible in context with eRAs [Wambach, 2004, p. 19].

Individual counter reactions	Collective counter reactions
[i] Complaint at the buyer [Voice]	[i] Collective weak bidding [Exit]
[ii] Weak/ no bidding [Exit]	[ii] Collective refusal to attend the auction [Exit]
[iii] Refusal to attend the auction [Exit]	
[iv] Total ending of the business relationship [Exit]	

Table 1: Systematisation of negotiation related counter reactions

b] Compensation of financial penalties: If suppliers decide to maintain the businessrelationship to the buyer despite eRAs they will probably try to compensate narrowed margins caused by sunk prices. This can either be achieved by an increase in margins or a reduction of costs. Looking at an increase of revenues three different options to achieve that goal can be separated: [i] Suppliers can ask higher prices for additional services [Emiliani/Stec, 2005, p. 283; Emiliani/Stec, 2004, p. 150], [ii] they can charge their customers in case of ex post adjustments [Carter et al., 2004, p. 244] or [iii] they can raise prices of additional contracts not negotiated through eRAs. If decreased margins shall be compensated through cost reductions there are also three possibilities: [i] A cost reduction through lower quality standards of the product itself [Carter/Kaufmann, 2007, p. 16], [ii] a cost reduction by cutting additional add-ons and services that have formerly been included in the product [Jap, 2003, p. 104; Beall, 2003, p. 11] -in both cases minimum standards of product specifications have to be acknowledged and [iii] a cost reduction through improvements of efficiency. Two potentials are feasible in that case: Improvements

emerging from the changed sales process through eRAs and improvements that have already been possible before the eRA introduction and are now used because of a higher market pressure.

Compensation of financial penalties	
Compensations through revenues	*Compensations through costs*
[i] Extra charging of additional services	[i] Reduction of quality standards
[ii] Extra charging of later adjustments	[ii] Cross out of additional services
[iii] Higher prices at future contracts	[iii] Cost reduction through efficiency

Table 2: Systematisation of attempts to compensate financial penalties

c] Strategic adoptions: Besides the operative reactions suppliers might feel forced to conclude long term strategic adoptions from the market structure changes caused by eRAs. In 1957 Igor Ansoff developed the Product-Market Growth Matrix to systemise strategic growth paths of firms. If suppliers decide to remain in conventional markets with incumbent products they can try to raise revenues with existing costumers [as described before] or they have to [i] look for new customers within their market. Suppliers can also try to [ii] modify their product in order to make it less suitable for an eRA supported procurement. In that case buyers have to be convinced that the product is of strategic relevance for them. If suppliers do not want to modify or replace existing products they can [iii] look for new markets in which eRAs are not used yet. Last but not least they can [iv] look for new distribution channels.

[i] Search for new customers
[ii] Search for new products
[iii] Search for new markets
[iv] Search for new distribution channels

Table 3: Systematisation of strategic adoptions

Conjunction Of ERA Perception And Counter Reactions: Looking at the conjunction of the suppliers´ eRA perception and the drawing of negation related consequences we

assume that a negative perception of the procurement tool eRA and a negative perception of the impact on the business relationship raise the probability of negotiation related responses. The first two hypothesis therefore are:

H1: A negative fairness perception of eRAs by a supplier raises the probability of negation related consequences.
and:
H2: A negative perception of an eRAs impact on the business relationship by a supplier raises the probability of negation related consequences.

Table 4: Conjunction of the eRA-perception and negotiation related counter reactions

The compensation of financial penalties should be linked to these two perceptions as well. The third and fourth hypotheses are as follows:

H3: A negative fairness perception of eRAs by a supplier raises the probability of actions to compensate financial penalties.
and:
H4: A negative perception of an eRAs impact on the business relationship by a supplier raises the probability of negation related consequences.

Table 5: Conjunction of the eRA-perception and attempts to compensate financial penalties

Strategic reactions to eRAs should also be more probable if the fairness perception and the perceived impact on the business relationship are negative. That assumption leads to the last two hypotheses:

H5: A negative fairness perception of eRAs by a supplier raises the probability of strategic adoptions by the supplier.
and:
H6: A negative perception of an eRAs impact on the business relationship by a supplier raises the probability of strategic consequences by the supplier.

Table 6: Conjunction of the eRA-perception and strategic adjustments

Set up Of The Survey: In order to reveal suppliers reactions to eRAs a sample of 1639 German industrial goods suppliers was chosen out of the data base “Hoppenstedt Firmendaten”. It contains the data of 300 000 German companies. A selection of certain industries was not conducted. We wanted to avoid a tampering of results. Additionally most suppliers have customers in a wide range of branches, a categorisation therefore would have contained many distortions. The companies were contacted via e-mail. That mail explained the purpose of the study and contained a link to an online survey. The language of the mail as well as the questionnaire was German. Links were sent out from November 2008 till February 2009. The survey itself contained 24 mostly closed questions leading to an average response time of 10 minutes. Overall the questionnaire itself consisted of four parts. First a short briefing about eRAs and their appearance in B-to-B negotiations was given to ensure only respondents who already participated as bidders in eRAs would respond. The second part consisted of questions concerning general company information [e.g. gross revenue] and the auctions conducted by the respondent [e. g. the number of auctions, the auctions design]. In the third part the suppliers´ eRA-perception was investigated. The perception was separated into a fairness perception of the tool itself and the perceived input on the business relationship. Both variables were asked using a five point likert scale. The fourth and last part dealt with supplier reactions to eRAs as systemised above. Suppliers were asked whether they conducted any actions in each of the three reaction fields. If the answer was yes, they had to name the reactions in detail.

	Highest	Lowest	Mean	Standard deviation
Gross revenue	> 10 bn	> 10 m	172,73 m	584,23 m
Number of auctions	20	1	4,38	3,44

Auction design	English	Dutch	No answer
Percentage	243	37	78
Visibility of competitors	Visible	Not Visible	No answer
Percentage	57	135	166

Table 7: The participants and their auction experience

The 1639 created contacts led to 81 filled out questionnaires which equals a response rate of 4,47%. One reason for the weak response ratio may be that in the economical strong 2007 buyers abstained from using a procurement tool which is unpopular among suppliers. The 81 participating companies took part in 358 auctions in 2007 [4,47 auctions in average]. The supplier who conducted most auctions took part in twenty eRAs. Five suppliers reported they did not participate in eRAs at all in 2007 but that they reckon that procuring companies will increase their use in future economically rougher times.

Examination Of Suppliers´ ERA-perceptions: *[a] Fairness Perception:* Suppliers largely regard eRAs as an unfair procurement tool. A result consistent with various prior studies [Emiliani/Stec, 2004, p. 68; Jap 2003; Jap 2000]. In that context the eleven percent of suppliers that view eRAs as a fair measure by their customers are of interest. They indicate that the introduction of eRAs and the resulting changes in the market structure also produce winners on the supply side. Buyers should observe this negative perception by their supplying stakeholders and develop mechanisms to decrease the disadvantageous point of view.

[b] Impact on business relationship: Table 8 shows the impact of eRAs on the attitude of suppliers towards the business relationship. As well as the evaluation of the fairness of the procurement tool the results are mostly negative.

Fairness Perception:	Very fair	Fair	Indifferent	Unfair	Very Unfair
Percentage	0,0%	11,1%	24,7%	40,7%	23,5%

Percieved impact on the business relationship:	Very positive	Positive	No consequence	Negative	Very negative
Percentage	0	2,5%	19,8%	56,8%	21,0%

Table 8: ERA-perception of suppliers

Examination Of Suppliers´ Reactions: Negotiation related behaviour in practice: 46,9% of supplying companies confronted with eRAs reported that they have responded with negotiation related actions. Table 9 shows the spreading of concrete reactions conducted by suppliers.

Negotiation relatet counterreactions	Yes	No
Percentage	46,9%	53,1%

The 46,9% conducted the following concrete actions:	Percentage
Complaint at the buyer	94,7%
Refusal to attend the auction	44,7%
Weak bidding behaviour	31,6%
Total ending of the business relationship	2,6%
Collective refusal to attend	2,6%
Collective weak bidding behaviour	0%

Table 9: Empirical examination of negotiation related counter reactions

Looking at these reactions in detail there is a clear preference towards the complaint which almost all suppliers have chosen. To refuse the auctions` participation or weak bidding behaviour are also common reactions by suppliers in practice. Collusions or a total ending

of the business relationship rarely were named in the survey. Like described above an ending of the business relationship would be one of the least economical solutions. That explains the little preference for that step. Whether the nomination of collusive behaviour reflects real circumstances or is caused by a mental distance to provide information about that illegal step can not be answered at this point.

Compensation of financial penalties	Yes	No
Percentage	71,6%	28,4%

The 71,6% conducted the following concrete actions:	Percentage
Cost reduction through efficiency	55,2%
Extra charging of additional services	44,8%
Cross out of additional services	37,9%
Extra charging of later adjustments	37,9%
Reduction of quality standards	22,4%
Higher prices for future contracts	17,2%

Table 10: Empirical examination of attempts to compensate financial penalties

Table 10 summarises the spreading of attempts to compensate financial penalties in practice. 71,6% of suppliers conducted these attempts. The results show that suppliers hardly exclude a measurement to compensate financial loses caused by eRAs. Cost- and revenue oriented measurements are almost preferred equally. For suppliers confronted with eRAs the results show that the sustained price reductions are not definite. In order to keep current revenues the pricing of products sold over eRAs has to be rethought. A separation into competitive basic components to auction and high price additional services or adoptions could keep existing margins. Additionally reverse auctions with their fixed product specifications seem to allow cost cuttings in regards of quality. These cost savings also seem to be able to compensate financial losings. On the buying side the importance of clear product specifications prior to the auction becomes obvious. They restrain these compensation attempts and prevent reduced quality standards, missing additional services and higher costs through extra charging. Important for selling and buying companies are

the reported cost cuttings through increased efficiency. It is of interest whether these opportunities are solely caused from a more efficient sales process through eRAs in contrast to more time consuming face-to-face negotiations.

Strategic adjustments	Yes	No
Percentage	29,6%	70,4%

The 29,6% conducted the following concrete actions:	Percentage
Search for new customers	70,8%
Search for new markets	50,0%
Search for new products	37,5%
Search for new distribution channels	37,5%

Table 11: Empirical examination of strategic adjustments

In figure 11 the strategic adjustments caused by eRAs are shown. Only a minority of suppliers [29,6%] adjusted their strategies as an eRA-consequence. The few companies who carried out adjustments chose a wide variety of concrete measurements. The search for new customers as an easy to execute and inexpensive option clearly was preferred before deeper transpositions like the search for new markets, new products or new distribution channels.

Examinition Of The Conjunction Of ERA-perceptions And Counter Reactions: The conjunction of these reactions with the fairness perception of eRAs and the perception of eRAs influence on the business relationship was measured using a logistic regression. That regression type tries to identify the probability of an event depending on the magnitude of designated determining factors [Backhaus, et al., 2006, p. 426]. It is the most suitable method given the situation of an independent metric and a dependent nominal scaled variable. The chosen logit model bases on the following cumulative probability function:

$P_i = F [Z_i] = F [\alpha + \beta \ldots]$

P_i represents the probability of a supplier reacting in a certain way to eRAs of its customer. Z_i as independent variable either stands for the suppliers´ fairness perception of eRAs or the impact of eRAs on the suppliers´ perception of the business relationship. The above model was converted to:

$$\text{Log. } P_i / [1 - P_i] = Z_i = \alpha + \beta Z_i$$

The dependent variable is therewith the odds that a supplier will conduct counter reactions to eRAs of his supplier. That applied to the three reactions fields suppliers can engage in which were systemized above leads to the following equations:

Ln [P_1 [negotiation related counter reactions] / P_1 [no negotiation related counter reactions]] = α + β fairness perception of eRAs Ln [P_2 [negotiation related counter reactions] / P_2 [no negotiation related counter reactions]] = α + β perception of the eRAs impact on the business relationship
Ln [P_3 [compensation of financial penalties] / P_3 [no compensation of financial penalties]] = α + β fairness perception of the eRA Ln [P_4 [compensation of financial penalties] / P_4 [no compensation of financial penalties]] = α + β perception of the eRAs impact on the business relationship
Ln [P_5 [strategic adoptions] / P_5 [no strategic adoptions]] = α + β fairness perception of the eRA Ln [P_6 [strategic adoptions] / P_6 [no strategic adoptions]] = α + β perception of the eRAs impact on the business relationship

Table 12: Logit models for the conjunction of the eRA-perception and counter reactions

	2 LL	Cox & Snell R^2 >0,2	Nagelkerkes R^2 >0,4	Sig.	Hypothesis accepted
H1	58,142	,450	,503	0,000	Yes
H2	56,622	,389	,698	0,000	Yes
H3	93,979	,138	,187	0,551	No
H4	95,251	,107	,185	0,010	No
H5	75,624	,325	,437	0,001	Yes
H6	63,745	,377	,463	0,000	Yes

Table 13: Quality criteria for the conjunction of the eRA-perception and counter reactions

The results of the logit analysis are shown in Table 13. According to the findings the fairness perception of eRAs as well as the perceived impact on the business relationship lead to a higher probability of negotiation related counter reactions. The odds of these reactions rise 3,17 with each grade of the likert scale measure of fairness perception and 2,52 with each likert scale measure of the perceived impact on the business relationship. This is an outcome that underscores the importance for buyers to improve the eRA-perception among their suppliers.

The data provides no evidence of a raised probability to the compensation of financial penalties if eRAs are perceived as unfair or the impact on the business relationship is perceived as negative. Suppliers seem to try to compensate financial losses regardless of their eRA-perception. If buyers want to terminate these tries [especially post-event attempts to raise revenues], a positive eRA-perception seems to be the wrong point to start. Probably more promising is a concentration on the specifications of the demanded goods or services ahead of the auction.

Strategic adoptions of suppliers are more likely if they perceive eRAs as unfair and negative for the business relationship. The conjunction however is not as strong as to the negotiation related counter reactions. The odds of strategic adoptions rise 2,58 with each likert scale grade of a less fair eRA-perception and 1,62 with each likert scale of more negative impact on the business relationship.

Implications And Future Research: The study leads to various managerial implications for purchasing as well for supplying companies. At first the widely assumed negative view of suppliers on eRAs could be confirmed in this work. Above that, both market participants gain an overview of eRA-reactions of their suppliers or competitors. Concerning those

reaction buyers should put a special emphasis on supplier complaints since they are mostly accompanied by other negotiation related counter reactions. All-clear can be given in regarding the danger of suppliers completely ending the business relationship. That uneconomical step seems to be totally obviated by suppliers. Interesting results have also been derived concerning the spreading of suppliers´ attempts to compensate financial penalties caused by eRAs and suppliers´ strategic adjustments.

The logit model introduced in this study showed which supplier reactions are linked to their fairness perception of eRAs and their perception of the eRAs impact on the business relationship. Buying companies that particularly fear negotiation related counter reactions or strategic adjustments of their suppliers [with the aligned danger of loosing the supplier] should put a higher focus on their suppliers´ eRA-perception. Procurement managers mainly fearing attempts by their suppliers to compensate financial penalties should rather focus on exact specifications of their demanded goods and services.

The systematisation of supplier reactions conducted in this paper is the first one of that kind. Future research should detail them critically and also test its completeness and accuracy. Beyond that it is unclear whether the reported quality reductions and cross outs of additional services are in the buyers advantage. One could argue that each reduction of quality or services of goods sold is against the objectives of a buyer. It is however possible that these decreases abolish unnecessary standards or product features and prepare the ground for future price reductions. A symmetric examination among buyers and sellers could deliver valuable contributions to answer that question.

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Performance Measurement for Supply Management

Carsten Reuter
Supply Chain Management Institute (SMI)
EBS European Business School
+49 611 360 18 800; reuter@supplyinstitute.org

Abstract. Purchasing and Supply Management (PSM) has experienced substantial change during the last decades, and turned from a clerical into a strategic function. Simultaneously, the scope of responsibility has broadened and there are no indications that the progress will come to a halt soon. While the PSM function has changed, so has the business environment. New challenges include securing current and future supply, safeguarding organizations from reputational damage due to unethical conduct in the supply chain, and optimizing working capital in order to maintain liquidity. Yet, PSM's performance is still largely assessed and reported based on cost savings despite the fact that some literature suggests that managers prefer to rely on non-financial controls in situations of high environmental uncertainty. This discrepancy raises a fundamental question and provides the core of this paper: What type of information concerning PSM's performance do high-level executives and top management actually require? Based on an in-depth case study and by drawing information processing theory, we propose that a more future-oriented approach towards performance measurement is necessary to meet internal stakeholders' demands.

Introduction. Purchasing and Supply Management (PSM) has experienced substantial change during the last decades; from a predominantly clerical and operational function, it has evolved into a tactical and strategic function. The scope of responsibility has broadened and this progression will unlikely come to a halt in the near future. Instead, the "importance of strategies in purchasing will further increase" (Wagner and Kaufmann, 2004) and purchasing will become an important source of sustainable competitive advantage (Carter, Kale and Grimm, 2000). Still, PSM professionals "often complain of a lack of recognition by senior management" (Bales and Fearon, 1993, p. 6) and Ferguson et al. (1996) conclude, "purchasing management must continually recognize the strengths of the function and market those strengths to upper management". Various approaches to address these challenges have been undertaken, often resulting in highly complex, barely manageable measurement and reporting systems (e.g. Nollet et al., 2008); in fact, ''[…] it is possible to argue that in many companies we suffer not from too few measurements but from too many, and those that we have are frequently of the wrong sort.'' (Syson, 1995, p. 25). Thus, it can be stated that PSM managers are still struggling to prove their contribution to the organization's bottom-line and to become a strategic heavyweight (Miller, Hickson and Wilson, 2008).

The spate of information managers face and the growing complexity of the business environment coming along with increasing uncertainty has turned management of information into a decisive factor in achieving and maintaining a competitive edge (Tihanyi and Thomas, 2003; Hansen, 2002). Especially high-level executives are confronted with high-information processing demands in a variety of situations because of the ambiguity of environmental factors (Ungson, Braunstein and Hall, 1981). So far however, little research has focused on the sources of the information processing needs (Tihanyi and Thomas, 2003).

Given the increasing environmental complexity, growing competition, technological advancements, and increased demands for more sustainable business practices, the prevalence of savings measurement (Harwood and Humby, 2008) as the dominant base for performance assessment of PSM needs to be questioned. Following the finding of Gordon and Narayan (1984, p. 37) that "as

decision makers perceive greater environmental uncertainty, they tended to seek external, non-financial and ex-ante information in addition to other types of information", savings-based PSM performance measurement will not contribute to the reduction of uncertainty and is thus of little relevance to decision makers. Purchasing scholars have long acknowledged the absence of appropriate measures and have called for more advanced, formalized measurement and evaluation systems Monczka, Trent and Callahan, 1993. Still, as recent studies suggest (e.g. Harwood and Humby, 2008), little has changed in practice and adherence to traditional, i.e. finance-focused and history-oriented, performance measures is increasingly recognized as an obstacle to the advancements of organizations in general and towards sustainability in particular (Pagell and Wu, 2009).

Having touched upon the limitations of traditional PSM performance measurement and the long-established call for new approaches the inevitable question arises: what hinders the performance measurement evolution in PSM? Although numerous frameworks regarding performance measurement in general and for PSM in particular have evolved, little empirical work addresses the two fundamental questions that needs to be answered prior the development of performance measurement systems (Lebas, 1995): (1) Why is performance measured? (2) What is to be measured?

This paper intends to address this void in PSM literature, in particular with regard to the often expressed lack of top management attention. The underlying line of reasoning is as follows: savings-based performance measurement in PSM cannot support decision makers in situations of high uncertainty (i.e. when information processing demand is high) e.g. induced by unforeseen occurrences or during planning processes (Rogers and Bamford, 2002; Hoque, 2004). Thus, PSM performance measurement in its current status is of little relevance to high-level executives. According to organizational information processing theory such irrelevant information is filtered in order to prevent information-overflow on higher hierarchical levels, where information processing capacity is limited (Egelhoff, 1991). Consequently, it should be in the interest of PSM managers to know, what kind of PSM performance information actually reduces uncertainty of decision-makers and will thus increase their awareness for the PSM function. Furthermore, from an organizational point of view, how should information processing capacity be utilized in order to meet information processing demand? Hence, the following two research questions guide our work:

(1)What information concerning PSM performance do executives and top management require?
(2) Which factors influence the information demand of top management?

Based on an in-depth case study at a German multi-national company (MNC), the demand for PSM performance information by executives and top management is analyzed and discussed from an information processing perspective. The remainder of this paper is organized as follows: Relevant literature is briefly reviewed and the methodological approach is introduced. The main findings of the case analyses are presented, discussed and interpreted in comparison to existing literature, before limitations and suggestions for further research are presented.

Literature Review. *Performance Measurement* Performance Measurement has been extensively studied for a long time (Holden, Fish and Smith, 1941; Johnson, 1972; Johnson, 1975; Chandler, 1962; Kaplan, 1984. It experienced substantial changes during the late 1970s and early 1980s when numerous frameworks for performance measurement originated due to a state of dissatisfaction with the prevailing retrospective, financial measures at the time Bourne et al., 2000. In the subsequent decade, frameworks evolved, which were more balanced and considered also non-financial and more foresighted measures (Guerny, Guiriec and Lavergne, 1984; Lynch and Cross, 1991; Epstein and Manzoni, 1998; Kaplan and Norton, 1992; Kaplan and Norton, 1993). In view of the increasing

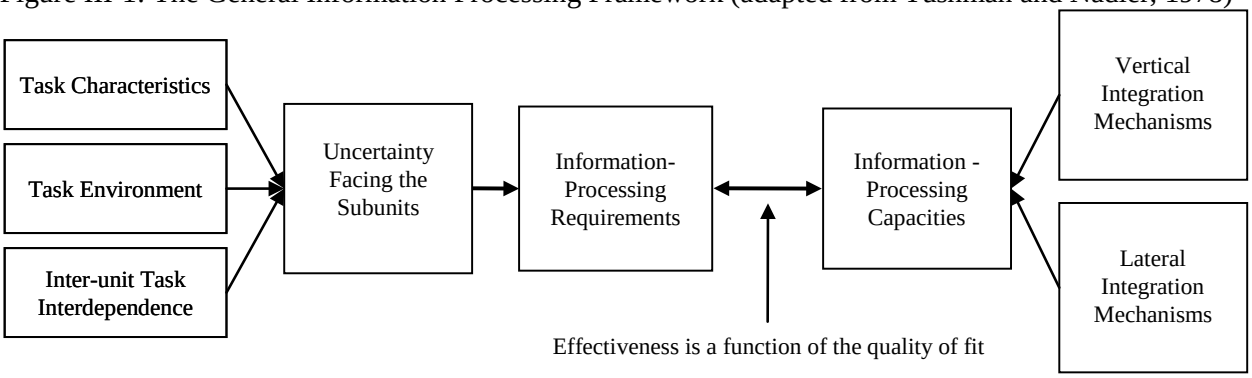
works on performance management in general management literature, Neely (Neely et al., 1995) even talked about a Performance Measurement Revolution. However, definitions of the term 'performance measurement' are still scarce and ambiguous (Neely et al., 1995; Lebas, 1995). According to Lebas (1995), managers and performance evaluators have to answer two fundamental questions: (1) Why do we want to measure? (2) What do we want to measure? According to normative literature, performance measurement may serve various purposes (Lebas, 1995; Schmitz and Platts, 2004): as a form of vertical communication, to support decision making and prioritizing, as a source of motivation, and to provide management information. Accordingly, measures need to be adopted for discrete users and the distinct purposes.

The scientific contributions in the field of PSM performance measurement are manifold and parallel, to a certain extent, those of general performance measurement. The need for discrete research in this area was expressed at the beginning of the twentieth century by Lewis (Lewis, 1933; Lewis, 1936). Since then, driven by the "evolution of purchasing to a strategic activity" (Wagner and Kaufmann, 2004), numerous approaches toward PMS in this field have evolved (e.g. Paperman and Shell, 1977; Dobson and Shorrock, 1980; Easton, Murphy and Pearson, 2002; Wagner and Kaufmann, 2004), also leading to ambiguous understandings of performance measurement. Unlike general management literature, literature on purchasing has not yet experienced a 'revolution' in performance measurement (Lardenoije, Van Raaij and Van Weele, 2005). While some studies focus on the measurement of supplier performance, others focus on the measurement of buyer performance or the performance of the entire purchasing function. Nevertheless, works are not limited to conceptual approaches. The impact of the implementation and use of PMS on company performance and employees were examined by various authors (Scott and Tiessen, 1999; Malina and Selto, 2001; Azofra, Prieto and Santidrián, 2003; Ahrens and Chapman, 2004; Raub, 2007; Wouters and Wilderon, 2007). Despite the variety of academic publications, the majority of PSM managers still base their assessment on long-established measures, such as savings (Harwood and Humby, 2008), which are popular but do not measure "the things that count in competition" (Monczka and Morgan, 1994). Roylance, 2006 highlights PSM managers' aspiration that their performance be recognized within the focal company but also indicates PSM's insufficient internal orientation. He further argues that an improved understanding of internal customers' requirements is necessary to better position PSM in the organization. We follow this notion and extend it to the specific field of performance measurement.

Information Processing Theory of Organizations. The information processing theory of organizations evolved among organizational researchers and is based on the assumption that information is the most critical contingency faced by modern organizations (Galbraith, 1973; Galbraith, 1977; Tushman and Nadler, 1977). Accordingly, organizations are built around information and information flows with the aim to reduce uncertainty. The theory emphasizes that a company's information processing demand (high quality and comprehensive information on performance for decision makers) Rogers, Miller and Judge, 1999 must appropriately fit information processing capacity (means of providing sound and comprehensive information on performance) in order to operate effectively (Galbraith, 1974; Egelhoff, 1991).

The idea of 'fit' between the organization's characteristics and its context originates in contingency theory (Burns and Stalker, 1961; Lawrence and Lorsch, 1967) as a prerequisite for effectiveness and has been adapted by information processing scholars (Galbraith, 1973; Galbraith, 1977; Tushman and Nadler, 1977; Egelhoff, 1982; Egelhoff, 1988). By viewing companies as information-processing systems, the grounding assumption is that companies, in order to operate effectively, need to establish a fit between information-processing requirements and information-processing capacity, as depicted in Figure III-1.

Figure III-1: The General Information Processing Framework (adapted from Tushman and Nadler, 1978)



Uncertainty is one of the key elements of IPT and is defined as "the difference between information possessed and information required to complete a task" (Tushman and Nadler, 1977). Companies face uncertainty originating from various internal and external sources (environmental conditions). The greater the level of task uncertainty, the greater is the demand for information processing during task-execution. However, information processing capacity is a restricted resource and its allocation depends on the features of organizational design, e.g. centralization, leadership-style, and formalization (Tushman and Nadler, 1977).

Galbraith (1973, 1977, 2000) proposes that organizations must adopt at least one of four information processing designs in order to improve performance: (1) manage the environment, or the modification of organizations' environment or organizations' response to the environment with the aim to reduce uncertainty. For example, organizations may choose to establish alliances and partnerships, increase efficiency of internal processes, or increase their knowledge about their customers; (2) create self-contained tasks in order to reduce the information-processing requirement at top hierarchical levels of organizations. Thereby, the decision-making authority is moved to lower hierarchical levels. In practical terms, this would include a shift from a functional structure to a divisional structure.; (3) invest in vertical information systems, to enhance the speed and amount of information transferred to top-level planners and decision makers without overloading the hierarchical communication channels. Consequently, organizations may increase the frequency of planning procedures in order to respond timely to increasing environmental uncertainty, ultimately leading to decreased decision-making time and increased effectiveness; or (4) create lateral relations to increase the information processing capacity as they bypass traditional lines of authority and deliver information directly to the place of information demand, i.e. place of decision-making. Similar to the creation of self-contained units, this design choice prevents information overload at the top hierarchical levels and enhances the flexibility to deal with uncertainty.
While the former two are considered to reduce the need for information processing, the latter two increase the organization's capacity to acquire and process information. According to Galbraith, organizations need to increase the amount of slack resources to prevent information overload of decision makers, unless they implement at least one of the design choices.

The Case Study of a Pharmaceutical and Chemical Company. An inductive case study approach was selected in order to explore the information demand of executives and top management concerning supply management's performance. This approach appeared to be adequate for the following reasons: (1) case study research is well suited for investigating complex phenomena, which cannot be illuminated by, for example, surveys alone since it allows the researcher to interact with the informant and to draw on multiple sources of information, leading to information-rich cases (Gerring, 2007, Yin, 2009); (2) the understanding of what constitutes PSM's performance diverges in literature and practice. Hence, clarification is required in order to account for content validity, which could be addressed best in the course of interviews; (3) collecting data from multiple sources allows

for triangulation, increasing internal validity. Our research approach is described best as theory elaboration (Lee, Mitchell and Sablynski, 1999) since the information processing theory of organizations affects our research design when studying the case's supply performance measurement.

(van Weele, 2007) indicates that a well-reasoned case selection is required in order to enhance the recognition of case study research in PSM. Dubois and Araujo, 2007 p. 16) even find that "case selection is the most important methodological decision". The purpose of this study is to identify the initial information demand of top management with respect to purchasing performance. As suggested by Nollet et al. (2008), performance measurement systems evolve in the course of time, beginning with rather straight-forward, hard savings-focused systems before becoming more complex and almost unrulable. Hence, we sought a company, where PSM performance measurement was at the beginning of the aforementioned development cycle in order to investigate the requirements unaffected by previous developments. However, finding information on the development status of performance measurement systems is not an easy task as such, and identifying companies with rather substandard systems is even more of a challenge because of social desirability bias. In the course of preliminary expert interviews with senior purchasing experts, it emerged that purchasing professionals of PhamChem[1] had recently approached their counterparts from various companies in order to identify ways of implementing a performance measurement system for PSM. We approached the PhamChem CPO with our intended research project. Support was granted on the condition that findings would be made available for internal use. Subsequently, the in-depth investigation took place at the headquarters of PhamChem, a large German chemical and pharmaceutical company with production facilities around the globe and more than 20,000 employees worldwide.

During the years prior to our investigation, PhamChem went through a major restructuring of its PSM function and introduced a hybrid lead-buyer organization. The portfolio of goods and services sourced was split into more than ten commodity groups, e.g., raw materials, travel services, packaging, logistic services, and clinical studies. Despite the restructuring efforts, PhamChem's CPO perceived the achievements of the PSM function to be undervalued by executives and top management. He identified the insufficient performance measurement system, and thus performance reporting, as the major hurdle that kept PSM's achievements from being distributed throughout the firm. The existing methods for savings calculation were considered insufficient to adequately present PSM performance to top management and other internal stakeholders.

Information for the case analysis was mainly collected from three sources: (1) semi-structured interviews, (2) regular follow-up interviews, and (3) internal documents related to the computation of savings and performance reporting. In sum, the multitude of sources, according to Yin (2009), provides a robust foundation for triangulation. The interviews with 20 executives and members of the board lasted between 30 to 45 minutes and were jointly conducted by the same interviewers. Except for two, the interviewees were ranked Vice President or higher and represented the major stakeholders of PSM based at the German headquarters, i.e. internal clients as well as representatives from Accounting and Controlling (see Table 1).
In order to obtain a better understanding of the current environment and preconditions, additional interviews were conducted with the CPO and the Vice President International Purchasing. Notes were taken during the interviews and further details were written by each author independently directly after the interviews. These observations were compared and supplemented or corrected if necessary. As a mean of addressing construct validity, a draft of the protocol was sent to each informant separately for confirmation purposes. In order to account for reliability, a record of the

[1] PhamChem is a fictitious name used for confidential reasons.

proceedings was kept, for example the dates of the interviews and information about interviewees, individual settings of each interview, and where and how archival data were collected. Inter-rater reliability was assessed according to the scheme presented by Pagell and Krause (2005). Furthermore, a case database stored individual notes, transcripts from the interviews, the questionnaires, and current performance reports (Gibbert, Ruigrok and Wicki, 2008; Yin, 2009). Secondary data, in the form of archival documents such as exemplary reporting grids, was taken into consideration to understand the current situation of performance reporting. Furthermore, a case database was compiled to store individual notes, transcripts from the interviews, the questionnaires, etc. (Gibbert, Ruigrok and Wicki, 2008; Yin, 2009).

Data Analysis. Data analysis was carried out in two major phases. The first phase consisted of an analysis of the responses of each individual interviewee. Individual profiles were developed to become familiar with the peculiarities of the individual function and needs. In the second phase, we sought to identify common patterns among the information given by the individual respondents. Tabular displays were used to identify differences and similarities among the individuals. The 20 informants were divided into three groups based on their primary function: (1) Accounting & Controlling, (2) Operations, (3) Others; the findings are presented accordingly. For each group, we elaborate on the respective stakeholders' perception of PSM's contribution and their primary information demand, before theoretical explanations based on information processing theory are presented. First, however, a brief overview on the status quo of PSM performance measurement at PhamChem is given.

Status Quo of PSM performance measurement

According to the retrieved reporting grids of the various commodity groups, and statements made by interviewees, the performance measurement system presented at the beginning of our investigation was informal and showed little stringency. Corporate-wide spend transparency was neither given nor available. Instead, database queries from various systems were necessary to yield approximations. Reports were issued regularly but only to a limited number of recipients. A variety of savings calculation methods were applied, based on period-to-period and quoted price comparison. However, these methods were explicitly tailored to certain commodity groups and required manual data gathering and calculation. None of the methods had ever been approved by the board and corporate standards were not established. Thus, a collective understanding of PSM's contribution to the organization's bottom-line did not exist and an aggregation of the performance to enable statements to be made regarding the overall performance was impossible. In addition to these already limited financial performance indicators, further qualitative or quantitative measures were not available.

Group 1 "Accounting and Controlling"

Due to its function, Accounting and Controlling (AC) was not a major internal client to PSM but was regarded to be a crucial stakeholder because of its role as process owner of reporting procedures and thus a major contributor do the design of information systems. Consequently, this department was considered the most knowledgeable source regarding the organizations' information demand because it linked the long-established performance measurement routines of other departments and divisions with PSM data. In general, the activities of AC were guided by the regulatory requirements for (external) accounting and the internal reporting scheme and schedule. Thus, the primary tasks were well predictable and posed little uncertainty during task execution. Yet, information processing requirements were high due to AC's function as a data consolidator and provider of information to management. Accordingly, informant 18 stated:

> "Controlling needs very detailed information. Usually they will be the first addressee and forward the processed information to the relevant recipients."

In order to handle the large amount of quantitative data, AC relied on comprehensive information systems and databases, partially enabling online data processing and on demand reporting. AC

considered PSM's greatest contribution to the business to be Supply Risk Management and ensuring the quality of products and services. The monetary contribution of PSM, i.e. savings or cost avoidance, was only considered to be of minor relevance. However, AC demanded information from PSM concerning the developments of quantity, price, and spend, based on an annual period-to-period comparison, in particular for recurring purchases. The AC informants made clear distinctions regarding reporting frequency and level of detail: an abridged monthly report, a more comprehensive quarterly report, and an exhaustive annual report were required prior the organizations' annual planning period.

Based on information processing theory of organizations, the findings can be interpreted as follows. Although task uncertainty of AC is low, information processing requirements are high due to its two-fold function as (1) a proxy for top management's information demand (due to high levels of environmental and task uncertainty), and (2) consolidator of company-wide quantitative, especially financial, data in order to meet regulatory requirements.

However, the uniformity of information demand would have allowed for the use of vertical information systems. Such vertical information systems enable high speed transportation of data to top level executives and strategic planners, but they are restricted to standardized, highly formalized data. Once in place, information can be processed automatically, allowing for frequent, i.e. even monthly or daily information input. Yet, these systems are complex and adaptations are costly, allowing for little flexibility once they are set up. These circumstances also explain the quantitative, financial focus of the information demand: The incorporation of other types of information would require either manual processing or the previously mentioned costly adaptations of the information system. Thus, the derived demand for information on PSM performance can be characterized as 'routine information processing' (Egelhoff, 1991) with low levels of uncertainty. The interdependence between AC and PSM resembles a single planning-cycle, since there is no feedback from AC to PSM. These 'pooled' interdependences are comparably less demanding (Thompson, Hamilton and Rust, 2005) and integration can be achieved rather easily. The necessary information processing requirements for the PSM function are well predictable and the information processing capacities can be well adapted to meet the requirements, and cause a good fit.

Group 2 "Operations"

Operations characteristically promotes the flow of production. The demand for commodities as a major input factor in the pharmaceutical and chemical industry is comparably stable. The products wer well-specified and purchases were predominantly re-buys. Accordingly, task uncertainty was relatively low, requiring little information processing capacity during task execution. However, purchasing volumes were high and products were highly critical since any interruption in supply might have posed severe consequences for the entire production facility. Moreover, the supply environment was subject to high price volatility. Price fluctuations on the commodity market pose opportunities and risks to PSM and Operations. In times of increasing prices, long-term contracts might provide a competitive edge; however, in times of decreasing prices, such contracts may impede competitiveness. Operation's informants agreed that PSM's monetary contribution was the most important for their business. Furthermore, Operations predominantly required less frequent, i.e. quarterly, performance reports on a Previous-to-Actual Year comparison regarding price and quantity developments. Ad-hoc reports were only requested for unforeseen changes (and reasons for the changes) affecting the most important or most valuable products. Accordingly, Informant 6 stated:

> *"Quarterly reporting is sufficient, except for deviations regarding our strategic products; then, information needs to be provided as soon as possible."*

Ad-hoc information was necessary, but not exclusively sufficient, in order to resolve the potential issues that arose as a consequence of the deviations. If, for example, a dramatic price increase

occurred on the commodity market, operations would rely on information provided by PSM in order to identify the cause-and-effect chain. Ex-post information on previous price developments was valuable to predict further developments. The unilateral flow of information became bilateral because decisions made by operations had to be immediately activated by PSM, commencing a feedback loop.

From an information processing perspective, the findings suggest the following: High product volumes and high risks increase the exposure to loss and enhance uncertainty. Hence, information on deviations, e.g. regarding security of supply, is of high importance and needs to be processed and forwarded immediately to the decision-makers. In the case of plan variance, information demand increases further, and previously routine information processing turns into reciprocal information processing. For the latter, a good fit can be achieved best by means of lateral relations, which provide the fastest way of transporting a limited amount of rich information, since hierarchical structures are circumvented. In contrast, information on the market environment and developing trends is important on a rather medium- to long-term perspective, for example, in order to identify new suppliers, and to determine the proper purchasing strategy. Thus, uncertainty concerning the future is existent but does not need to be resolved immediately, explaining the comparably long reporting intervals.

Group 3 "Others"

Although this group is made up of various departments such as Marketing, Environmental Health and Safety, and Corporate Information Systems, a number of communalities could be identified. First, one-time purchases related to rather complex, costly and highly customized projects were prevalent. Second, pro-active communication of PSM's contribution to business performance was demanded. Third, quarterly or even less frequent performance reporting was preferred, except in the event of unforeseen circumstance. Finally, a clear perception of the monetary contribution as the most important contribution to the business was observable. Despite the latter, there was noticeable ambiguity on how the contribution was achieved and subsequently on the actual information demand. For example, informant 16 stated:

> *"PSM should stop focussing on savings; they should provide transparency on their value added to the business."*

In a similar vein, informant 14 said:

> *"The advantages of CP involvement are not obvious and CP should improve its 'internal marketing'"*

Based on information processing theory of organizations, the findings can be interpreted as follows: The high degree of novelty among purchase transactions and the complexity of those projects induce high degrees of uncertainty, since experience and knowledge of the purchase are comparably low. Planning provides means of reducing uncertainty by anticipating various conditions and outcomes but requires comprehensive information prior task execution. However, once planned, little additional information is required during task execution. This is exemplified by (1) informants call for 'ad hoc' instead of frequent performance reports concerning the purchase of projects, and (2) their preference for plan-to-actual spend comparisons. Once the project has been initiated, only deviations from plan are of relevance for executives, since they may require immediate counter measures. Otherwise, the project is assumed to be on track and frequent information would unnecessarily overload information processing capacity.

The ambiguity concerning PSM impact on business performance can also be explained by the extensive planning efforts: during planning of one-time purchases, PSM and its internal client work closely together; their interdependency is of reciprocal character. According to information processing theory of organizations, this causes high levels of uncertainty. In practical terms, the contribution by the individual participants in this reciprocal process is hard to identify and would require extensive tracking of the sources and effects of every single amendment in the planning

phase. In turn, this would pose high information processing requirements, for example, by taking minutes of every single discussion and finally identifying the effects in monetary terms.

Summary and Conclusion. Based on an in-depth case study at the German pharmaceutical and chemical company 'PhemChem', we assessed contingencies of information demand and information processing requirements for PSM performance reporting, as well as measures to meet these requirements.

The findings indicate that the information demand varies according to the uniqueness of the purchasing situation. For this study, two conditions were distinguished: (1) straight/modified rebuy, and (2) new task. New tasks induce higher uncertainty since experience and knowledge related to the purchase are strictly limited. In the particular context of PhemChem, new tasks were predominantly related to more complex, one-time purchases, inducing high uncertainty. Planning provides a mean of reducing uncertainty by anticipating various conditions and outcomes but requires comprehensive information prior to task execution. However, once planned, little additional information is required during task execution. This is exemplified by two situations: (1) informants called for 'ad hoc' instead of frequent performance reports concerning the purchase of projects; and (2) informants preferred plan-to-actual spend comparisons. Once the purchasing project is initiated, only deviations from plan are of relevance for executives because they may require immediate counter measures. Otherwise, the project is assumed to be on track and frequent performance reporting would unnecessarily utilize information processing capacity. The focus on plan-to-actual spend comparison also has significant implications for PSM: the reliability of its planning activities becomes a major determinant of its performance.

Compared to one-time purchases, the findings for re-buys are not entirely contrary but distinct. Although expertise evolves in the course of (re-)buying the same products, thus reducing uncertainty about product specifications and range of potential suppliers, the environment induces high degrees of uncertainty especially concerning the purchase of commodities. Price fluctuations on the commodity market provide opportunities as well as risks to the PSM function. Long-term contracts might provide a competitive edge in times of increasing prices, but may actually impede competitiveness in times of falling prices. Case company informants predominantly required frequent performance reports on previous-to-actual year comparisons and price developments, and ad-hoc reports only for changes affecting the most important or most valuable products. High volumes and greater risks increase the chance of loss and enhance uncertainty, providing an explanation for the high information demand. Concurrently, this study identifies the relevant basis for PSM performance assessment regarding recurring purchases: the price development on a previous-to-actual year comparison. This comparison allows for evaluation of PSM performance based on how well it exploits market dynamics in favour of the focal company.

The findings further indicate a particularly high information demand prior to PhamChem's annual planning period. Such strategic planning activities are characterized by high degrees of uncertainty and information processing requirements. The case study informants additionally emphasized the need for more qualitative and non-financial performance information. According to information processing theory of organizations, highly-formalized information, such as accounting data or data on cost savings, allows for the transportation of comparably large amounts of standardized data, for example via vertical information systems, but requires information processing capacity for coding and decoding of the information. However, during this transformation, information is irreversible condensed. For example, PSM performance can be expressed by a monetary value in terms of savings for every purchased product and this data could be easily further aggregated by addition. However, information on the circumstances under which the savings were achieved is lost. Thus,

lateral information systems, based on formalized data, provide comparably less rich data than, for example, qualitative data.

The contribution of this paper is threefold. First, we have complemented the mainly conceptual research on performance measurement in PSM by empirically assessing the information demand of top level executives as important addressees of performance reports. Second, we emphasized the need for more contingency research on performance measurement. Third, we have sought to complement the discussions on performance measurement in PSM by providing theoretical explanations based on information processing theory of organizations for varying information demands. By adapting the model developed by Tushman and Nadler (1978) and under consideration of the presented case study, we can summarize by stating that three key contingencies affect information demand for PSM performance by top level executives: (1) purchase characteristics, (2) planning environment, and (3) interdependence between PSM and other organizational units.

The presented findings have important practical implications for companies and managers in PSM responsible for designing and maintaining performance measurement systems. First, the results suggest that PSM needs to follow a contingency approach to performance measurement, depending on the addressee of performance reports. Different recipients require different types of information in varying depth and frequency. Second, understanding the implications of various approaches of information processing is essential and matching the information processing capabilities with information processing requirements will not only be beneficial to the organization as a whole, but also to PSM and its recognition as a strategic function. Third, by providing suggestions for contingent usage of adequate integration mechanisms, executives receive guidance on how a better fit of information processing demand and information processing requirements can be achieved. By providing these insights, we hope to enable managers to take these considerations into account when designing and maintaining performance measurement systems for PSM that meet the objectives.
To conclude, we highlight potential areas for further research. The findings derived from the presented case study might be specific to the focal organization, the industry, or the developmental status of the PSM function. Hence, further research is needed to assess whether the findings hold true under different circumstances as well. Furthermore, it would be fruitful to follow up on the actual use of information provided by PSM performance measurement systems. Performance measurement should not be the ultimate answer to success. However, considering the limited information processing resources present in organizations, their efficient use is key to improving organizational performance.

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SUPPLY INTEGRATION, MARKET INTELLIGENCE, AND PERFORMANCE: INITIAL MODEL DEVELOPMENT AND CONSTRUCT FORMULATION

George A. Zsidisin, Ph.D., C.P.M.
Bowling Green State University
419/382-8260; gzsidis@bgsu.edu

Ednilson S. Bernardes, Ph.D.
Georgia Southern University
912/478-5375; ebernardes@georgiasouthern.edu

Janet L. Hartley, Ph.D.
Bowling Green State University
419/382-8645; jhartle@bgsu.edu

Abstract. There has been a recent focus in business scholarship on how firms can benefit from integrating their supply chains. However, the benefits of internally integrating the supply management function are less clear. Further, we propose that the benefits of internal integration may be limited, and that firms need to scan the supply market in order to capture new knowledge and developments outside of the current supply base. This working paper will examine how strategic supply management influences internal integration and market intelligence, and their subsequent effects on firm and supplier performance.

Introduction. The purpose of this working paper is to present a conceptual model and create constructs for examining the mediating roles of interfunctional integration and supply market intelligence on the relationship between strategic supply management and supplier and firm performance. Carr and Pearson (1999) initially conceptualized Strategic Supply Management (Purchasing) as consisting of formally written long-term plans that are reviewed and adjusted to match changes in the corporation's plans on a regular basis. From this initial definition, other researchers have expanded the concept to include supply management professionalism, status, and external relationships (Ogden et al., 2007). Although the terms have varied in the literature, we argue, similar to that of Lawson et al (2009) that strategic supply management serves as an enabler of high-level activities focused on the interface between a firm and its suppliers that has a long-term orientation toward improving firm and supply chain performance.

Researchers have examined the mediating role that various supplier management practices play between strategic purchasing and firm performance (Carr and Pearson 1999; Chen, Paulraj, and Lado 2004; Lawson et al., 2009; Sanchez-Rodriguez, 2009). However, supply

managers' responsibilities extend beyond managing external suppliers to managing a variety of internal and other external activities. Thus, this research makes a contribution by examining two of these important roles: a) the interfunctional integration of supply management within the firm and b) the environmental scanning for supply market intelligence.

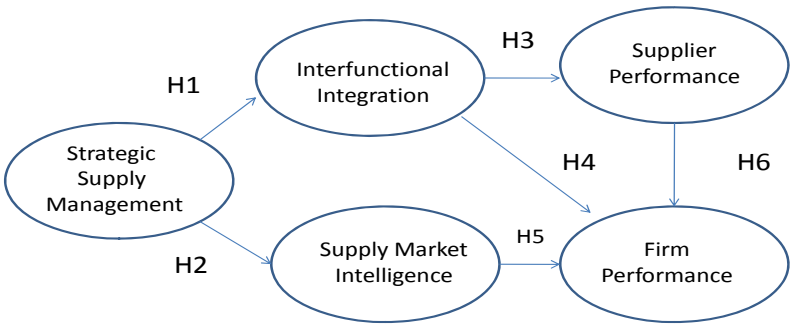
The overall theoretical framework for this study is grounded on the "strength-of-ties" perspective of supply chain management (Granovetter, 1973; Hansen, 1999; Zaheer et al., 1998; Gulati, 1995). The extent of integration between two interacting entities (individuals, functional departments or firms) can be conceptually positioned on a continuum from low level or "weak ties", which consists of relationships characterized by arm's length interactions, to higher levels or "strong ties", which incorporate frequent and "thick" lines of communication and knowledge transfer. Individuals, business functions, firms, and supply chains all interact as part of an overall interconnected social network. In particular, the dyadic relationships between the supply management function and its internal functional counterparts involve ever more interactions and dependence, leading to the development of an internal social web. In this study, we view activities that facilitate interfunctional integration as techniques that strengthen the ties within an internal or external supply chain. Inherent in its definition and conceptualization, Strategic Supply Management creates strong ties at the strategic level of the buyer-supplier relationship, as well as with the top management of the corporation. Further, although less often examined, this integration also occurs within the firm. Interfunctional integration focuses on the relationships formed by the supply management function within a firm and its respective peer departments.

Although strong ties through integration can result in improved supply management performance (Lawson et al., 2009), there are also circumstances and environmental factors under which the structures established by strong ties can become too rigid and preclude quick adaption to changes. Therefore, activities such as Supply Market Intelligence (Handfield, 2006), which consists of continually scanning the supply market for changes and opportunities, can create value for the purchasing firm. Supply Market Intelligence is viewed as a "weak-ties" practice, because it relies on many different potential sources of information. These linkages with the supply market are not done on a frequent, recurring basis with repetitive information exchange, but more instead from the consistent scanning from many potential sources of information that exists external to the direct supply chains that firms participate. These "weak ties" to the external environment can provide firms substantial benefits by leveraging new developments in the marketplace.

In this working paper, we argue that firms need to have a combination of strong and weak ties to achieve positive supplier and firm performance. We present and briefly describe our research model and hypothesis. We then provide a high level overview of the research methodology used in this study and provide some initial data analysis and results concerning the research constructs.

Research Model and Hypotheses. The conceptual model is shown in Figure 1. Each of the research hypotheses will briefly be discussed in this section.

Figure 1: Conceptual Model



Markets are characterized by intense foreign competition, rapid technological change, and shorter product life-cycles have imposed great adaptive pressures upon firms. This, coupled with the need for greater flexibility, has forced firms to increase interfunctional interactions. Due to the inherently boundary spanning nature of the supply management function, supply managers are usually responsible for managing the connections between the internal functions and external suppliers (Moeller, Fassnacht, and Klose 2006). Strategic supply management involves planning, implementing, evaluating, and controlling so supply management's activities are focused on attaining a firm's long-term goals (Carr and Smeltzer 1997; Carr and Pearson 1999). Supply managers, therefore, need to work with other internal functions to ensure that sourcing decisions are in the best interest of the organization's overall goals. Based on an extensive review of the literature, Pagell (2004) suggests that strategic census is a driver of interfunctional integration. Because of the focus on the organization's overall goals, when supply management is more strategic, we would expect greater levels of communication and interaction between supply management and other internal functions. These dyadic internal relationships between the supply management function and its functional counterparts should lead to strong ties, or functional embeddedness, over time, which is a relational type of integration. Thus, we propose that:

Hypothesis 1: Strategic supply management is positively related to internal integration.

Supply managers also have a key responsibility to scan the environment, gathering information on factors such as supply, demand, and technology. Supply managers must understand, identify, and capitalize upon opportunities that exist for their organizations in supply markets (Handfield, 2006). When the supply management function is more strategic, the importance of this environmental scanning role is likely to increase. Thus, we propose that:

Hypothesis 2: Strategic purchasing is positively related to supply market analysis.

Better alignment of supply management and functional goals should clarify goals and expectations for suppliers. When suppliers more clearly understand their customer's goals and expectations their performance is likely to increase. Thus we propose:

Hypothesis 3: Interfunctional integration is positively related to supplier performance.

Increasing interfunctional integration increases an organization's ability to process information that it needs for decision-making (Galbraith, 1973). Firm-wide integration has been shown to be directly related to overall firm performance (Haozhe, Mattioda, and Daugherty, 2007). In addition, strong interfunctional ties should provide more flexibility for decision-making, enhanced innovative potential, and more agile implementation of actions, all leading to better performance. As suggested by Pagell (2004), better alignment of supply management with other internal functions is also likely to directly impact firm performance. Thus, we propose:

Hypothesis 4: Interfunctional integration is positively related to firm performance.

Internal integration in the form of strong ties should lead to higher firm performance. However, although strong ties may facilitate decision-making and action-implementation, due to its inherent nature, it may also be detrimental to the infusion of new knowledge. Thus scanning a broad array of weakly-tied suppliers should offset the potentially negative effect of functional embeddedness. Scanning the environment for information has long been viewed as an important organizational level activity (Aguliar, 1967; Hambrick, 1982). Environmental scanning has been explored in a strategic management context and shown important for developing both marketing and R&D competencies (Danneels, 2008). Supply market intelligence is essential for developing effective supply management strategies (Handfield, 2006; Hanfield et al., 2009) and should contribute to the infusion of product, process, and strategic innovations. Thus, we propose:

Hypothesis 5: Supplier market analysis is positively related to firm performance.

For most organizations, purchases from suppliers account for a large percentage of the buying organization's overall costs. Researchers have shown that there is a relationship between supplier performance and the buying firm's overall performance (Tan and Kannan, 1998). Supplier performance has been shown to be directly related to a firm's cost performance

(Carter 2005) as well as its quality and delivery performance (Park and Hartley, 2002). Thus, we propose:

Hypothesis 6: Supplier performance is positively related to firm performance.

Research Methodology. The instrument used for data collection is part of a wider project involving researchers in North America and Europe. The researchers identified an initial list of items from past literature to represent aspects of supply management in terms of context, strategy, structure, process and skill sets of supply management professionals in developing the survey instrument. Interviews with practitioners across the different countries and discussions between and among the international teams, all of which consist of active researchers in the field of supply management, were used to ensure and assess face and content validity of the constructs.

The initial data analysis for this study first consists of forming constructs from the data collected in the U.S. The data was collected through an internet-based survey instrument. A cover email was sent to supply management professionals during the summer of 2009 inviting them to participate and directing them to the survey-website. The implementation of the survey followed the guidelines of Dillman's (2000) total design method: an initial email distribution was sent, followed by two waves of reminders. From the US data, 72 usable surveys were completed.

The U.S. data were gathered from two different sources. One source was the American Purchasing Society. The second source of respondents was a list of alumni of an undergraduate supply management program, whose emails were on file with the alumni office. Because these graduates may not currently be working in supply management, an initial email was sent explaining the survey and asking if they were interested in participating. A more thorough description of the survey sample demographics and protocol, as well as tests for nonresponse bias (Lambert and Harrington, 1990; Armstrong and Overton, 1977), will be provided during the presentation.

Data Analysis and Findings. At this stage in the research project, the data analysis consists of scale and construct development and purification for the research model presented in Figure 1. Appropriate references will be provided during the presentation.

We assessed the initial dimensionality, validity and reliability properties of the measures representing the theoretical concepts used in our framework. Unidimensionality refers to the existence of one latent trait underlying a set of measures, i.e., the homogeneity of such items, while reliability addresses the extent to which measures are free from random error and, therefore, yield consistent results on repeated trials. Construct validity refers to the extent to

which a set of measures correctly represents the concepts of study. There are various types or ways to establish construct validity, at least two of which are considered fundamental or minimally necessary to support evidence of validity: convergent validity and discriminant validity. Convergent validity refers to the degree of correlation among the empirical indicators used to measure the same latent construct, while discriminant validity is the degree to which empirical indicators of different constructs are unique from each other.

At this early stage of the scale development, we examined various internal consistency and item-based statistics in conjunction with exploratory factor analysis (EFA) to purify the scales and study their initial psychometric properties. A Corrected Item to Total Correlation (CITC) score was calculated for each item to assess item reliability. The intention was to eliminate items with CITC values below 0.30. All the items had values above this threshold (see Table 1). We also conducted the Harmon's one-factor test to assess common method bias, which is present when correlations between measures can be explained by the fact that the same individual provides the responses for all measurement scales rather than by any true relationship between constructs. Using all measurement items, we performed a factor analysis to check if a single factor would emerge. The results revealed that no single factor accounted for most of the variation in the data. So we concluded that any common method bias that may exist should not be problematic for our initial sample analysis. To assess initial divergent validity, all the items were subjected to an exploratory factor analysis using principal components and oblimin as a means of rotation to extract common factors (see Table 2). Initial convergent validity was examined by conducting factor analysis at the individual factor level, and the internal consistency of each factor was assessed using Cronbach Alpha. Results from factor level EFA suggested that all items had significant loadings on their respective factors and Cronbach Alpha for each of the factors ranged between 0.79 and 0.91, as shown in Table 3, indicating acceptable initial internal consistency.

Discussion. The purpose of this working paper is to create constructs for examining a model investigating how supply integration and market intelligence affects supplier and firm performance. Although this conference proceeding paper has provided some initial analysis from U.S. respondents, we have also collected data in ten additional countries. As time permits, we will discuss elements of this additional data collection and venues for future research.

Table 1. Corrected-item total correlations for initial purification

	CITC
Strategic Supply Management	
SSM1. Purchasing views are considered important by most top managers	0.76
SSM2. Purchasing is recognized as an equal partner with other functions of the top management team	0.75
SSM3. Purchasing actively participates in organization-wide process improvement	0.72
SSM4. Purchasing is included in the firm's strategic planning process	0.80
SSM5. Purchasing performance is measured in terms of its contributions to the firm's strategic objectives	0.69
SSM6. Purchasing focus is on longer term issues that involve risk	0.69
Interfunctional Integration	
II1. To what extent do purchasing supervisors and subordinates communicate in your organization?	0.62
II2. To what extent are new ideas from the purchasing department communicated to other departments?	0.60
II3. To what extent are employees supportive of each other?	0.57
II4. To what extent do employees have a sense of belonging to your organization?	0.78
II5. To what extent do employees share ideas freely with each other?	0.78
Supplier Market Intelligence	
SMI1. To what extent do you seek to learn from tracking new market trends in your supply industry?	0.37
SMI2. To what extent you seek to learn from benchmarking best practices in purchasing?	0.64
SMI3. To what extent do you seek to learn from trying out new technologies?	0.81
SMI4. To what extent do you seek to learn from your suppliers?	0.77
Supplier Performance	
SP1. The purchasing price	0.67
SP2. The cost of managing the procurement process	0.64
SP3. The level of supplier conformance to specs	0.82
SP4. The level of supplier product/service quality	0.75
Firm Performance	
BP1. Return on investment	0.80
BP2. Net Profit	0.85
BP3. Sales growth	0.81

Table 2. Exploratory factor analysis after initial purification

Item	Strategic Supply Management	Interfunctional Integration	Supplier Market Intelligence	Supplier Performance	Firm Performance
SSM1	0.76				
SSM2	0.74				
SSM3	0.49				
SSM4	0.83				
SSM5	0.82				
SSM6	0.71				
II1		-0.69			
II2		-0.58			
II3		-0.61			
II4		-0.86			
II5		-0.82			
SMI1			-0.77		
SMI2			-0.84		
SMI3			-0.82		
SMI4			-0.74		
SP1				0.70	
SP2				0.69	
SP3				0.96	
SP4				0.82	
BP1					0.87
BP2					0.91
BP3					0.88
Eigenvalue	7.5	4.5	2.5	1.1	1.1
% variance	25.2	14.9	8.4	6.0	3.8
Cumulative % variance	25.2	40.1	48.4	68.1	71.9

Table 3. Means, standard deviation and correlations

Construct	Cronbach Alpha	Mean	s.d.	1	2	3	4
1. SSM	.90	25.46	6.9				
2. SP	.86	21.7	5.7	0.05			
3. SMI	.88	16.5	4.3	-0.19	-0.11		
4. BP	.91	13.5	5.0	0.02	0.19	-0.12	
6. II	.85	20.14	4.9	-0.36	-0.10	0.22	-0.03

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Working Paper for the 20th Annual North American Research/Teaching Symposium on Purchasing and Supply Chain Management

Business Innovation through Proactive Contracting: A Conceptual, Interdisciplinary Framework for Service Procurement Practices

Helena Haapio, Master of Laws, Master of Quality, PhD Candidate
Lexpert Ltd, Finland
+358 9 1355800; helena.haapio@lexpert.com

Katri Rekola, PhD
CEO, Rekola Design Oy, Finland
+358 505445730; katri.rekola@kolumbus.fi

Dr. Gerlinde Berger-Walliser, Associate Professor[1]
ICN Business School and CEREFIGE, France
+33 3 83 29 01 07; gerlinde.berger-walliser@icn-groupe.fr

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[1] Corresponding author.

Business Innovation through Proactive Contracting: A Conceptual, Interdisciplinary Framework for Service Procurement Practices

Abstract. In order to succeed in today's interconnected and global economy, companies need to source and manage external resources. Quite often, these involve services and not just tangible goods. Suppliers, customers, and users have become co-creators of value and innovation. To manage collaborative arrangements and their outcomes, companies need tools and capabilities that help them make expectations and commitments explicit and transparent and roles, rights, responsibilities and remedies visible and implementable. This working paper presents interdisciplinary research in progress focusing on contracts and contracting: the tools and processes without which service procurement and collaboration cannot happen. Using a proactive approach to merging service development, contract design and the underlying laws that apply, this research aims at producing new, innovative tools for service contracting and for improved organizational understanding.

Introduction. With the tremendous growth of outsourcing and networking, supply chains have become more complex and global. An increasing part of products is being purchased from specialized suppliers in various parts of the world. The trend over the recent years goes towards actively managed supply chains (Sturgeon, 2002) and concentrates more on the commitment of the parties involved (Fawcett et al., 2006). Supply chains move from vertical integration towards collaborative processes that focus on continuous innovation and quality improvement and that need to be supported by supply chain contracts drafted in accordance with these changing business goals (Gilson et al., 2009).

In addition to this, the global economy is shifting from manufacturing towards services (Nystén-Haarala, 2009, Sorsa and Salmi-Tolonen, 2008). With the advances of technology, manufacturing companies are enhancing their offerings by attaching increasingly complicated services to their products. Along with selling equipment, manufacturers are taking over part of the customer's process. Different levels of service relationships like full service, performance partnering, and value partnering have developed over the recent years (Rekola and Haapio, 2009a), and these services become increasingly important for the supply chain.

In the current economic downturn, the pressures on increasing revenue and cutting costs and cycle time are growing. Traditionally, manufacturers have offered product support services such as maintenance without considering them a serious source for revenue or profit. Now the focus is more and more on services, and service providers are increasingly becoming responsible for creating value to the supply chain (Rekola, 2008). They must ensure that their service offerings meet the expectations of the customer and even the customer's customer and need to be prepared to suffer the consequences if they fail to deliver the promised value.

Being intangible – apart from materials, equipment, etc. connected to them – services are harder to test, evaluate, and compare than manufactured products. This presents challenges to service procurement professionals choosing between different suppliers and comparing their offerings. The legal framework for services is not the same as for goods, especially in the international context, where a uniform international sales law for goods exists, but one for services is still missing. Because of the intangibility of services it is often difficult to describe and specify expectations, roles, and responsibilities. This can be the case for both sides – service provider and customer alike.

These rapid and fundamental changes in the manufacturing industry entail new challenges for the whole organization, supply chain management, procurement practices, and product and service design included. They call for continuous interaction between buyers and sellers, which needs to be reflected in contracts. These new procurement contracts differ considerably from

traditional contracts for the purchase of goods and need to take into account the international dimension, new processes and different expectations of customers mentioned above.

With this research we hope to contribute to the understanding of the current situation and future challenges for service procurement practices, and to develop tools that can help achieve business innovation and improve performance through the merger of proactive service design and proactive contracting.

Scientific Context and Current Research. This research project is multidisciplinary. It is mainly located in the industrial management (or industrial engineering) paradigm, with close links to the emerging fields of proactive/preventive law, interorganizational governance research, and research on contracting, sensemaking and understanding (e.g., Vlaar, 2006), as well as positive organizational scholarship and design science. One of the main principles of positive organizational research is promoting and researching the positive, focusing on what works instead of what is wrong (e.g., Blatt, 2009, Fineman, 2006, Center for Positive Organizational Scholarship), which is also the goal in this project in particular and in the proactive approach in general. The ideas of design science are well suited to the constructive research method: aiming to bridge the gap between academic research and practitioners[2]. The idea of making a connection between contracting and service/product development and design is the underlying assumption of this research, and does not come up much in current research into either industrial management, law, or related areas[3].

Proactive Law. *Proactive law* has its starting point in law. The scientific context is, however, somewhat different. A range of research demonstrates the interdisciplinary character of proactive law. The interaction between legal theory and practice and between legal science and other sciences is crucial for the success of proactive law.

In the traditional legal field, discussions have been *ex post*-oriented. Legal research has been mainly concerned with failures – shortcomings, delays, and failures to comply with the law. Legal research in the field of contracts has concentrated on legal rules and case law: what courts have done, for example, to protect the weaker or less sophisticated party – in hindsight, ex post. The focus in this research is different; it is on the future, and on success rather than failure. Here, the question is not what courts have done or are likely to do, but what people and businesses can and should do – using foresight, *ex ante*.

The idea of an *ex ante* view (or proactivity) in law is not new in itself. It has been known for years that the earlier a dispute or a potential dispute is addressed, the better the chances of a fair and prompt solution. Most contract lawyers and in-house counsel actually practice future-oriented law: they help clients to plan and structure transactions and manage risk. In the context of practicing law, the idea of prevention was first introduced by Louis M. Brown (Brown, 1950, Brown 1955, Brown 1972, Brown 1986). In his ground-laying treatise *Preventive Law*, he states a simple but profound truth that has not lost any of its value in more than fifty years: "It usually costs less to avoid getting into trouble than to pay for getting out of trouble" (Brown, 1950)[4].

[2] A supply-chain related study found that "Another poorly executed infrastructure element is the legal/contractual language that discourages collaboration. For both the primes and supply network, legal and finance are rarely involved in development of collaborative relationships and processes. The result is conflicting or restrictive clauses that protect against litigation rather than encourage trusting relationships." National Council for Advanced Manufacturing, Supply Chain Integration: The Key to Aligning the Network-Centric Enterprise, 2007, p. 22.

[3] Noteworthy exceptions include Gilson et al., 2009, Winn, 2008, Jennejohn, 2007, Vanderbergh, 2007, and Wuyts and Geyskens, 2005, but they do not specifically address service development and design.

[4] For recent developments in Preventive Law see www.preventivelawyer.org.

The approach specifically called *proactive law* emerged in Finland in the 1990s. Its origins are in *proactive contracting* (Haapio, 1997/1998). Originally, the goal was to provide a framework for integrating legal foresight into the tangible practice of everyday business and to merge good contract, legal, project, quality and risk management practices with a proactive approach to law. Recently the proactive law approach has been taken over in other areas such as tax legislation (Zimmer, in Wahlgren, 2006), ICT (Information Communications Technologies) law (Magnusson Sjöberg, in Haapio, 2008, Jakobsen, in Wahlgren, 2006), data and information resources (Magnusson, in Wahlgren, 2006), and law-making (EESC Opinion 2009, Sorsa 2009)[5].

Research Objectives. The proactive approach as described above differentiates two aspects of *proactivity*: one being the *promotive* dimension (promoting what is desirable; encouraging good behaviour) and the other being the *preventive* dimension (preventing what is not desirable, keeping legal risks from materializing) (EESC Opinion 2009). Along with this definition, this research analyses and seeks to provide solutions to the following questions:

How to incorporate contracting into the service design process? How to design contracts, services and related processes proactively in order to better achieve business innovation and value? How to take into account the growing international dimension of service procurement contracts and how to prevent legal problems and litigation?

Discussion. This paper describes a work in progress. The following discussion reflects the methodology used for this research and some initial findings and preliminary or expected answers to the research questions stated above and shows the directions of further research.

Traditional legal research is *explanatory* rather than *exploratory*. This research aims at producing new, innovative tools for service contracting and for improved organizational understanding. The methods of conventional legal research are unlikely to produce such results. Contracts are highly context-dependent. They often comprise several documents specifying their object and the parties' responsibilities, key performance indicators, pricing principles or fee structures, management routines, etc. Thus, contracts are a combination of financial, technical and legal aspects of business, added with relationship management, organizational and strategic issues. To bring about strategic innovations, research related to contracts and contracting must be cross-disciplinary.

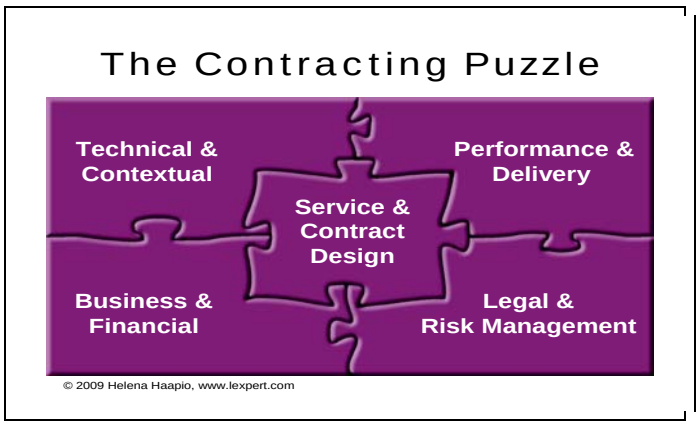

Figure 1: The Contracting Puzzle

[5] The importance of exploring the proactive law approach has recently been recognized in the European Union, in the Opinion of the European Economic and Social Committee (EESC) published on 28 July 2009 in the Official Journal of the European Union (OJ C175, available in all official EU languages). Co-author Helena Haapio acted as Expert to the EESC in preparing this Opinion.

Many industrial companies operate globally and procure from their suppliers more than half of what they offer to their customers. As the number and complexity of trading relationships continues to grow, companies need a reliable foundation for business. Contracts can provide this foundation. Contracts enable companies to define and shape their transactions and relationships. Within the global inter-connected economy it becomes increasingly important to know what to expect from foreign laws and jurisdiction. Unlike the international sale of goods which is governed by an international treaty – the Convention on Contracts for the International Sale of Goods (CISG) - there is no such international treaty providing a common legal ground for services. Therefore, in international service contracts, there is a particular need for the parties to the contract to understand both business and legal issues and to provide solutions to the legal difficulties raised by varying laws and jurisdictions through a carefully drafted service contract.

Today's companies develop new solutions, business models and revenue streams at a growing speed. Design, marketing, and production processes are no longer under one roof: companies rely on others to provide products and services for them. New methods of collaboration and new technologies are creating new opportunities and, at the same time, increasing uncertainties. As companies innovate, outsource, network, and collaborate, they become more and more dependent on each other – and on contracts.

Still in the vocabulary of many managers and researchers, the word “contract” implies legal documents which can be assigned to legal professionals. Such a narrow approach bears the risk that business goals, for example innovation, are not sufficiently taken into account in the written document. As contracts have many functions, they cannot and should not be evaluated by their legal qualities alone. Contracts must capture, merge and articulate different stakeholders’ interests and requirements: strategic, financial, technical, legal, regulatory, etc. In addition to the core actors on the sell-side and buy-side during negotiations, the stakeholders include product and service owners, project and delivery team members, people accountable for monitoring performance, and many others. At the pre-contract and contract design stage, expectations need to be recognized, aligned, and managed. Shared expectations must be translated into responsibilities, which must be appropriately reflected in contracts. The supplier must understand and solve the customer’s problem while satisfying its own requirements for profitability and risk management. The following figure illustrates how expectations, intentions, promises and the ability to deliver the agreed service come together in the service relationship, guided by a service contract as a road map.

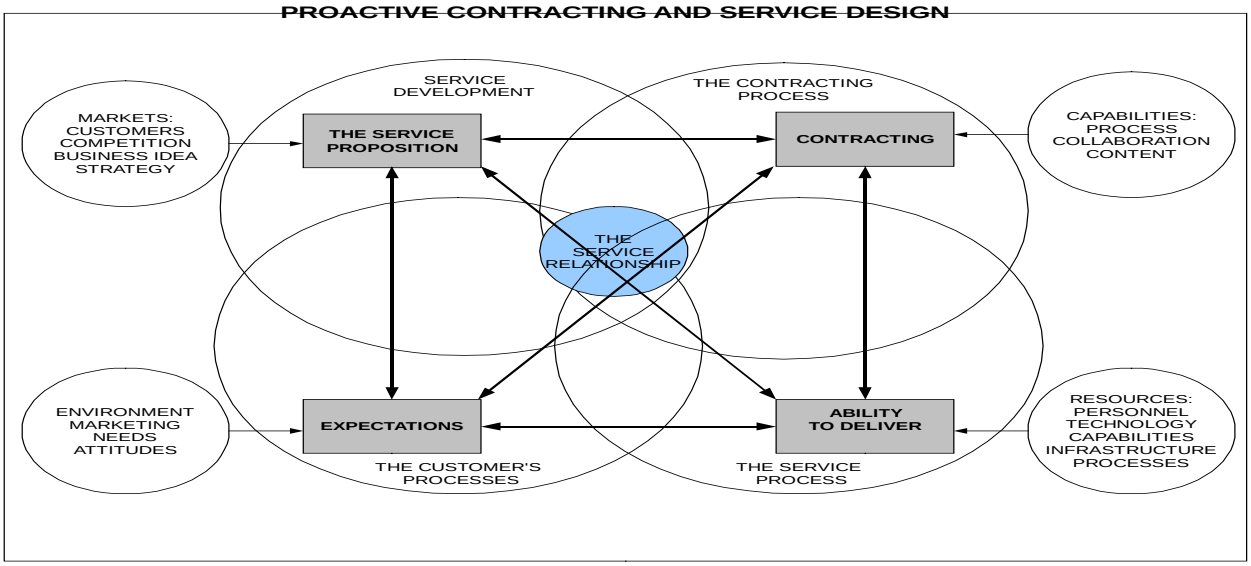

Figure 2: Proactive Contracting and Service Design (Rekola and Haapio, 2009a)

In order to function as business and management tools, contracts must translate goals, expectations and promises into a language that is understood in the way intended and, in turn, translates into successful performance. Taking into account the number of participants involved, the challenge is to achieve a balance between the different requirements and preferences and to facilitate communication and coordination, including a seamless transition between the different stages of the life-cycle of the contract. One possible way to achieve this goal is through *contract visualization* (Rekola and Haapio, 2009b) as a possible means to manage complexity, attract attention, and convey information quickly. *Contract visualization* makes contract information more interesting and accessible and helps to make complex contracts more comprehensible and understandable, internally, inside the company, and externally, between the different parties in, for instance, a supply chain. The goal is to get new products and services to the market faster, to make selling and buying easier, and to prevent problems. This involves (re)designing and reorganizing information and using graphs, charts, diagrams, maps, pictures, visualizations, sample risk lists, review checklists, term sheets, heads of agreements and other means of effectively identifying, assessing, negotiating, managing and implementing information.

Largely unexplored remains also the application of *user-centered design* to contracts. Hardly ever are the needs, wants, and limitations of business users given attention during contract design or related research. If users of contracts are discussed, they are deemed to be lawyers, judges and arbitrators rather than business users, such as sales, procurement, and project managers or delivery team members. The proactive law approach aims at changing this perspective.

Contracts have the ability to make companies and supply chains stronger and to support offerings and projects throughout their life-cycle. Well thought-out and communicated contracts can also help to clarify the interfaces between different offerings, projects and contracts (such as contracts for the supply of equipment and services, financing, transportation and insurance) and to synchronize the terms of the contracts that are connected. For example in the case of “back-to-back”, the concept that in a supply chain, the sub-supply contract should, as far as possible, be consistent with the supplier’s obligations under the main contract. The supplier’s obligations and risks relating to the main contract, the scope and duration, etc., should pass through to the sub-supplier. In this way, disturbances can be minimized and risks can be maintained at an acceptable level. In theory, it should work well in both long-term supply arrangements and in one-time major equipment supply projects. Yet in practice, companies encounter major challenges. While best practice corporations have addressed the integration of buy-side and sell-side contracting, many still procure products that lack appropriate terms that back up their offerings to their customers or fail to address crucial requirements early and explicitly so that they are available to those in the supply chain who need to know about them (Haapio, 2007).

Along with the *contractualization* of business, companies face another major trend impacting their business models: *servitization*. Recent developments are pushing manufacturing companies towards offering services and solutions. In service and solutions business, value is co-created with the customer. In order to succeed, the parties need to know their roles and responsibilities. This calls for a new approach to contracts and contracting.

As companies are increasingly dependent on external services to succeed in their own business, effective procurement practices and methods to test, evaluate, and compare services are needed. To further complicate the situation, the services often form or are part of a complex supply chain that consists of both services and manufactured products. This means that traditional approaches to supply chain management do not necessarily work. Some service testing and evaluation methods and tools do exist, for example so-called mystery shopping (Rekola and Rekola, 2005), but most of them do not work in the particular situation of a

manufacturing company buying and selling industrial B2B services. What is needed is a simple, practical method to assess B2B services by for example assigning points to different aspects of the service and then weighting them case by case. The method should also take into account the placement of the service in the supply chain in order to be able to optimize service procurement decisions taking into account how they affect and are affected by decisions elsewhere in the value chain. A theoretical framework for service procurement as part of a supply chain can then provide the basis for more practical, hands-on approaches, methods and tools.

Modular product design can help optimize for example the maintenance and repair processes, thus affecting the quality and cost of service. Modular thinking can be extended to service/offering design and contract design as well, making it easier for service procurement professionals to make smart service acquisitions and simplifying the contracting process. *Service productization* – which is an essential part of the proactive service design agenda and promotes modularity – is a way to not only facilitate selling services, but productized services are also easier to buy, evaluate, compare, monitor and validate. Consequently one indication of the quality of a service might then be whether – and how well – it has been productized. The research also aims to explore the possibilities of extending the principles of productization to contracting in order to help promote easier understanding and acceptance of contracts as tools and also facilitate a smoother contracting process in the form of productized contracts or terms and conditions, for example.

Considering the servitization trend and the relative novelty of the idea of industrial services as chargeable products in their own right, there is a need for new understanding of how to innovate and improve service contracting practices, especially in the context of service procurement and services as part of international supply chains. Companies need and want practical tools and methods, but there is also a gap in the theoretical arena. This research aims to add to the theoretical understanding by developing a framework for service procurement practices and also provide a starting point for the development of practical tools.

Future Research Direction. So far our research has been theoretical, mainly pointing out the problematic and specific features of service contracting and analyzing what needs to be changed in order to enhance business innovation through productization, service design and proactive contracting including visualization. Besides an in-depth analysis of the international legal environment for service contracts, the next step will be to provide practical tools and methods to achieve the goals set out in the discussion above through a qualitative approach. The novelty of the area of study, the complexity of the involved processes and the limited availability of large amounts of data to be studied, speak for the appropriateness of case study approach for this research (Yin, 1994; Gummesson, 1993; Gummesson, 2000). According to Gummesson (2000) case studies offer an opportunity for a holistic view of the studied process. In a holistic view the whole is not identical with the sum of its parts, and can thus only be understood by treating it as the central research objective.

According to the concept of constructive research (Kasanen et al., 1991, Kasanen et al. 1993) and the case study approach, the idea is to select projects from the participating companies to this research for closer observation as well as to collect data from existing contracts and related documents and other relevant material. Based on those observations, literature review and theoretical findings, further research should aim at developing and testing proactive tools and methods for service contracting, demonstrating that the proposed tools and methods work, show the theoretical connections and the research contribution of the solution concept and examine the scope of the applicability of the solution.

Further research could include an organizational aspect: how to make organizations more proactive and how to facilitate the adoption of new tools and methods, such as the service

procurement method and contract productization and visualization. This research could be initiated during the developing and testing of the aforementioned tools. In fact, if the proactive tools were to be accepted and become part of a company's regular practices, it would, besides being a validation for the tools themselves, provide a fruitful target for research on how a company has become and is becoming more proactive.

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Balancing Government Risks with Contractor Incentives in Performance-Based Logistics Contracts

Jeffrey A. Ogden, Ph.D.[1]
Associate Professor of Logistics and Supply Chain Management
Operational Sciences Department
Air Force Institute of Technology (AFIT)
Wright Patterson AFB, OH
(937) 255-3636
jeffrey.ogden@afit.edu

Christopher P. Gardner, Captain, USAF
Logistics and Supply Chain Management Student
Air Force Institute of Technology
Wright Patterson AFB, OH

Stephan Brady, Ph.D.
Assistant Professor of Operations and Supply Chain Management
School of Business Administration
Penn State University – Harrisburg
(717) 948-6643
spb7@psu.edu

ABSTRACT

Performance-Based Logistics (PBL) as a sustainment strategy for weapon systems has been mandated by the Department of Defense (DoD) and embraced by acquisition and contracting professionals in both government and private industry. Despite its apparent success, there is an inherent conflict that DoD implementers of PBL often face: the PBL goal of developing long-term partnerships that encourage investment from commercial partners is best achieved through lengthy, guaranteed contracts—but such contracts increase the DoD's risk in an environment that is intended to transfer more risk to the contractor. This exploratory research examines issues associated with the type and length of PBL contracts, addressing the question of how the DoD can balance PBL contracts mitigating operational and financial risks while simultaneously building long-term partnerships that encourage investment from commercial contractors. The results reveal five areas in which the government should focus its efforts to improve PBL implementation.

BACKGROUND

The current preferred product sustainment strategy for improving weapon system readiness within the Department of Defense is known as Performance-Based Logistics (PBL) (DAU, 2005). Unlike traditional strategies PBL shifts "from buying iterative discrete quantities of

[1] The views expressed are those of the authors, and do not reflect the official policy or position of the United States Air Force, Department of Defense, or the U.S. Government.

goods and services (transactional logistics) to acquiring sustainment via top-level outcomes" (Fowler, 2009). By focusing on purchasing outcomes rather than transactions, PBL strategies incentivize the providers to invest in their logistics infrastructure to reduce total system life cycle costs while simultaneously meeting system performance and support (Kim, Cohen, and Netessine 2007).

Under the old cost-plus strategy a firm contracted to supply, for example, aircraft parts profited off every part sold, but also had no inherent incentive to improve the product. The incentive was to maximize the sale of parts. Under a PBL strategy, that company may now be responsible for providing availability, or "up time" thereby shifting the incentive from volume and towards quality. Paying the contractor a fixed price for availability encourages them to reduce the amount of parts, increasing their margins (Geary, S., Vistasek, K., 2008). Some argue that PBL has, "for the first time in the history of DoD supported contracting and aligned the interests of each link in the chain with the end-user — the war fighter (Vitasek et al., 2006)." A well structured PBL maintains or improves performance, lowers costs to the government and increases profits for the supplier.

PBL-based contracts are intended to shift risk away from the customer and move it to the supplier, while simultaneously increasing the supplier's potential for reward. In traditional support strategies the risk rests with the government. By contracting for transactions (for instance, purchasing parts) the government risks increased failure rates, unavailability of parts, and obsolescence. To protect against these risks the government typically increases purchase volume thereby increasing safety stock. (Openshaw, 2006) By purchasing a capability the customer seeks to share these risks with the supplier. There are several ways suppliers can be incented to take on these risks, including the pricing model, incentives for reaching targets, provisions for "off-ramps" or exit criteria for both customer and supplier, workscope flexibility, and finally contract length (Geary,S., Vitasek, K.. 2008).

As noted, PBLs are seen as generally providing long-term contracts to enable suppliers to invest in systemic improvements that reduce system costs over the long term. However, such contracts may increase DoD's risk through uncertainty of funding, operational tempo, and supplier performance. (Mahon, 2007) While contracts of shorter term lengths may reduce risk for the government, the supplier's incentive to make significant up-front investments providing long-term benefits for the system is also reduced.

DoD faces the challenge of finding a balance between mitigating its own risks while making commitments to commercial contractors that encourage affordable, long-term support. No study has yet been undertaken to broadly examine if DoD's current contracting strategies are achieving this balance. This research investigates the factors most important to decisions for PBL contract type and length, examining contracting trends in past and current PBL programs, and garnering the opinions of subject matter experts in both DoD and private industry. This is not to examine whether PBL is a viable sustainment technique, but rather to identify what steps can be taken to contractually improve PBL structure by moving the government closer to finding achieving the necessary balance.

In order to address these issues, the following **research question** was investigated:

How can the Department of Defense ideally balance PBL contracts to mitigate operational and financial risks while simultaneously building long-term partnerships that encourage investment from commercial contractors?

Subsequently several **investigative questions** were established to guide the research and to frame the methodology:

1. What types and lengths of PBL contracts have proven most successful and effective to date?
2. What risks and other criteria most frequently play a role in determining PBL contract type and length?
3. Are contracts adequately structured to consistently meet the PBL goal of establishing long-term partnerships?
4. Are PBL contracts adequately structured to consistently provide incentives for contractors to make cost-reductions in system support?
5. How satisfied are PBL experts in both DoD and private industry with the government's risk aversion in PBL contracts?
6. Would any significant benefits be gained if the maximum contract length allowed by the Federal Acquisition Regulation was increased?
7. Are award term and option year contracting strategies being used effectively, and should their use continue in a lesser, similar, or greater capacity?
8. Should Working Capital Funds (WCFs) be used more extensively in PBL programs?
9. Does a PBL agreement's place among the "four stages" of PBL have any impact on contract length decisions?

LITERATURE REVIEW

PBL Partnerships

The processes of acquisition and sustainment in DoD have been continually evolving. In recent years the focus has shifted from organic development of technology emphasizing weapon effectiveness to commercial technology and sustainment strategies that increase performance while reducing costs over the life of systems. DoD seeks to gain the most efficient and effective performance of systems throughout their entire life cycles and to align the goals of all involved organizations for the duration of the programs (Berkowitz et al., 2005). By mandating implementation in the 2001 Quadrennial Defense Review, DoD identified PBL as the ideal strategy for attaining these goals provided that a thorough business case analysis justifies its use.

The Defense Acquisition University (2005) defined PBL as:

> The purchase of support as an integrated, affordable, performance package designed to optimize system readiness and meet performance goals for a weapons system through long-term support arrangements with clear lines of authority and responsibility. Simply put, performance based strategies buy outcomes, not products or services.

Berkowitz et al., (2005) further developed the definition capturing the essence of this new strategy:

> An integrated acquisition and sustainment strategy for enhancing weapon system capability and readiness where the contractual mechanisms will include long-term relationships and appropriately structured incentives with service providers, both organic and non-organic to support the end user's (warfighter's) objectives.

Both definitions point to the establishment of "long-term support arrangements" (DAU, 2005) or "long-term relationships" (Berkowitz, 2005) as being essential elements of a successful PBL. The literature makes it clear that these long-term relationships extend beyond simply the length of the contract but in the development of partnerships. (Stark, 2004; Devries, 2005; Vitasek, 2006; Geary, 2008). According to Lambert et al. (1996), "A partnership is a tailored business relationship based on mutual trust, openness, shared risk, and shared rewards that yields a competitive advantage, resulting in business performance greater than would be achieved by the firms individually." Partnerships are often viewed as centrally important to the success of PBL programs. The core of the PBL strategy involves capitalizing on integrated logistics chains and public/private partnerships (DAU, 2005). DeVries (2005) identified strategic alliances and partnerships as being among the key enablers of PBL implementation.

Lambert et al. (1996) notes that partnerships can differ significantly and that not all business relationships are truly partnerships. The same can be said of PBL within the context of DoD contracts. Contractual relationships that are largely transactional, involving very little integration of operations between DoD and smaller support providers, are generally not considered to be performance-based contracts. In contrast, DoD and major defense contractors, such as Lockheed Martin and Boeing, increasingly enter into performance-based accords that display several characteristics of partnerships. (Department of Defense Inspector General, 2006; Blumberg, 2007; Goure, 2009) Lambert et al. (1996) contend that, in such relationships, "Both parties must believe that they will receive significant benefits in one or more areas and that these benefits would not be possible without a partnership." The expected benefits form the compelling reasons to partner. The four primary reasons are asset/cost efficiencies, customer service, marketing advantage, and profit stability/growth. Although it is unlikely that the drivers will be the same for both parties, a sturdy partnership requires that they be strong for both.

The DoD partners to improve service to its customers, the warfighters, and to improve asset performance and cost efficiencies. By employing the PBL strategy, DoD aims not only to better meet the needs of the operational end-users by improving system performance and readiness, but also to minimize the total system life cycle costs and logistics footprints associated with those systems (DoD 5000.1, 2003). On the other hand, firms are driven to partner with DoD by the potential benefits of profit stability/growth and marketing advantage. Profitability is enhanced by long-term volume commitments for products, services, or both (Noordewier et al., 1990).

Lambert et al. (1996) classifies partnerships into three types, based on the level of commitment and integration of the relationships. Type I is just above arm's length relationship and Type III being the highest level of partnership. PBL programs are weapon system unique (DAU, 2005) so it could be argued that programs exist at all three levels. (Geary, 2008) However, most PBL contracts between DoD and the major defense contractors fit into the category of Type II partnerships, defined as: "The organizations progress beyond coordination

of activities to integration of activities involving multiple divisions and functions within the firm. Although not expected to last 'forever,' the partnership has a long-term horizon." (Lambert et al., 1996)

Risk

Inherent in any discussion of contracts is the sharing of risk. Firms are most concerned with financial risk; that is, ensuring that they will have enough business to realize an adequate return on investment. Vendors seek to ensure profitability and reduce financial risk through longer contracts, but also weigh their risks in determining the level of service they are willing and able to provide.

The government is concerned with operational and financial risk. The primary concern is operational risk, or the ability to meet mission objectives (Doerr et al., 2005). Contracting support puts certain aspects of the mission in the hands of the supplier. The length of a contract that DoD is willing to grant is often directly related to the amount of operational risk assumed by the commercial support provider. Doerr et al. (2005) propose that "when commercial sector vendors assume less (measurable) operational risk under a PBL contract, the term of that contract should be less." This implies that when vendors take on greater risk, the government should offer a longer contract. DoD is also concerned with financial risk. Flexibility, affordability and cost reduction are important aspects of PBL. DoD contracting behavior is often tempered by the risk of being unable to divert funds when changes to the mission require the use of different weapon systems. Economic uncertainty and potential price adjustments are also taken into consideration by contracting officers who craft long-term deals (FAR, 2005).

It is important to understand the impact that financial and operational risk have on PBL contract decisions. Doerr posits that by lowering financial risks for the supplier, multi-year contracts enable those suppliers to accept greater operational risks (2005). Long-term relationships are at the core of a successful PBL strategy because multi-year contracts may be the best incentive for vendors to provide the greatest weapon system support possible.(Keating, 2005). It is argued that firms may prefer long-term relationships with lower but sustained profit generation versus short term contracts with higher margins. "Profit earned over an extended period, however, is better aligned with the longer strategic goals of a firm, and therefore exerts greater influence on shaping contractor performance." (Stevens and Yoder, 2005)

Advantages & Disadvantages of Long-term Contracts

There are intrinsic advantages and disadvantages that accompany long-term contracts whether they are in the public private sectors. Monczka et al. (2005) summarized the literature listing some rewards and drawbacks that organizations can experience when executing long-term contracts. (See Table 1)

Table 1. Advantages and Disadvantages of Long-Term Contracts

Potential Advantages:
Assurance of supply
Access to supplier technology
Access to cost/price information
Volume leveraging
Supplier receives better information for planning
Potential Disadvantages:
Supplier opportunism
Selecting the wrong supplier
Supplier volume uncertainty
Supplier foregoes other business
Buyer is unreasonable

Contract Structure and Incentives

In addition to contract duration consideration must be given to how the vendor will be paid and how to incentivize performance. DoD support contracts typically fall into one of two broad categories: *Cost-Reimbursable* or *Fixed Price* (FAR, 2005).

While a *Fixed Price* contract guarantees that a vendor will be paid a set price regardless of the costs incurred, a *Cost-Plus* contract is expense-based: when the contractor completes the agreed-upon work, the compensation received is equal to costs plus a bonus provided that the expenses are allowable and reasonable. The major determinant in choosing between a Cost-Plus and a Fixed Price contract is the degree of pricing risk present in the support cost (DAU, 2007). Such risk is higher during the early phases of program development and deployment, when costs are less certain, thereby making Cost-Plus contracts are more appropriate. In general, however, the contracting objective is to eventually achieve a Fixed Price contract, in conformance with the PBL concept of buying defined outcomes at a defined price (DAU, 2007).

Consideration must also be given to the types of incentives that will be utilized in a PBL contract. For vendors to earn the rewards associated with PBL incentives, they must meet or exceed the contractual metrics for performance and/or support (DAU, 2007), depending on specific contract requirements. For a more thorough discussion of contract structures and incentives, see Geary, et al., 2008.

The Four Stages of PBL

The “Four Stages” is the most well-known method of classifying PBL arrangements according to their “level” of strategy implementation. Stage 1 describes support at the component level, Stage 2 describes support at the major subsystem level, Stage 3 deals with the weapon system platform level, and Stage 4 assures mission availability/support at the system level (Vitasek et al., 2006). The Four Stages are frequently used to describe the wide range of PBL possibilities and the potential evolution of such programs. While the Four Stages do not exist

to provide any sort of prescription for PBL contract structure, the possibility of conceptual correlations between the different stages and varying types and lengths of contracts warrants investigation.

METHODOLOGY

Research Design

This exploratory research utilized case studies of existing PBL programs and interviews with PBL experts were used to gain a greater understanding of those factors having a significant impact on contract type and length, to what degree contract length has been an issue during implementation, and how this information can apply to future decision making. Case studies and subject matter expert (SME) interviews were selected as appropriate methods for this research because the study asked several "how" and "what" questions that required an exploratory investigation (Yin, 1994). Choosing the best contracting methods for PBL programs are often based on opinion and difficult to support with empirical data. Case studies provide insight into lessons learned by those involved with high-profile PBL initiatives. Data was gathered at two levels or units of analysis.

The first unit of analysis, the program level, incorporated a representative sample of PBL programs as case studies. Representatives of commercial programs, primarily at the system or platform level were solicited for support amongst the Army, Air Force, and Navy. These respective program personnel interviewed are listed in Appendix 1. Interviews were conducted with program personnel in both DoD and private industry. Analysis conducted at this level sought to reap historical information and expert opinions associated with PBL programs at their points of execution.

The second unit of analysis, the DoD level, incorporated an executive-level view of PBL implementation within government. Interviews were conducted with PBL "Subject Matter Experts" (SMEs) not associated with specific programs in order to broaden the perspectives on contract length issues. A SME was defined as any government or private sector representative who had at least five years experience working closely with, overseeing, or evaluating multiple programs. Most SMEs offered opinions based on conclusions they had drawn as a result of working on multiple programs thus adding a degree of "veteran" opinion.

Data Collection & Analysis

The interview questions employed were designed to answer the investigative questions and illuminate the areas of PBL contract structure in which improvements might be made. Interview questions were divided into four sets corresponding with the four categories of respondents:

1) DoD Personnel associated with Case Study Programs
2) Private Industry Personnel associated with Case Study Programs
3) DoD PBL SMEs
4) Industry SMEs

Ultimately, seven PBL programs were studied resulting in interviews with 12 individuals. Addition, interviews were conducted with six SMEs for a total project total of 18 individuals. The specific programs studied and affiliations of personnel who contributed data to this research are listed in the following tables:

Table 2. Case Study Programs Selected and Associated Personnel Interviewed

PBL Program	Organizations Represented by Personnel Interviewed	Type of Contract[1]	Length of Contract[2]
C-17 Globemaster III Sustainment Partnership (GSP)	• U.S. Air Force Acquisition Program Office, Logistics Management • Boeing Company, Business Development Dept.	• Combination of Firm Fixed Price Award Fee and Cost Plus Incentive Fee	• PBL contract began in 1998 • Current contract period: 2004-2008 • 5-year base with 3 option years • Current J&A lasts until 2011[3]
T-45 Goshawk Contractor Logistics Support	• U.S. Navy, NAVAIR Logistics Management Integration Dept. • L-3 Communications Corp., Program Management	• Firm Fixed Price with Over & Above Contract Line Item Numbers & performance bonuses	Current contract period: 2004-20081-year base with 4 option years
High Mobility Artillery Rocket System (**HIMARS**) Life Cycle Contract Support (LCCS) I/II	• Lockheed Martin Corp., Missiles & Fire Control (section that provides post-production support for product line) • U.S. Army, LCCS Team, Precision Fires Rocket & Missile Systems Project Office	• Firm Fixed Price with Incentive Fee • Cost-Plus Fixed Fee for contingency deployments	• LCCS I covered 2004-2007 • LCCS II will cover 2008-2010 • 1-year base plus option years (both contracts)
E-8 Joint Surveillance & Target Attack Radar System **(JSTARS)** Total System Support Responsibility (TSSR)	• Northrop Grumman Corp., Aerospace Prime Contractor (3 personnel)	• Cost Plus Award Fee and Award Term	• PBL contract began in 2000 as 1-year base with 5 option years • J&A period of 22 years[3] • Contract years have been negotiated up to 2010 (award term)
F/A-18 Hornet F/A-18 Integrated Readiness Support Teaming (FIRST)	• U.S. Navy, F/A-18 and EA-18G Program Office, Office of the Director of Logistics and Naval Inventory Control Point	• Firm Fixed Price • Current contract combines 2 former separate contracts for NAVAIR & NAVICP	• Current contract period: 2006-2015 • 5-year base with single 5-year option
F-117 Nighthawk Total System Performance Responsibility (TSPR) & Total System	• Lockheed Martin Corp., Strategic Plans & Sustainment Integration	• Cost Plus Incentive Fee • "Stabilized Funding" for first 8 years	• TSPR period: 1999-2006 (5-year base with 3 option years) • TSSP period: 2007-2008

Support Partnership (TSSP)			
F-35 Joint Strike Fighter[4]	• Lockheed Martin Corp., Global Sustainment Business Integration IPT	• No official PBL contract yet in place	

[1]Refers to the contract's present or last documented form
[2]Dates refer to fiscal years
[3]J&A = Justification and Authorization from Congress for sole source
[4]Sustainment of the JSF is anticipated to become one of the largest PBL agreements ever established around the year 2013. Because the contract was merely in planning stages at the time this research was conducted, information was obtained on this program for purposes of comparing the results of the study with current plans for a future large-scale PBL program.

Table 3. PBL Subject Matter Experts Interviewed

	Department of Defense	Private Industry
Organizational Affiliations of	☐Directorate of Innovation & Transformation, Headquarters United States Air Force	☐Booz Allen Hamilton, Inc. – Senior Associate
	☐Naval Air Systems Command (NAVAIR) – Logistics Integration, ☐Naval Inventory Control Point (NAVICP) – Supply Chain Solutions Division *	☐Lockheed Martin Corp. – Corporate Focused Logistics
	☐Air Force Materiel Command (AFMC) – Acquisition Logistics	

*One interview conducted with two personnel

The subsequent analysis organized the data into the four categories based on the participants' affiliations. Responses for each interview question were consolidated, arranged according to the matched to respective investigative questions, and examined for similarities and differences. This was achieved by searching for key words, themes, and implications communicated by the interview participants. Conclusions were drawn based on these apparent themes, common views, and key opinions of the interviewees.

DATA ANALYSIS AND FINDINGS

This section is organized around those investigative questions utilized during the case study interviews. Implications of these findings and their influence on the overall research question will be addressed in the conclusions and recommendations section.

1. What types and lengths of PBL contracts have proven most successful and effective to date?

Interview participants at the program level were asked to express their (or their organizations') degree of satisfaction with the type and length of the PBL contract in question, and to assess the contract's effectiveness in the context of type and length. Interestingly, in all three cases where both public and private sector representatives were interviewed for the same program,

both sides were in agreement on the suitability of the type and length of the contract, whether good or bad.

Results for Contract Length

A consistently high level of satisfaction with contract length was found amongst programs that had contracts with a 5-year base, followed by option years or award terms. Respondents in these cases expressed that the contract length allowed for an appropriate amount of risk sharing and return on investment. One interviewee noted that the option years strengthened the arrangement by allowing flexibility for contract changes while extending the agreement into the future. This was a recurring finding throughout the research. The most notable case of dissatisfaction from both government and contractor involved a contract with a one-year base and four option years. They agreed it was too short, because it was limited to five years by the FAR regulations for service contracts. A ten-year contract consisting of a five-year base with five option years was preferred. The government interviewee argued that the benefits of a longer contract would outweigh the costs and the contractor agreed, contending that a longer agreement would allow for more creativity in managing spares.

Results for Contract Type

A consistently high level of satisfaction with contract type was found amongst programs with Firm-Fixed Price contracts, which supports the idea that FFP is the desired end-state for PBL contracts. One contractor expressed some dissatisfaction with the current CPAF contract structure on their program, noting that while the Cost-Plus style of contract was appropriate in earlier years, the contract is now in its eighth year. Government personnel were unavailable to provide a DoD perspective, but the finding supports the expectation that PBLs should ideally transition from Cost-Plus to Fixed Price.

Of particular interest are the CPIF based PBL contracts for the F-117. These contracts have always been CPIF but the well-known criticism of the Total System Performance Responsibility contract from the Air Force's perspective was "fixed price" in nature. A clause written into the contract called for "stabilized funding" requiring the government to obligate funds at the beginning of each year. While this was beneficial to Lockheed-Martin, many within Air Combat Command (ACC) considered it a mistake—the clause essentially created a bill that had to be paid in full even if operational requirements changed the use and/or amount of funding directed towards the F-117. However, Lockheed-Martin used this stabilized funding to successfully reduce costs over the long run, and when the follow-on TSSP contract was created, ACC verbally agreed to continue funding the program in the same manner and has followed through. The "must-pay bill" issue is still prominent in PBL contract structure discussions, and the arguments and suggested solutions concerning this issue are further discussed in the results for investigative question #4.

2. What risks and other criteria most frequently play a role in determining PBL contract type and length?

Responses pertaining to this investigative question varied greatly, which created difficulties in conclusively identifying which criteria have the greatest influence. Table 4 lists all of the issues

that interviewees cited as either having influenced contract structure or having the potential to influence contract structure.

Table 4. Factors that Influence PBL Contract Type and Length

Factors for Government	Factors for Contractors	Factors for Both
• DoD budgeting process—significant changes in operations may need to be addressed annually • Precedents set by past PBL programs • May need to rely on OEM because there are no organic support options • Best value of cost vs. performance	• Risk of underbidding and getting stuck with an unprofitable contract • Reputations at stake—performance may be more important than short-term profitability in order to earn future business • Setting up a support infrastructure (personnel & installations) requires significant investment • General risks: - System reliability trends - Obsolescence - Program stability - Profit margins - Inflation - Overall relationship with customer	• Newness of program/contract (are requirements/costs clear?) • Lack of historical data for system • Risks associated with rapid changes in environment and material costs • Risks associated with accuracy of demand forecast • Contract length can be an enabler for affordability improvements • Cash-rich contractors can afford to take risks when government funding doesn't come through as expected

3. In general, are contracts adequately structured to consistently meet the PBL goal of establishing long-term partnerships?

By and large, case study interview participants classified their associated programs as long-term partnerships and had positive views of the programs in this regard. Participants from both sides acknowledged the need to make commitments and share both risks and rewards.

4. In general, are PBL contracts adequately structured to consistently provide incentives for contractors to make cost-reducing investments in system support?

There existed a wide range of views concerning individual contracts' levels of effectiveness in meeting these PBL goals. The satisfaction with investment incentives was highest amongst programs that had multiple guaranteed contract years or guaranteed funding. Suppliers with shorter or less guaranteed contracts expressed that investment incentives were lacking. In most cases, ROI did not seem to be a significant issue, because defense contractors will rarely enter into contracts with the government that are unprofitable, even if they are not as lucrative as would be preferred.

One significant comment was offered by a representative for a major program who suggested that the two biggest enablers for vendors to accomplish weapon system affordability improvements are long-term contracts and price-based (vs. cost-based) contracts. This would

suggest that it is in the government's best interest to work towards long-term, fixed price PBL contracts whenever possible.

Another contract incentive that has not been traditionally implemented but has potential to result in greater affordability improvements is the concept of *profit sharing*. The government has seen efficiencies achieved by contractors as opportunities to lower costs and attempt to get a lower price whenever possible. This tends to limit creativity and incentive for investment on the contractor's part because the government is the only party who enjoys the return on improvements made. One SME expressed his belief that while the government has done a good job of incentivizing performance in the short term, it has not found a way to truly incentivize cost reduction over time. Profit sharing may be the key to solving this problem.

5. In general, how satisfied are PBL experts in both DoD and private industry with the government's application of risk aversion in PBL contracts?

Assessments of the government's risk aversion in PBL varied significantly amongst SME interview participants at the DoD level; while some government representatives thought risks had been appropriately addressed on both sides, others (both government and industry) felt the government was too risk averse and that risk sharing had been ineffective. The majority expressed dissatisfaction with the government's risk aversion in PBL contracts. One industry executive claimed that "virtually all PBLs are successfully achieving their objectives and saving life cycle costs for the government, and the process for performing business case analysis as a precursor for award is torturous." He suggested that the DoD's risk aversion has kept PBL from becoming a more prevalent contracting strategy. Another senior industry representative suggested that there is not enough due diligence in government to fully understand the risk profiles that contractors are taking on, noting it is worth understanding because sometimes the contractor isn't taking on much risk.

Several results from interviews conducted at the program level were applicable to the topic of risk aversion. There was considerable acknowledgment from both DoD and industry that risks must be shared for PBL contracts to be effective. Notably, this was mentioned repeatedly as a success factor for two of the "high satisfaction" programs. In contrast, an industry representative for another program felt that while risk sharing was sufficient in the early years of the contract, the government was now showing a little too much risk aversion in its reluctance to give serious consideration to a fixed price contract. Risk is best summarized by one industry representative who commented that crafting a PBL contract is "really all about risk sharing."

6. Would any significant benefits be gained if the maximum contract length allowed by the Federal Acquisition Regulation was increased?

In the cases under consideration, of the eight individuals who were asked whether or not FAR limitations had affected program contract lengths, five indicated that the FAR was irrelevant. Two of the respondents who believed the FAR had limited contract length were associated with a program that was classified as a "service" and thus was prevented by the FAR from attaining the "5+5" structure that was desired.

Several SMEs asserted that there was little evidence to suggest any real need to change the contract length limitations in the FAR; PBL goals can and are being accomplished using initial base contracts of five years or less. One private industry authority expressed that the FAR limitations are indeed relevant, but not as important as the funding limitations associated with the "one-year" Operations and Maintenance money that is used to fund major PBL efforts.

The Emerging Problem

A recurring finding throughout the research was that the real issue was not the limitation on the number of base years for a PBL contract, but a lack of guaranteed funding during those years. This seems to represent what industry wants most out of PBL deals, but is something the government can't truly provide using current practices. The concept of PBL says that a longer contract is better, but reality dictates that funding will only be approved annually, and this limits implementers' ability to get the full potential out of PBL. It is clear that most defense contractors seek to achieve FFP contracts that are guaranteed over several years. The government also benefits from FFP contracts, but struggles to guarantee them for longer than a year at a time because military requirements can change rapidly, and Congress reacts with annual changes to the defense budget. Unfortunately, Congress is not likely to change its funding methods in the near future, so PBL contract builders can expect to continue to face the challenge of creating long-term deals with fiscal uncertainty.

7. Are award term and option year contracting strategies being used effectively, and should their use continue in a lesser, similar, or greater capacity?

Award terms create an obligation for the government to extend a contract if the specified conditions are met, whereas option years give the government the choice to extend regardless of performance. This study found that while most programs have used options years, only Air Force contracts seem to have used award terms. While the distinction does exist in practice it seems to be a distinction without a difference. Despite the fact that award terms (and options) are not guaranteed, it was found that they provide incentives to contractors to perform well in the long run. One SME asserted that award terms can be effective because keeping business is a very strong incentive; once a revenue stream is established, firms don't want to lose it. A DoD SME believed that while the award term can be an effective tool, it "needs to be tied to better cost reduction incentives."

Guidance for PBLs consistently point to award terms and option years as "off ramps" for the government in big PBL contracts giving the government a way out if the contractor is failing to meet performance standards or price. Obviously, contractor performance is central to the decision to continue a PBL contract. This research uncovered no instances in which award terms/option years were needed to provide the government with a way out of a PBL deal gone bad. Interestingly, even amongst the examples given, the reasons for contract termination did not include bad performance on the part of the contractor.

8. Should Working Capital Funds be used more extensively in PBL programs across DoD?

According to those interviewed in the case study, working capital funds have been used to fund supply support for PBL programs in various parts of DoD, most e extensively by the Navy.

When applied, WCF have successfully allowed longer PBL contracts; however, they have restrictions on where they can be used and therefore do not seem to be recognized as a widespread strategy for lengthening contracts.

Most SMEs agreed that WCF are best suited for employment at the subsystem or component level. An Air Force interview participant assessed that the Navy has made the use of PBL more straightforward by cordoning off some WCF money to be used on PBLs classified as supply contracts. He maintained that the Air Force is learning how to use these funds more effectively and that AFWCF will be used in more PBLs in the near future, especially with proposals such as the 'fenced funding" described under investigative question #6 comes. Most experts expressed a belief that there is room for improvement in the Air Force and Army in the use of WCF for PBL, and that the Air Force has taken steps in that direction (no assessment of the Army was provided). The research did not reveal the utilization of WCF to be at the heart of PBL contract structure issues, however. Most felt that questions about what is achievable and affordable and which contracting approach is best suited to the task were of greater importance.

9. Does a PBL agreement's place among the "four stages" of PBL have any impact on contract length decisions?

This research found little evidence to suggest that there is any direct link between contract length and where a PBL fits within the four stages. DoD SMEs interviewed did not believe that the four stages had much impact on contract decisions. One stated that the "four stages don't properly express what's being done" in PBL, and another pointed out that, because "there is little real benefit from PBL in the short term," PBL should address long-term sharing of risks and costs regardless of the level at which it is implemented.

One industry SME believed that programs at higher levels and maturity, such as platform-level responsibility, require more long-term commitment, while material management support contracts that require little to no investment do not need to be long term. This suggests that the length of commitment from both parties in a PBL agreement should increase in proportion with the stages of implementation. While this is a logical assumption, PBL contracting behavior does not necessarily support it. Supply support contracts enacted at the stage one or two level are not only typically less risky than stage 3 contracts, but can also usually draw income from working capital funds, which allows for longer contracts. There was also a general consensus that no stage 4 PBL has ever truly been implemented. It was suggested that the upcoming Joint Strike Fighter contract (an anticipated PBL program) may be the closest yet.

The most interesting finding repeated by most interviewed is that the four stages concept is misperceived in the acquisition and contracting communities, and that contrary to popular belief, PBLs should not strive to move up to the next stage in this supposed "PBL evolution." Stage 4 is often presented as a goal for all PBL programs to strive for. Vitasek et al. (2006) describe the four stages model as "a tool for program managers in charting a path to extend their PBL strategies to higher levels and broader scope," but as several interviewees agreed, there is nothing wrong with an effective stage 1 PBL. Higher-stage PBLs are difficult to implement, and when a lower-stage PBL has been properly implemented, the war fighter is

better off as a result. Attempting to move such a program to the next level may not be necessary or achievable.

CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations are divided into three sections. The first section brings together the research findings and examines how they can be used to answer the overall research question. The second section discusses limitations that were encountered in this research, and the final section puts forward some recommendations for future research.

Answering the Research Question

How can the Department of Defense ideally balance PBL contracts to mitigate operational and financial risks while simultaneously building long-term partnerships that encourage investment from commercial contractors?

This research sought to draw conclusions about how the DoD can achieve the balance depicted in the research question above. The findings listed above revealed five main areas where efforts for improvement should be concentrated.

1) Congressional Funding Methods are Not Compatible with PBL

As discussed above the annual allocation of funds (primarily O&M) creates difficulties for implementers of PBL. In fact, the findings of this research suggest that it is the single biggest challenge facing those who seek to craft PBL contracts consisting of multiple guaranteed contract years. DoD simply cannot always guarantee the funding levels that would allow it to commit to long-term contract periods. Other methods are being explored for funding PBL in such a way that mitigates the risk of budget fluctuations, such as “fencing off” money within the services to be used for PBL programs. If significant changes in PBL funding methods were to take place, they could eventually force changes to contract length limitations in the FAR, which currently do not appear to have a widespread impact on PBL contracts. Alternate funding methods for PBL are controversial, however, and it is not reasonable to expect that Congress will alter its O&M funding methods in the near future. Therefore, for now, PBL officials must use other methods to build funding flexibility into contracts, such as option years, award terms, and flexible performance metrics.

2) Option Years Provide Flexibility Today; Flexible Performance May Be the Solution for Tomorrow

Option years and award terms are typically described as providing the government with “off ramps” in a PBL contract, giving the government a way out if the contractor is not performing adequately. While contractor performance is important to decisions to extend PBL contracts, this description does not seem to reflect the way option years and award terms are being used. This research failed to find an instance of a PBL program in which the DoD needed a way out due to performance. This finding, combined with the history of DoD’s relationships with major defense contractors, suggests that the risk of a contractor underperforming in a PBL arrangement is rather small. Their use, then suggests another rationale: optional contract years provide the government with the flexibility it needs to make adjustments based on

budget fluctuations. When option years and award terms are negotiated, the government has the opportunity to make changes to the contract as a response to changes in funding. Therefore, option years/award terms provide one method of building flexibility into PBL contracts.

Considering that the option year and award term concepts were devised with intentions other than what they are primarily being employed for, it would be wise to explore other options for making PBL contracts financially flexible over the long run. One suggested alternative is the concept of flexible performance. Utilizing flexible performance metrics, PBL contracts can be written to accommodate unexpected fluctuations in operational requirements and funding, eliminating the government's fear of being penalized for funding reductions that affect a long-term contract. Put simply, flexible performance provisions allow contractors to deliver less performance when the DoD needs to pay them less money. Changes in performance delivered are measurable, meaning that they are directly proportional to changes in funding, and allow program managers in both the public and private sectors to predict how much performance will decline as a result of an anticipated reduction in funds. This is an advantage that typically cannot be found in non-PBL programs, and should be leveraged as a means of allowing longer contracts where they are needed.

3) Improve Incentives with Increased Use of Profit Sharing

Effective partnerships require the sharing of both risks and rewards. While risk sharing is understood to be at the core of PBL relationships, reward sharing seems to have received less attention. Because the government has historically seen efficiencies achieved by contractors as opportunities to lower costs (primarily in Cost-Plus situations), contractors have often had little incentive to make creative improvements and investments in sustainment because only the government enjoys the return. In contrast, when contractors improve efficiencies that result in profits in some Fixed Price situations, the government may see performance improvements but not cost reductions. If PBL contracts more frequently included provisions for profit sharing between DoD and private vendors, benefits may be realized by both parties. Because profit sharing benefits everyone and is conceptually well-suited to the "win-win" partnerships that PBL agreements claim to be, it would seem that financial returns on improvements should be shared whenever feasible.

4) Long-Term Contracts Aren't Always the Answer…But They Usually Are

Because PBLs are tailor-made to fit requirements of different types of programs, it is difficult to make generalizations about ideal contract length. Nonetheless, it cannot be denied that long-term contracts are at the heart of PBL strategy. While there is no universally agreed-upon definition of "long-term" in the PBL context, this research found in practice the term refers to agreements of five years or more. PBL programs in DoD have seen substantial success in the execution of contracts that consist of five base years plus three to five option years or award terms. This type of contract length has many benefits, including:

- Long-term agreements strengthen the partnership between DoD and private industry.
- When combined with the right contract type, there is more incentive for contractors to invest in logistics support for systems, enabling affordability improvements.
- Contractors see opportunity for greater return on investment.
- Labor is not expended rewriting the contract from year to year.

There are drawbacks associated with this contract structure as well, the most prominent of which is the loss of flexibility during the initial guaranteed years to deal with fluctuating budgetary requirements (ways of dealing with this problem are discussed later in this section). There are also instances where both parties felt the shorter contract was ideal due to unique circumstances. But in general, data indicates that commitment to long-term contracts produces effective performance-based partnerships, and that the government's reliance on OEMs for weapon system sustainment tends to be drawn out over many years. Therefore, whenever possible, PBL implementers should strive for something that resembles a "5+5" contract structure.

5) Keep Working Towards Fixed Price/Price-Based Contracts

This research supports the notion that whenever possible PBL implementers should strive to achieve a Fixed Price contract for their programs. The success of programs with some form of FP demonstrates that this is a meaningful goal. FP contracts align with the PBL goal of purchasing a defined outcome at a defined price; they stabilize prices for the government while guaranteeing a specific level of revenue for vendors. In turn, this provides incentive for contractors to make affordability improvements to systems because money saved can be turned into profit (ways to make these improvements beneficial to both parties are discussed in the following section). A long-term contract alone does not encourage a supplier to make investments; it must also have provisions that reward such behavior. As one commercial SME put it, "without a fixed price, a long contract only serves to reduce the contracting burden," meaning that less frequent contract revisions are the only notable benefit.

Fixed Price contracts can be difficult to accomplish; data that supports a stable price is often difficult to gather and comprehend. If not properly planned for during cost-reimbursable stages of a contract, a fixed price may never be attained. Therefore, PBL implementers should keep the FP goal in mind from the inception of a PBL contract, and work towards it over time. Note that some elements of a PBL contract may not be suited for FP; therefore the effort to reach a FP should not preclude keeping some elements of a contract in a CP state.

Summary and Implications

Performance-Based Logistics, while embraced by the DoD as a preferred strategy for weapon system sustainment, remains a relatively new, complex, and at times misunderstood process. Improvements made to the way PBL contracts are structured can have significant impacts. This research addressed the question of how to balance PBL contracts to mitigate operational and financial risks while simultaneously building long-term partnerships that encourage investment from commercial contractors. Findings from the research suggested that improvements can be made in PBL by focusing (when applicable) on the five areas described in the previous paragraphs.

Assumptions and Limitations

This research was constrained by certain limitations and assumptions. The time allowed for research completion and the accessibility of personnel and information limited the number of cases studied and personnel interviewed. Because both the PBL programs studied and the

number of experts interviewed were greatly dependent upon the responsiveness of personnel contacted and their willingness to participate, the population in this study is represented by more of a “convenience” sample than a random sample. Given more time and/or resources, a broader, more balanced study might provide a greater understanding of the issues, further substantiate the findings of this study, or suggest alternative conclusions not discussed in this study.

The very nature of Performance-Based Logistics made it difficult to generalize results across the entire PBL spectrum. As discussed repeatedly, every PBL agreement is tailored to fit unique requirements, and because PBL is not a “one size fits all” approach, it is difficult to make generalizations that can be applied to all programs. In addition, the different military services seem to have differing philosophies about how PBL should be approached, and these differences become more complex when the different system levels (i.e. platform, subsystem, etc.) are factored in.

Lastly, the possibility of bias must be assumed: while interview participants attempted to give unbiased assessments of PBL issues, it is possible that in some cases their opinions may have been skewed by the perspectives of their organizations; that is to say they may have highlighted what was in their organizations’ best interest.

Recommendations for Future Research

A study of effective PBL contract structures and incentives that more clearly delineates between practices at the subsystem/component levels and practices at the platform-level could prove beneficial. A comparison of best practices at the different levels could serve to identify if the recommendations presented in this research should be generalized across all PBLs or if they are appropriate only at certain levels of system support.

Similarly, a comparison of PBL contracting approaches amongst the Air Force, Army, and Navy may help to determine whether some contract-building strategies are best suited to specific branches of the military. Such a study could clarify the degree to which the generalizations presented in this research are applicable in each of the armed forces, or perhaps identify areas where the different services should better align their methods.

Future research may also investigate how the recommendations presented in this study might best be carried out. Of particular interest would be an exploration of potential alternatives for PBL funding methods, or new ways to overcome the barriers that the current budgetary process creates.

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Developing an Environmental Approach to Paper Procurement at the World Bank

Jane Bloodworth, Liang Wang, Jeanette Rennie[1], Michiel R. Leenders[2]

[1]All of the World Bank, 1818 H Street, NW Washington, D.C., 20433. Tel. +1 202.458.0438. Fax: +1.202.522.2088. jrennie1@worldbank.org
[2]Richard Ivey School of Business, London, Ontario, Canada, N6A 3K7. Tel: +1.519.661.3284. Fax +1.519.850.2366. mleenders@ivey.uwo.ca.

Abstract

In November, 2007 the decision was made to review paper purchases at the World Bank Group (hereinafter referred to as the 'Bank') headquarters in Washington, D.C. to reflect the environmental commitment of the organization. A significant initiative was undertaken over the next year and a half to develop a more sophisticated approach to environmentally sustainable paper procurement. A major challenge was the establishment of a formal approach that balanced environmental criteria and commercial business criteria while focusing on value to the Bank. This paper focuses on the procurement and relationship challenges of developing and implementing an innovative approach to formal practices.

Keywords

Environmental, paper, sustainable procurement, relationships, World Bank

Educator and practitioner summary

This paper looks at the development of a significantly more sophisticated approach in terms of environmentally sustainable paper procurement. After the application of some of the more standard approaches such as duplex printing, reducing paper use and increasing the percentage of recyclable content, the next challenge became: how can we do even better? The level of environmental sophistication of suppliers was not sufficient to get the Bank's print shop where they wanted to be. Tracking the chronology from conceptualization to supplier selection and results provides a useful insight into the process whereby a large multi-national and very prominent public sector institution manages to achieve significant environmental improvement. Key to the approach was a strong interdepartmental partnership among groups with different expertise.

Introduction

Concern over the environment and sustainability has increased considerably over the past decades. That supply chain performance and the environment are closely connected has been amply demonstrated in both academic and practitioner literature.

This paper focuses on the process of developing a new, sustainability-focused approach to paper procurement at the Bank. After providing a brief overview of the Bank, the Corporate Procurement Unit (GSDPR), the Corporate Responsibility Program (CR), and the Printing, Graphics and Map Design Unit (GSDPG), the three Bank parties involved in this procurement, the existing paper requirements and procurement practices are identified. Extensive information gathering and criterion development, REI, and the RFP evaluation led to a technical evaluation of environmental impact and award. Some reflections on this process form the conclusion.

The World Bank Group

The Bank is made up of five agencies: the International Bank for Reconstruction and Development (IBRD), the International Development Association (IDA), the International Finance Corporation (IFC), the Multilateral Investment Guarantee Agency (MIGA), and the International Center for Investment Dispute Resolution (ICSID). The IBRD was formed in 1944 to rebuild Europe and Japan after World War II. It is a cooperative, owned by 186 member countries. Its mission is to fight poverty with passion and professionalism for lasting results and to help people help themselves and their environment by providing resources, sharing knowledge, building development capacity, and forging public and private partnerships. Today, the Bank has approximately 11,000 staff, from 161 countries, working in 120 countries.

Environmental degradation and the challenges of climate change are major and urgent development challenges affecting the Bank's owners and clients. In Fiscal Year 2009, the Bank made new loan commitments to developing countries of $47 billion, of which 11 percent was for environment and natural resources, and 13 percent was in the energy sector. The Bank has made a commitment to dramatically scale up its renewable energy and energy efficiency loan portfolio and to strengthen the capacity and resources available within the development community to fight climate change.

In an effort to 'bring the talk home', the Bank measures, reports, and offsets the greenhouse gas emissions associated with its global business operations. It also has committed to reduce its emissions through energy efficiency initiatives and business behavior changes. It currently offsets its emissions through the purchase of renewable energy certificates for new wind installations and verified emissions reductions (carbon credits) associated with independent energy efficiency and alternative energy projects in client countries. Much of this success in reducing our global impact has been accomplished in partnership between the Bank's General Services Department, including Corporate Procurement and Printing, Graphics and Map Design units, and the Bank Corporate Responsibility team in the Environment Department.

The World Bank Corporate Procurement Unit

The Bank's Corporate Procurement Unit (GSDPR) spends approximately $900 million a year for goods, works and services for its own internal requirements. Most Bank procurement is conducted by GSDPR. Very small purchases may be made directly by Bank managers. GSDPR's goal is to obtain the best overall value for the Bank through competitive processes that are transparent and fair to all vendors. The Bank is a socially and environmentally responsible organization. As such, the Bank addresses, in its procurement process, vendors' commitment to appropriate wages and benefits, safety, environmental programs, and diversity in its supply chain. Corporate Procurement has 51 staff working out of Washington, DC, with 15 staff working out of a satellite office in Chennai, India.

The Environment and World Bank Business Operations

In 2004 the Bank introduced environmentally and socially responsible (sustainability) guidelines governing procurement policies for administrative goods and services.

Environmental Procurement

The Bank's policy states that the Environmentally Responsible Procurement policy "will be reflected in Requests for Proposals (RFPs), Invitations for Bids (IFBs), and solicitations issued by General Services Department, Corporate Procurement Unit (GSDPR) will reflect the policy. Applicable environmental evaluation criteria will be included in the technical evaluation and considered in the cost analysis of all quotations, bids and proposals received in determining the successful bidders/offerors…. Given that many environmentally preferred products and services can produce a variety of tangible benefits, full consideration should be given to the long-term and complete costs and benefits of environmentally responsible procurement."

More specifically, in order to contribute to waste reduction and to increase the development and awareness of environmentally sound purchasing, wherever possible, Contractors will perform the Work by using durable products, reusable products and products (including those used in services) that contain the maximum level of post-consumer waste, post-industrial and/or recyclable content, without significantly affecting the intended use of the goods or services. It is recognized that a cost analysis may be required in order to ensure that such products are made available at competitive prices.

The Bank views striving toward environmental best practice as central to assuming its corporate responsibility as a global citizen, to being a model for country client partners, and to positioning itself as an environmentally sustainable investment choice for its bond holders, particularly for investors who are part of the Sustainable Investment community.

The Corporate Responsibility (CR) Program[1]

The Bank Corporate Responsibility (CR) Program is a partnership of the Bank's Environment, Treasury, and General Services Departments and focuses on three key areas— promoting greater corporate transparency in the Bank through sustainability reporting, working with our Treasury Department in its strategic effort to develop new 'green' funding products and to reach out to the sustainable investment community, and supporting the reduction of the environmental footprint of our corporate operations through the Corporate Greening Program, which supports the General Services Department (GSD).

The **Corporate Greening Program** partners with GSD and other champions around the Bank through research, communications, and training initiatives to:

- Measure, manage and report our greenhouse gas emissions;
- Promote GSD's energy conservation initiatives through efficiency upgrades and green building commitments, such as meeting LEED and Energy Star standards;
- Minimize waste through source reduction, reuse, and recycling;
- Promote the use of local and sustainable products; and
- Educate staff on environmental issues.

[1] Judith Moore is the head of the Corporate Responsibility Program and has worked on World Bank environmental projects and initiatives since 1990. She has a PhD from the Massachusetts Institute of Technology in Regional Planning, specializing in environmental policy and planning, and a degree in forest science from Yale University. She is supported by a team of two environmental and sustainability specialists, Monika Kumar and Adam Rubinfield, who worked with Jane Bloodworth to develop the guide and scoresheet for paper procurement. Monika has an MA in Environmental Management from Yale and Adam has an MS in Conservation Science from Oxford Brookes University, UK.

The program has previously partnered with GSDPR to incorporate environmental standards into computer purchases and to heighten environmental initiatives in the most recent food services contract. The program supported with research and tool design, the initiative of the GSDPG unit's innovative step to scale-up consideration of environmental criteria in its latest paper procurement.

General Services Department Printing, Graphics and Map Design Unit[2]

The Printing, Graphics and Map Design (GSDPG) unit's mission is to be the provider of choice for leading-edge, cost effective and environmentally preferred, in-house printing, and associated graphic arts products and services for the Bank. GSDPG provides over 160 million print impressions annually, primarily operational documents, publications, and conference and meeting materials. Additionally, GSDPG produces 45 million other graphic arts and digital products each year, including graphic design, maps, large format posters, business cards, photographs, CDRoms, DVDs, and digital files for various electronic media uses. With the exception of the Bank's operational documents, Bank units can use any printer (in-house shop, or external commercial printer) to obtain services. GSDPG operates on a fully loaded chargeback basis and do not have first right of refusal. They strive to provide cost effective, high-quality products, value added, environmentally differentiated products and services at a market competitive price.

GSDPG utilizes leading edge capabilities to provide a mix of traditional and emerging technologies including cut-sheet and web, offset and digital presses, as well as various non-print services. Revenue through chargeback is approximately $12 million annually utilizing a staff of 33 Bank and 32 Contract employees. Strategically, they strive to help the institution reduce paper usage by printing only what makes sense, reducing waste, using environmentally friendly processes and products. This has resulted in a 2/3 reduction in paper usage in the institution over the past 10 years.

Paper Requirements

Since her arrival at the Bank, Jane Bloodworth had been actively involved in the pursuit of environmentally sound printing and paper procurement. Prior to 2007, Jane had undertaken various initiatives to advance both the Bank's and her personal environmental concerns as they applied to paper and printing. Influenced by Rachel Carson's book The Silent Spring at the age of 13, Jane had made concern for the environment and sustainability a strong value in both her personal and professional life.

[2] Jane Bloodworth manages the Printing, Graphics and Map Design unit at the Bank. She holds a post graduate degree in Music from the University of Central Florida. Her responsibilities include strategic planning, technology planning and implementation, sustainability initiatives, as well as daily oversight for the Bank's photography, mapping, graphic design, offset and digital printing, electronic products, mailing and distribution services and photocopier programs. Prior to joining the Bank in 1996, Jane was the Director of Travel Publishing Operations at AAA National Headquarters in Heathrow, Florida. She has over 30 years experience in a broad cross section of the Graphic Arts industry with emphasis on strategic planning, technology implementation, change management, process improvement and environmental/sustainability initiatives.

GSDPG is responsible for the acquisition of copy as well as printing paper. All paper is acquired from local distributors in the Washington D.C. area, because volumes are low and quick turn of small deliveries are required since the Bank print shop does not warehouse large amounts of paper eliminating the ability for direct dealings with paper mills. In 2007, GSDPG had four suppliers under contract, of which one had the bulk of the business. Total annual paper purchases for the Bank amounted to about $1.7 million.

Some of the Bank print shop's previous environmental initiatives included the elimination of blank pages in documents, the reduction of paper waste, the elimination or reduction in the use of plates and film, the use of soy inks and digital printing equipment, the recycling of packaging and waste materials, use of default settings for double sided printing on copiers, and requirements that printers and copiers must be able to run recycled content papers. Another interesting effort included alternative communication media such as CD Roms.

It was Jane's conviction that an increase in the usage of post-consumer fibre in purchased papers would further reduce the environmental footprint and enhance sustainability. Jane had over the years tried to encourage the mills to produce paper with higher post-consumer content and was always ready to test a new product for its printing viability. The American market changed slowly over the years to about 30% post-consumer content on some papers, led primarily by the government sector after then-President Bill Clinton's issuance of Executive Order 13101 in 1998 mandating use of recycled papers by Federal agencies.

By the start of 2008 Jane had found and successfully tested several brands of 100% recycled papers and wanted the procurement group to contract, without the benefit of competition, specific quantities with specific suppliers based on the Environmental Procurement Policy. However, the procurement team assigned to paper was reluctant to accept Jane's advice because of the need for fair and open supplier access, and the apparent lack of proof of environmental impact. Therefore, Jane engaged in extensive consultation with major paper purchasers, attended conferences on green practices and identified several helpful industry documents. "A Common Vision for Transforming the Paper Industry: Striving for Environmental and Social Sustainability" was particularly useful as it confirmed Jane's perspective gained from her years of experience in the industry. This document was ratified at the Environmental Paper Summit in 2002, with the accompanying documents: "Guidance to Best Practices for Advancing Environmentally and Socially Sustainable Papers" and "Environmentally Preferable Paper Purchasing Guidance". All three documents affirmed Jane's belief that the use of post-consumer fiber content in paper was both environmentally preferable and available.

Partnership with the Corporate Responsibility Program

In April, 2008, Jane contacted the Corporate Responsibility (CR) team to ask whether CR had any guide for evaluating the environmental impacts of paper. Monika Kumar, of the CR team, contacted a sustainability colleague, Suzette Carty, Manager of Environmental Stewardship Programs, at Brown-Forman Corporation. Suzette shared a basic, easy-to-use guide. The guide drew from various sources, but primarily built upon Monadnock Paper Mills' *A Field Guide to Eco-friendly, Efficient, and Effective Print*. The Guide color-coded various environmental impacts of paper and printing into Good (Green), Ok (Yellow), and Reconsider (Red). The CR team modified the document, splitting the paper impacts from the printing impacts, as Jane needed a guide specifically for the paper industry.

Procurement Perspective

Corporate Procurement Contracts Officers are responsible for the development and management of a formal solicitation process that meets the Bank's requirements for being fair, transparent and competitive while achieving the best total value. Contracts Officers are tasked to design a process that best suits the needs of the business and are held to a high standard by the Chief, Corporate Procurement.

In the past, formal paper procurements were typically completed through an Invitation for Bid (IFB) process, with responsive and responsible vendor bids being evaluated on price only. Spot market purchases were used in periods of high price volatility or where supply allocations restricted market availability. The Bank had over the years entertained both short term and long term contracts, with mixed results. Contract terms were typically reflective of the current and expected market conditions. The Bank was sensitive to the cost of paper fluctuations and reflected this by establishing a maximum price increase allowable that was tied to the RISI index as published in Pulp and Paper International (PPI) for the respective paper types.

By early spring of 2008, Jane had successfully tested a number of papers from different suppliers and was using products that contained higher post-consumer-fibre content. Her current price reflected recycled content market pricing through the spot market purchases. Jane was prepared to recommend specific suppliers capable of producing high post-consumer fibre content papers that would run well on her equipment. She had proposed evaluating criteria other than price to previously, and she escalated the request to the Chief, Corporate Procurement for further discussions. In March 2008 Liang Wang, Contracts Officer in the Procurement Group was assigned the paper portfolio and from then on Liang worked with Jane to lead a formal solicitation for paper and to assure Bank procurement policies and procedures were followed.

From a procurement perspective, there were a number of issues at play which impacted the procurement process. Jane's motivation was to improve the sustainability of the Bank's paper usage by moving beyond recycled content and chlorine processing being the only environmental considerations, and move to quantifying and evaluating all the environmental aspects of paper manufacturing that are delineated in the "Common Vision for Transforming the Paper Industry" – a body of knowledge and recommended practice that is broadly recognized and accepted as good environmental policy. She wanted to use the Bank's Environmental Procurement Policy to facilitate that effort, however, that proved difficult initially because the Policy did not include implementation guidelines. Therefore, this procurement became a process of working with procurement and environmental professionals to develop a working, measureable framework. Liang, on the other hand, was focused on developing a process which would meet Jane's objectives while meeting policy requirements for open competition. Liang was responsible for ensuring that any technical evaluation methodology would achieve an outcome that was in the best interest of the Bank and would stand up to the scrutiny of the vendor community. Since Liang was new to the portfolio, he had not had the opportunity to build a strong relationship with Jane personally, or had the required subject technical expertise to support Jane's vision. Both recognized the need to find out what other paper alternatives and paper suppliers still unknown to the Bank were available in the market. After lengthy discussions it was agreed to adopt a more formal approach by proceeding more slowly and developing a more sophisticated environmental rating process. Thus, the use of an Expression of Interest (EOI) gave Liang the ability to understand the market's ability to respond to the environmental questions posed as well as the opportunity to validate the evaluation criteria.

Suppliers were invited to respond to an EOI first to alert them to the Bank's more formal environmental approach and to seek information on product options. It took a considerable degree of effort to prepare the EOI document to get it into a shape that both Jane and Liang were comfortable with.

In the past, Corporate Procurement had discussed the opportunity of running a joint solicitation for paper with another International Financial Institution (IFI) located in Washington, DC. The IFI was invited to join in this environmental initiative to make the total procurement volume more attractive and subsequently a Memo of Understanding was signed between the two organizations and a joint procurement for paper was embarked upon.

Expression of Interest

On July 23, 2008 Liang sent out an EOI to determine the availability of various papers suitable for the print shop and for which samples could be obtained for testing. The second intent was to determine potential suppliers. This EOI was posted on GSDPR's website, the United Nations Development Business online (UNDB) and sent to potential bidders to direct them to the websites. Nine firms responded by the August 5, 2008 deadline. The EOI requested each potential supplier to identify alternate products for the 83 different paper items currently used by the Bank and the IFI. The EOI included:

Section A General Information and Mandatory Criteria
Section B Printing Paper Specifications *(bound separately)*
- Annex A. Paper Procurement Guidelines *(bound separately)*
- Annex B. "A Common Vision for Transforming the Paper Industry: Striving for Environmental and Social Sustainability" *(bound separately)*
- Annex C. "The World Bank Group Responsible Paper Purchasing Guidelines" *(bound separately)*
- Annex D. "Paper & Printing Selection Practices" *(bound separately)*
- Annex E. Environmental Paper Data Sheet *(bound separately)*

Section C Certificate and Affidavit

The additional documentation on environmentally desirable papers provided general background, a document ranking desirable environmental features into three ranks: recommended, good or reconsider for nine paper printing categories. These categories included fibre type, fibre source, chemical processing, certification when sourcing ink, energy source, transportation mode and distance, printing and finishing. Additional references were to a paper calculator developed by the Environmental Defense Group, The Conservation Guide from San Francisco and the Green Press Initiative. The last document was the World Bank Paper Group Procurement checklist which each supplier was to fill out for each non-specified paper on which the supplier intended to bid (See Exhibit 1). The EOI indicated that the Bank's intention was to develop a two year contract with two one-year renewable options.

The EOI was sent to distributors as the Bank did not have sufficient volume to go direct to mills. Nine distributors responded to the request. Considerable supplier contact was required after the EOI to gather additional information not supplied by the seven responding suppliers. Also the Bank and the IFI tested all alternative papers offered with which they had no prior usage

experience. A small Technical Evaluation Committee that included Jane and an IFI representative went carefully through all supplier submissions and identified information and testing gaps.

The EOI identified a number of issues. The lack of sophistication relating to environmental factors was apparent from distributor responses. The relationship between the distributors and the mills with respect to environmental factors was underdeveloped, as reflected in the responses. The readiness of the market to participate was immature in its development, as information was neither readily available nor presented in a way that could serve the industry responding to environmental considerations. Thus, a great deal of back and forth communication was required.

Ranking Environmental Factors

The supplier information sheet identified the factors shown on Exhibit 1. However, there was no indication yet as to how important each of these factors was from an environmental perspective. One of the internal sustainability experts at the Bank worked with Jane in an attempt to translate the information contained in the three key documents from the Environmental Paper Summit into a paper environmental ranking scheme. Using documentation from the Environmental Summit, in alignment with the hierarchy outlined in the "Common Vision" and the thinking of the Bank's Environmental Department, Jane and the sustainability experts estimated the environmental impact of each factor. For example, since both the Common Vision and the Bank were particularly conscious of energy use and its carbon footprint, energy was given special attention. After considerable discussion and thought, the allocation agreed to was as shown in Exhibit 2 for all lots except for lot B.

Only lot B was pre-specified by the Bank as 100% post-consumer fibre content. This lot accounted for more than half of the total dollar volume and included copy paper. Four of the B sub lots were in rolls and four were cut sheet. Because lot B was prespecified as 100% recycled the environmental ranking fibre type no longer were a rating factor and the 20% allocated for fibre type in the other five lots was distributed across the other six environmental rating factors. Based on the EOI responses, the lot compositions were adjusted to reflect market availability for all lots and sub lots as well as the environmentally most desirable papers.

Financial versus Environmental Ranking

One further hurdle remained. Since proposals would be evaluated financially as well as environmentally, what percentage of the evaluated score points should be allocated to each? The procurement group advocated a 30% environmental weighting and 70% financial. To assist in this matter, the team contacted a variety of public paper purchasers and Liang along with his Team Leader, Francine Holloway, benchmarked with other organizations and determined that a 70% financial weight was acceptable. Based on interim bids issued, the Bank had already extended the use of 100% white free sheet paper from the offset and high speed digital production and copy centers to all of the copy and printer paper used in the organization. As such, any premium in the price of the 100% post consumer products was reflected in the current pricing. This gave the Bank the strength of conviction and commitment to flip the numbers in order to make a strong 70% commitment to the value of the environmental side of the equation.

The RFP

The RFP of January 23, 2009 was posted on the Bank's Bidding Opportunities website. Each potential bidder received a copy of the environmental criteria and weights attached (See Exhibit 2) as well as a summary sheet of the technical proposed evaluation (See Exhibit 3).

Five of the nine firms invited to bid responded to the RFP after having requested additional information on the specifications, which were responded to in three additional addenda. The new deadline requested by suppliers became February 24, 2009, one week later than the original deadline in the RFP.

RFP Evaluation

For this part of the procurement process the Technical Evaluation Committee was expanded to seven individuals – two from GSDPG, one from the IFI print organization, two from CR, plus two non-voting members, one from GSDPR and one from the IFI procurement division. The RFP indicated that Mandatory Criteria would be scored on a pass/fail basis. Next the Technical Proposals would be evaluated followed by the Financial Proposals. Five bids were submitted by the February 24 deadline. Subsequently, it took considerable time to clarify responses. As pointed out earlier, one of the lessons from the EOI was a lack of integration and communication between the mill and the distributor. In an attempt to address this in the RFP, the questionnaire was redesigned to differentiate the roles of each participant. In spite of this, the RFP responses continued to demonstrate the difficulties in collecting individual data. It was also understood that actual responses would be dynamic and differ depending upon the individual supply chains, however, it was believed that this would not significantly impact the evaluations. The seven key evaluation criteria remained relevant for all supply chain models presented.

The mill information was easier to obtain than the distributor's information. The issue was that distributors had sent the Annex used to collect the technical information to the mill to complete. The mill completed their information, however, the distributor was reluctant to add information since the sheet had been already signed by the mill. It was known that a great amount of detail from both the mill and the distributor relating to their part in the supply chain was necessary.

It was difficult to gather information from both distributors and mills. There was some confusion where both the mill and the distributor information were requested, such as transportation and logistics, processing methods, and packaging materials. In some cases, multiple responses were given when only one was requested. Additional clarifications were sought throughout the evaluation process, adding an unusual amount of time to the evaluation process.

Since all five bidders were found to be compliant on the mandatory requirements, the bid evaluation on the Technical Requirements began. The final evaluation phase of financial rating was also relatively simple as standard practice was followed. The evaluation results ranked one supplier superior on both technical and price on the significant majority of paper volume. Three other suppliers split the remaining contract volume for contract awards. In only three cases was a sub lot not awarded to the lowest bidder as the volume was small and it made sense to consolidate with one of the other awards.

During the May 2008 – July 2009 period, during which the new environmental approach to paper procurement was developed, the Bank used spot market purchases to assure the Bank's paper supply. Fortunately, this was a period of relative price stability due to a soft overseas

market. As a result, the Bank was successful in securing favorable prices for high post-consumer fibre content paper.

The final award recommendation had to be submitted to the Procurement Review Committee (PRC). The purpose of the PRC is to provide an independent review of the GSDPR recommendations for all major awards (exposure value of $1 million or more) and selected other awards that may present special risks to the Bank. Liang prepared this submission for July 7, 2009 and after approval from the PRC actual contracts were awarded on July 11, 2009. In the submission to the PRC Liang outlined the background for this paper contract, the criteria used and the recommended suppliers. Also included was an estimate of the annual environmental benefit achieved (See Exhibit 4) and an estimate of overall financial savings of about four percent.

The four suppliers awarded paper contracts on July 11, 2009 were the same suppliers that held the previous contracts. However, a major shift in percentage of business took place. The former prime supplier slipped to third place, while the former third place supplier became prime under the new contract. Moreover, compared to the contracts in place in 2007, the type of papers purchased changed drastically to very high post-consumer fibre content. Additionally, the overall profile of papers shifted to a more sustainable position based on transportation distances and modes, manufacturer's energy sources, chemical processing methods, and other key environmental factors considered in the RFP process. The RFP ensures that the Bank is using the greenest products available in the North American market at a competitive price. It moves the Bank into a leadership position in the greening of print and environmental procurement processes, and supports the Bank's Millennium Development Goals to ensure environmental sustainability by reducing the environmental footprint of development.

Reflections

One of the special aspects of the Bank paper purchase is the strong partnership forged among the user and specifier, the Printing, Graphics and Map Design Manager, the Procurement group and the Corporate Responsibility team. The manager with strong personal convictions about sustainability and extensive research efforts reached her goal of finding a more environmentally friendly solution by a relentless pursuit of the market over many years. In her spot buying of paper in 2007, 2008 and the beginning of 2009 she accomplished her goals. Further, her personal goal will be met going forward through the actual contract awards that resulted from the RFP. The Procurement group, concerned about supplier access, the Bank's environmental policies and the need to measure environmental impact persuaded GSDPG manager to develop a set of clear metrics and turn them into a viable supplier evaluation tools. In collaboration with the Environment department, a model for evaluation and financial criteria was developed. The CR team, with expertise in environmental sustainability, worked quickly to climb the learning curve on key aspects of the paper industry's footprint, and then translated the extensive information on environmental impacts into easy-to-use tools. Their broad view of sustainability helped expand the boundaries of issues considered in this environmentally sustainability procurement. Given the shortage of resources on all sides, this was a remarkable accomplishment.

In this particular procurement, the Bank also partnered with another IFI. There was a potential risk that defining a new process would impede a successful outcome for both partners. In this case, the IFI concurred that the Bank procurement process was satisfactory and in fact benefitted directly from the work of the Bank, improving their procurement capability and their ability to

measure the impact of their paper consumption on the environment, something that they were previously not able to do.

Even with all of the pre-solicitation work and testing, the technical evaluation team had to invest significant time in the clarification process of both the EOI and the RFP. The EOI, although necessary in this particular case, would likely not be required in the future, since the subsequent process confirmed that the model presented was appropriate to the marketplace and to achieving the goals of the buying organization.

Jane's proposed methodology was seen as critical not only from an environmental perspective, but also would allow GSDPG sales growth opportunities. The RFP financial savings of approximately 4% was primarily driven by savings in copy paper, the cost of which was paid through direct charge back to internal clients, so savings did not have a significant budget impact on the printing operation. Jane had increased the recycled content of paper on a gradual basis, with corresponding production efficiencies to offset any premiums paid for recycled paper. In some requirements, it was mandatory that staff use GSDPG, but for some jobs Jane competes with external suppliers. The Bank spends approximately $7.7 Million per year on external suppliers for print publications and business cards, with GSDPG revenues at approximately $12 million. Jane's cost model does not include profit or sales commissions in overhead calculations which affords her the ability to invest in technology and process efficiencies to further grow her business.

Some of GSDPG's clients were early adopters of environmental initiatives. Some had embraced sustainable procurement due to the recent 'going green' trend in the US. The opportunity for Jane and the Corporate Responsibility team to jointly engage the Bank in an open dialogue on the tangible impact of using recycled paper reinforces GSDPG's support for the Bank's sustainability objective.

It was interesting to note that a few distributors were reluctant to invest the time in presenting a thorough and complete response to the bidding opportunity. There was a significant amount of time spent clarifying responses since the required information was technical and very specific in nature. Distributors had to engage the mills to respond to some of the questions. Due to the variety of requirements, paper sourcing was required through multiple mills. It was identified also that the sustainability of the distributor, their knowledge of the program and their willingness to pursue the objectives, impacted responses from the mill's perspective. Upon further investigation, factors such as formal distributor agreements with paper mills, the interest and pursuit of distributor representatives, and Jane's relationship with the distributors were believed to have an impact on responses. Procurement required technical information that was not available through traditional market research. Specific technical information was required from multiple layers in the distribution channel so the supply network needed to be integrated, with a strong communication system. In some cases, new mill alliances were needed by the distributor.

It was clear that some distributors saw the opportunity to leverage this work to obtain more business. In fact, new opportunities to test environmentally friendly paper in two other multinational agencies have arisen. In their search for more environmental paper choices, other multinational agencies have come to the Bank to leverage what we have learned through the paper procurement. This has resulted in distributors benefiting from the opportunity to obtain more business. Going forward, further sustainability work to conserve resources, generating additional revenue through the recycling of waste and the reduction of water, air and ground

pollution through an alliance with the mills and distributors will continue to be considered in order to optimize the supply network. In the future, any positive impact on the environment through the distributor and mill supply relationship will result in additional positive opportunities for the Bank to leverage environmental improvements.

Procurement's meaningful involvement in a process that evaluated technical and commercial criteria assured that good value was achieved by GSDPG. Procurement can now evaluate the opportunity to leverage existing contracts to include all Bank paper requirements with internal Clients bidding out printing and finishing processes only. The quantification of environmental impact will also provide a solid base for future procurement initiatives to balance the value achieved by the client in addition to supporting the Bank objective of sustainable procurement.

Exhibit 1: World Bank Paper Procurement Checklist

World Bank Group Paper Procurement Checklist 07/23/2008

ENVIRONMENTAL PAPER DATA FORM

Please fill out this form completely for each non-specified paper you plan to bid.

Mill Location (City, State, Country): _____

Vendor Name: _____

Product Name: _____

Manufacturer: _____

Post-Consumer Waste Recycled Content _____ %

Pre-Consumer Waste Recycled Content _____ %

Tree Free? ☐ Yes ☐ No

Is Fiber Source: ☐ Processed and Shipped Locally (<500 Miles) ☐ Processed and Shipped Regionally (<1000 Miles) ☐ Processed and Shipped Nationally (<3000 Miles) ☐ Processed and Shipped Globally (>3000 Miles)

Fiber Source Location (City,State, Country): _____

Transporation Mode: ☐ Rail short-distance ☐ Rail long distance ☐ Trucked short distance ☐ Ocean Shipped Long Distance ☐ Air Transport

Chemical Processing:

☐ Process Chlorine Free (For Recycled Content Paper Only) ☐ Totally Chlorine Free (For Virgin Content Paper Only) ☐ Enhanced Elemental Chlorine Free (E-ECF) w/ Ozone. ☐ E-ECF w/ extended or oxygen delignification ☐ Elemental Chlorine Free

Certifications When Sourcing: ☐ FSC 100% ☐ FSC <100% ☐ FSC Recycled ☐ FSC Mixed Sources ☐ Rainforest Alliance Certified ☐ Sustainable Forestry Initiative Certified ☐ Green Seal ☐ No Certification

Certification #: _____

Primary Mill Energy Source:

☐ On-Site Renewable Energy Generation ____% ☐ Direct Purchase of Renewable Energy ____% ☐ Renewable Energy Certificates(Green-e Certified) ☐ Carbon Offset Credits Purchased ☐ No renewable energy used or purchased ☐ No carbon offset credits purchased

I certify that the above information is true to the best of my knowledge and will notify the World Bank if it comes to my attention that any of the information is incorrect.

Signed: _____

Date: _____

Other Sustainability Related Info/Comments:

Exhibit 2: Evaluation of Technical Proposal

EVALUATION OF TECHNICAL AND FINANCIAL PROPOSAL

6.1 TECHNICAL PROPOSAL EVALUATION (70 Points)

6.1.1.1 Technical Proposal evaluation is focused on the evaluation of environmental considerations as detailed below.

6.1.1.2 Only Offerors meeting the mandatory criteria will advance to the technical evaluation in which a maximum possible 70 points may be awarded. An evaluation committee appointed by the Bank/IFI will carry out the technical evaluation applying the evaluation criteria and awarding points as listed below. Detailed description of the environmental features preferred by the Bank/IFI can be found in Attachment A, The World Bank's Paper and Printing Selection Practices.

Lot/Sublot Description	Maximum point	Technical Evaluation Criteria - - Environmental/Sustainability Preference Features						
		1	2	3	4	5	6	7
		Fibre Type	Transportation – Pulp to Mill and Mill to Bank/Fund	Chemical Processing	Certifications When Sourcing	Energy Source at the Mill	Packaging	Compliance & Other Sustainability Considerations
Lot A - Miscellaneous Offset/Digital Cut Sheet Cover, Text & Rolls								
SUBLOT A-1 Uncoated Cut Sheet	70	20	12	8	5	15	2	8
SUBLOT A-2 Coated Cut Sheet	70	20	12	8	5	15	2	8
SUBLOT A-3 Miscellaneous Rolls	70	20	12	8	5	15	2	8
Lot B - Uncoated White 100% PC Cut Sheet & Rolls								
SUBLOT B-1 Uncoated Web Rolls	70	0	16	12	8	20	3	11
SUBLOT B-2 Uncoated Cut Sheet	70	0	16	12	8	20	3	11
Lot C - Coated Cut Sheet Offset/Digital Print and Web Roll Papers								
SUBLOT C-1 Coated Web Rolls	70	20	12	8	5	15	2	8
SUBLOT C-2 Coated Cut Sheet Text & Cover	70	20	12	8	5	15	2	8
Lot D - Colored Copy, Laser and Index Tabs								
SUBLOT D-1 Colored Copy Paper	70	20	12	8	5	15	2	8
SUBLOT D-2 Laser Paper	70	20	12	8	5	15	2	8
SUBLOT D-3 Index Tabs	70	20	12	8	5	15	2	8
Lot E - Miscellaneous Items: Crack and Peel, NCR,								
SUBLOT E-1 Crack & Peel	70	20	12	8	5	15	2	8
SUBLOT E-2 NCR Paper	70	20	12	8	5	15	2	8
Lot F – Miscellaneous NO SUB Items								
Lot F – Miscellaneous NO SUB Items	70	20	12	8	5	15	2	8

Exhibit 3: Evaluation of Technical Criteria

Criteria	Weight	
Fiber Type	**100% Recycled Specified**	**Other**
Post-Consumer Waste Recycled Content	100%	2 pts for every 10% PCW, Tree Free, TRF - above the minimum specified
Tree Free		
Totally recycled fiber (TRF)		
Pre-consumer waste content	0	1 pts for every 10% PCW, Tree Free, TRF - above the minimum specified
Virgin paper	0	0
Maximum points	**Pre-Requisite**	**20**

Fiber Certification	**100% Recycled Specified**	**Other**
FSC 100%	8	5
FSC Recycled	7	4
FSC Less Than 100%	6	3
FSC Mixed Sources	6	3
Rain Forest Alliance Certified	4	2
CSA	4	2
PEFC	4	2
Green Seal	4	2
SFI	1	1
Other	1	1
No Certification	0	0
Maximum Points	**8**	**5**

Chemical Processing	**100% Recycled Specified**	**Other**
Process Chlorine Free	12	8
Totally Chlorine Free	12	8
Enhanced elemental Chlorine Free	9	6
E-ECF w/ extended or oxygen delignification	9	6
Elemental Chlorine Free	1	1
Processed w/ Chlorine	0	0
Maximum Points	**12**	**8**

Energy Source at Mill	**100% Recycled Specified**	**Other**
On-Site Renewable Energy Generation	2 pts for every 10%	1.5 pts for every 10%
Direct Purchase of Energy	1.5 pts for every 10%	1 pts for every 10%
Renewable Energy Certificates (Green-e)	1 pts for every 10%	0.5 pts for every 10%
Carbon Offsets (CER/VER)	1 pts for every 10%	0.5 pts for every 10%
Renewable Energy Certificates (other)	0.5 pts for every 10%	0.25 pts for every 10%
No renewable energy certificates	0	0
No carbon offsets	0	0
Maximum Points	**20**	**15**

Source of Pulp and Distance traveled (Pulp to Mill)	**100% Recycled Specified**	**Other**
Rail	8	6
Trucked <300 mi	8	6
Trucked 300 - 2300mi	4	4
Shipped	4	4
Trucked 2300<	1	2

Exhibit 3: Evaluation of Technical Criteria (continued)

Air	1	2
Maximum Points	8	6

Source of Product and Distance traveled (Mill to Customer)	100% Recycled Specified	Other
Rail	8	6
Trucked <300 mi	8	6
Trucked 300 - 2300mi	4	3
Shipped	4	3
Trucked 2300<	1	1
Air	1	1
Maximum Points	8	6

Recycled/Recyclable Packaging	100% Recycled Specified	Other
100% recycled content paper wrapper, no pla	3	2
All other paper wrapper	2	1
Plastic wrapping/plastic coated	0	0
Maximum Points	3	2

Compliance	100% Recycled Specified	Other
No violation of any environmental regulation	1	1
Attached a Code of Conduct policy	1	1
Maximum Points	2	2

Sustainability Criteria	100% Recycled Specified	Other
Publish Sustainability Report Established Greenhouse Gas (GHG) emissions inventory and reduction target - discuss below Established strategies or procedures at the mill to reduce energy, water and material use Member of EPA Smartway Transport Program Use alternative fuel in transport fleet Distribution warehouse is LEED certified Established GHG emissions reduction target a Work with NGO partners / community stakeholder groups Receive any Sustainability Awards (or rank on sustainability listings).	1 point for each sustainability criteria met	
Maximum Points	9	6
Total Points	70	70

Exhibit 4: World Bank Environmental Impact Expected

Lifecycle Environmental Impact	**Impact by The Bank** Switching 614 ton copy paper from 30% to 100% post consumer recycled	**Impact by The IFI** Switching 55 ton copy paper from 0% to 40% post consumer recycled	**Total Impact**
Wood Use:			
Use/Produce Less (Tons)	1,589	81	1,670
Equivalent Of Number Of Trees	11,120	569	11,689
Net Energy:			
Use/Produce Less (Million BTU's)	3,524	180	3,704
Equivalent Of Homes/Year	39	2	41
Sulphur Dioxide (SO2):			
Use/Produce Less (Pounds)	1,057,246	54,117	1,111,363
Equivalent Of 18-Wheelers/Year	96	5	101
Greenhouse Gases:			
Use/Produce Less (Lbs CO2 Equiv.)	5,091,923	260,638	5,352,561
Equivalent Of Cars/Year	8	<1	>8
Wastewater:	309,152	15,824	368,277
Use/Produce Less (Gallons)	11	<1	>11
Equivalent Of Swimming Pools			
Solid Waste:			
Use/Produce Less (Pounds)			1,670
Equivalent Of Garbage Trucks			11,689
Biomass Fuel Vs Standard Paper Facility Fuel Sourcing			
CO2:			
Use/Produce Less (Lbs CO2)	1,057,246		
Equivalent Of Cars/Year			
SO2:			
Use/Produce Less (Lbs SO2)	448		
Equivalent Of Semi Trucks/Year			

The paper calculator chart is run from the website of the Environment Defense Fund
http://www.edf.org/papercalculator/

NETWORK CENTRALITY IN CONSTRUCTION MEGA PROJECTS
THE ROLE OF GLOBAL ARCHITECTURAL PRACTICE

Arash Azadegan*

New Mexico State University

David M. Boje

New Mexico State University

Gerri E. McCullough

New Mexico State University

* Corresponding Author

Arash Azadegan, PhD
Department of Management
P.O. Box 30001
New Mexico State University
Las Cruces, NM 88003
Phone: 575 646 7570
Fax: 575.646.1372
azadegan@nmsu.edu

NETWORK CENTRALITY IN CONSTRUCTION MEGA PROJECTS
THE ROLE OF GLOBAL ARCHITECTURAL PRACTICE

ABSTRACT

Centrality in networks is associated with importance and power. In inter-organizational networks, firms with increased centrality are better able to influence the behavior and outcome of network members. However, centrality can be manifest in different forms, including between-ness centrality, local centrality, and global centrality. As networks become more complex, these forms of centrality become more divergent. In this theory extension study, we apply the three forms of network centrality to the role played by global architectural practices in orchestrating construction mega projects. Using results from face to face interviews of 43 informants in architectural practices and architectural professional associations, we develop a series of propositions on how organizational behaviors and capabilities of global architectural firms explain their network centrality. Specifically, we propose that practices with higher design capabilities show more between-ness centrality, those with higher technical capabilities show increased local centrality and practices with project management capabilities show higher global centrality. Moreover, each type of capability positively enhances the others' association with their respective centrality form.

INTRODUCTION

Centrality in networks is associated with advantage (Pillai 2006). How central a unit is can affect its ability to better recognize, more effectively respond, and therefore influence outcomes of the network toward its own advantage. In inter-organizational networks, a more centrally located firm can have better access to knowledge and practice of others than what is available to less-centered firms (Boje and Whetten 1981). Centrality can lead to better opportunities in sharing

resources, fewer constraints and having possibilities of better leveraging what resources are made available.

We know that centrality in networks can lead to improved access to resources (Sparrowe et al. 2001), increased power (Hoffman and Shrader 1990) and influence (Friedkin 1993) and thereby enhanced performance (Ibarra 1993). Research has established the importance of network centrality in inter-organizational networks (Gulati 1999; Soh 2003; Bell 2005; Hagedoorn et al. 2006). What seems lacking from our understanding are characteristics that are associated with central players of the network. Moreover, given that centrality can take on several forms (Freeman 1979), capabilities that lead to different forms of centrality may not be the same. Therefore our research question is: How do organizations' capabilities relate to their centrality in network settings?

To explore the phenomena, we tap into the role played by global architectural (GA) practices in developing mega construction projects. GA practices are organizations with multiple international offices that provide architectural design and technical services (Knox and Taylor 2005). Such firms tend to focus on "the high value-added design and project management end of the process, rather than site execution" (Winch 2008; pg 3). Mega projects are capital intensive, highly publicized and often innovative large scale construction projects that require the accumulation and interface among a large network of specialized organizations to generate ground-breaking monuments (Van der Westhuizen 2007). Examples of such projects include the National Olympic Stadium in Beijing (Olds 2001), Burj Al-Arab in Dubai (Charney 2007) and the New York World Cultural Center. Creating the concept and developing the physical structure of such projects requires a combination of organizational creativity, technical know-how and

managerial capabilities. Usually there are many contenders for managing and executing these projects, including general contractors, construction firms, commercial investors and other development entities. However, a notable portion of such projects are designed and managed with GA practices as important constituents. Being involved in the midst of mega projects requires organizational capabilities that can effectively leverage power and influence on other network constituents. As such, how GA practices are able to remain central to managing mega construction projects provides a unique perspective on the study of network centrality.

The rest of the paper is structured as follows. In the next section, we discuss the concept of network centrality, its importance and its different forms. We then discuss our context, namely the role played by GA practices in mega projects. Next, using transcripts from interviews with architectural firm and architectural association informants, we develop a series of hypotheses on how capabilities and behaviors of such firms explain their network centrality. The paper ends with a series of conclusions and remarks on future research.

NETWORK CENTRALITY

Research has explored how the concept of centrality is associated with importance and power (e.g. Burkhardt and Brass 1990; Tsai 2001). Ahuja et al. (2003) show how centrality can mediate effectiveness of one's functional role in the organization. Gulati suggests for network centrality to be an important consideration in alliance formations (Gulati 1999). Powell et al. (1996) suggest that firms with central positions in a network have better access to new ventures. These authors posit that centrality in networks generates visibility, which in turn allows for accessing valuable resources. Boje and Whetten note how centrality of organizations may be manifest in many forms: "Members of a central organization may indicate the organization's location by

serving as authorities on changes in policies and procedures in other organizations, by acting as arbitrators in conflicts between other organizations, or by serving as brokers in the formation of coalitions between other network members" (Boje and Whetten 1981; pg 381).

In simple network structures (such as a star or a hierarchical organizational chart) being central runs parallel with being exposed to more opportunities and lowered constraints. However, in larger and more complex networks centrality can take on different forms. For example, a node can be centrally important because it is the only connecting point between two clusters. On the other hand, a node can be centrally important because it is located in proximity of many other nodes. While there have been many attempts at capturing the concept of centrality, perhaps the most commonly used measures are those of Freeman (1979), namely between-ness, local and global centrality. These three distinct measurements of centrality become less convergent as the network size and complexity increases. For example, in Figure 1 whereas node 8 has the highest between-ness centrality, node 7 has the highest local centrality and nodes 4 and 5 have the highest global centrality. In the next sections we define, describe and leverage the three forms of centrality outlined by Freeman as a baseline in our contextual investigation of network centrality on GA practices.

GLOBAL ARCHITECTURAL PRACTICE, SERVICE SUPPLY NETWORKS AND MEGA PROJECTS

Networks of specialized service supply firms allow for gathering distinctive competencies of different professional firms for collaborations that last for finite periods of time (Jones et al. 1998). Examples of such service supply networks include R&D consortia (Gomes-Casseres 1994), global media services (Parisotto 1997), management consulting (Aharoni 1997) and

architectural design and engineering services (Winch and Schneider 1993; Sabbagh 1996). Coordination and management of these networks can be particularly complex (Doz and Hamel 1998) as it involves the integration of efforts of different specialist firms, while considering the expectations from a highly customized final outcome. Added to the complexity is the work style and priorities placed on the task from each member of the network. Under these circumstances, having a network position that allows better access to gaining and sharing information with others can be of clear advantage.

Perhaps some of the most challenging, publicized and politically charged tasks performed by service supply networks are those related to mega construction projects (see McNeill and Tewdwr-Jones 2003; Charney 2007; Ren 2008). Completing mega projects requires a massively scaled supply of design for one or more building structures alongside supervising the construction of the structure on site (Winch 2008). We provided examples of mega projects earlier. Other examples include the Guggenheim Museum in Bilbao, Spain by Frank Gehry, the Pompidou Center in Paris completed by a team spearheaded by Renzo Piano and the London building known as the "Gherkin" in 30 St. Axe, by Norman Foster and Partners (Charney 2007).

Beyond the subjective issues related to these highly visible and costly projects are several technical factors that make the task of designing, and supervising the construction of more complex projects (Lampel et al. 1996). First, mega projects involve multifaceted contracts among many parties, which weigh heavily on how project tasks are scheduled and delegated among the network of professional services. Second, the construction industry is heavily regulated. As such, building designs need to consider a multitude of national, regional and local

building and construction codes (Lampel et al. 1996). As Winch (2008) notes: "… a successful design needs to take account of local regulations with regard to both the permission to build (planning or zoning regulations) and the specification of the building (building regulations) with regard to features as varied as behavior in a fire, access for the less able, energy efficiency, and structural integrity". Clearly, mega projects receive their fair share of scrutiny from regulatory officials.

Rewards for effectively conducting these mega projects are heavy, both in terms of monetary gains and in terms of social notoriety. As a result, having power and influence on how the mega project is completed can be quite coveted. Acting as the "lead" organization provides significant opportunities for passing a more favorable agenda to one's own priorities in terms of timing and budget. The role of GA practices in such projects can be dependent on numerous traditional, cultural, industrial and firm level factors (Winch 2000; Winch 2002). Some mega projects, by tradition, are handled by large engineering firms, while in other cases a general building contractor may allocate a subcontract to engineering and architectural firms. For example, Japanese contracting has traditionally been design/build and as a result, a large majority of the contracts are awarded to large construction firms (Nielsen 1997).

METHODOLOGY

Analysis

Interviews from a total of 43 informants from GA practices and architectural associations based out of influential cities including London, New York, Paris, Tokyo and San Francisco - well known for the high caliber of their architectural capabilities (Rimmer 1991)- were used in this study. Each interview was held face to face and one-on-one in semi-structured format. Questions

focused on assessing how the firm's social practices such as its internal teamwork, external collaboration with other firms and the inter-personal networks of communication among its employees enhanced its performance. Table 1 and Table 2 provide the list of informants from GA practices and from professional associations. Recorded and transcribed interviews were coded by multiple researchers (King 2004) and tested for inter-rater reliability (Neuendorf 2001). We also triangulated our findings through the use of company related data, and media publications (Lewis 1998).

In assessing the interviews, we considered communication interaction among the GA practice, other service providers, local constituents and the client as a network of knowledge exchange (Podolny 2001). We considered the exchange of information as our unit of analysis. We started our analysis by first reviewing the transcripts for factors that enhance the performance of a GA. We first coded the transcripts based on these preliminary performance factors (Yin 2002). Based on the results of our initial coding we developed matrices (Miles and Huberman 1994) where narrative sections from each interview were categorized (King 2004). Eisenhardt and Graebner (2007) suggest for a theory-building process to occur through a recursive cycling among the case data, emerging theory and extant literature. Following their suggestions, we iteratively refined the performance factors to better capture the characteristics of the GA firm, to better reflect the interview contents and to better align with the definition of the three forms of centrality. In each iteration cycle, propositions that would link the characteristics of an architectural firm to its forms of network centrality were developed and tested based on the narratives and our previous coding, and new matrices were developed. After four iterations, we considered for three key capabilities to be of most importance in how GA practices play an influential role in the network.

Below is how we explained the role of GA practice's capabilities in determining its influence in a mega project after the fourth iteration:

First, as the architect, the GA practice needs to be able to create designs that are innovative enough to match other competitors and to meet the demands of the client's high expectations of novelty and creativity. Second, the GA practice needs to carry technical capabilities that can include them as effective participants in the engineering and construction program. Lastly, the GA practices need to ensure that they have effective project management capabilities in their organizational arsenal. Without abilities to be involved in directing and managing the various internal and external resources allocated to the project, the GA practice may rapidly lose its position of power. Moreover, there is a mutually enhancing element to the development of each of the three capabilities. The mutual enhancement among the three capabilities is our fourth proposition.

Following the development of the four propositions, we reviewed the transcripts again for narratives that were in support of each of the four propositions. Table 3 provides a summary of the number of passages that supported our propositions verified by multiple coders. Table 3 also includes the number and average length of the interview transcripts held in each city. In the next section, we explore how these three capabilities, namely design, technical and project management capabilities and their mutual enhancement delineate how central a GA practice can be in mega projects.

Propositions

The interviews typically started with questions related to the informant's background and quickly lead to their perception of how projects are executed. Following suggestions by case study

(Stuart et al. 2002; Voss et al. 2002) and narrative researchers (Riessman 1993; Casey 1995), we leverage excerpts from the transcribed interviews to provide further detail on the opinions of the informants. For example, a San Francisco based informant notes about the nature of the GA practice in mega projects as follows:

> **Informant:** *"…We get "parachuted" in to a remote country that doesn't have any of the infrastructure we take for granted here, so [we] have to establish contacts with local architects and engineers over there, there is no obvious way to identify who those people are, we have the internet which helps a lot, cell phones help a lot, but a lot of places just don't have architects and engineers. There are language issues, there are cultural issues, there is time change issues. So we have learned some lessons, the first thing is to really understand what the resources are then, when we go over there, how do they build things? Typically the labour is unskilled and the companies that are operating over there tend to be large international firms from Europe, the US, so we learn from them…".* (Partner, San Francisco; emphasis added)

Mega projects are special because they are one-of-kind (Selg and Rihel 2007). As such, much of the professional expertise required for conducting such projects is not locally available. This lack of expertise allows for the GA practice to start the project by taking center stage in executing the project from its initial steps of the project. A London based informant notes:

> **Informant:** *"In a lot of these markets there is no precedent for the type of buildings we're designing. So there is no vernacular in that sense. There's a kind of new vernacular that we're helping to develop".* (Managing Partner, London)

The unavailability of local capabilities and lack of prior history of managing mega projects allows for the GA practice to automatically take on a central role. However, some of the necessary capabilities during the beginning stages may not be sufficient enough to guarantee a central role for the GA practice throughout the remainder of the project. We noted earlier how

the possible benefit of being in charge of such projects attracts many entities including construction firms, commercial investors, general contractors and real estate developers. In the next few sections, using responses from our informants, we explore how GA practices highlight capabilities that allow them to maintain centrality throughout the mega project.

Between-ness Centrality and Design Capabilities

One form of centrality is that of between-ness. An organization with high between-ness (BC) is essentially located on a path where important exchange occurs. High BC implies high level of influence on the network as it can allow for withholding or bestowing of information (Salman and Saives 2005). BC may allow for the organization to act as a bridge between organizations that are not directly connected to one-another (Kilduff and Tsai 2003). In Figure 1, node 8 carries a high level of BC since information from nodes to its left and to its right is bound to traverse through it to be exchanged. Moreover, such a placement in the network allows for the organization to act as a broker or gate-keepers of innovation (Scott 1991). BC is particularly beneficial when there are structural holes in a network (Burt 1992). Structural holes occur when there is a gap between entities that have complementary capabilities. High BC nodes can fill in the gap and therefore take advantage of the opportunity.

Several characteristics of GA practices enhance their possibilities for gaining high BC. First, many GA practices are inherently cultured to develop a full understanding of the client's characteristics and expectations. Architects have been shown to use various conversational techniques that allows them to involve the user in the design process and thereby better associate

with their needs (Ivory 2004; Luck and McDonnell 2006). This understanding allows for GA practices to develop a link to the client that other firms may not be able to develop.

A similar thread of opinions among our informants alluded to the development of close links with the client as well. A thorough understanding of the client's expectations, followed by appropriately challenging and modifying unreasonable expectations was mentioned occasionally as part of the interview responses. One informant noted that they considered inquiry into the client's vision of the project as an essential starting point for developing innovations. Another informant suggests the process of developing innovative designs as follows:

> **Informant:** *…A lot of it starts with a deep dive into the client. So I try to benchmark their comfort zone and some clients have a high tolerance for innovation and some don't, we try to go for those who have a high level, you have got to get the level where they are at* (Principal, San Francisco)

Others echoed how spending ample time in gathering information about the client, their expectations and the project setting are required precedence for developing strong designs:

> **Informant:** *the real innovation … always comes from looking at a problem or a brief and then trying to think outside the box that are not obvious or clear … So the brief and the client can really help in being innovative in the end.* (Project Architect, London)

> **Informant:** *To be innovative you have to ask a lot of questions. You have to be critical about what you do but also what you see. You have to approach it with an open eye and ask the right questions. Why is it like this? I notice that people are doing that, why is that? … Maybe they would behave differently if something else was on offer.* (Project Architect, London)

In most cases the connections made between the GA practice and the client move beyond simply understanding the client's needs. Part of the information exchange involves educating and

therefore effectively influencing client's opinions towards solutions that would pave the way for innovative designs:

> **Informant:** *You have to educate clients. It is one of the roles of an architect. But also to understand what their problem is. What you have to do as a good architect is to understand what the client really needs and then come up with a beautiful architectural solution. They might not grasp that so educate them to the point that they understand it, because they might think the best solution to their problem is something pretty horrible* (Principal, San Francisco)

Another informant further iterates the importance of learning from and educating the client in the design process:

> **Informant:** *….we're involved in a project at the moment in [place x] where the client has some very ambitious aspirations … And it would be very easy to be seduced by the client into producing something entirely non-sensical. Our responsibility is to maintain a balanced perspective and ensure the client themselves understands their business drivers.* (Managing Partner, London)

GA practices also recognize that in working on a mega project their responsibility is beyond meeting the expectations of an immediate client. Rather, there are social and cultural elements to responsibly developing a mega structure. Part of their information gathering is from entities within the social aspect of the project:

> **Informant:** *You definitely want to understand the local issues from a cultural point of view, usually it is completely different materials. In Saudi Arabia they separate the sexes so that effects what you do for school design, you can't just transfer things over, maybes stack office buildings, some of it is cultural. In China they want you to work with Feng Shuei and that is important so you have to understand that.* (Principal, San Francisco)

GA practices need to ensure that their design ideas are not created in a vacuum, and that they are easy to understand and are persuasively presented to other members of the project. As a result,

involvement and coordination of efforts with other project disciplines is critical for innovative designs to come to fruition. An informant highlights the importance of gaining assent from other disciplines:

> **Interviewer:** *So is working with engineers part of this innovation process?*
> **Informant:** *I think it's crucial for what we are doing. ….And it's not only to verify that we are on the right track but also we are working with engineers that are good in their field…They actually sit down with us and they come-up with their own ideas and they have solutions and will suggest something and we'll say maybe that's a good idea. It's almost them being part of a team, rather than them executing what we dream up.* (Managing Partner, London)

The same informant mentions the benefits gained from exchanging information with local expertise and the importance of having close links with local consultants:

> **Informant:** *Local architects, consultants, clients. The better the brief, the better the client the better the project becomes. The more they input and discuss and express preferences or have experience the better it is for the project.* (Managing Partner, London)

The result of these efforts allows for the GA practice to have a heavy influence on how the network operates. An informant highlights the outcomes of this strategy of being interconnected with many project constituents by GA practices:

> **Informant:** [in response to a question on the role of the architect] *[it is] bringing value to the job through questioning and understanding of what are the best ways to do it and bridging between the consultants and our construction team and making sure that what we design can actually deal with it. …..* (Associate Architect, London)

Cohen et al. (2005) discuss the social context in which design and construction of buildings such as that of mega projects occur. They note how the context may "include the profession, firms, clients and practitioners. All these stakeholders have strong ideas about how buildings ought to look and function, but they do not always agree" (Cohen et al. 2005; pg 778). Others suggests

that by having close interactions architects can "manipulate the flow of information through the project, resist demands of conservative clients" and "stabilize choices that match their own choices" (Ivory 2004; pg 506). Similarly, GA practices that are able to leverage their position to act as bridges for the development and transfer of technologies (Bessant and Rush 1995; Winch and Courtney 2007). This continued interaction and acting as a bridge between two other entities has been noted as an important capability of service providers in international settings by Li and Choi (2009) as well.

In sum, by appropriately making connections with all parties involved, the GA practice can act as a central bridge where ideas can accumulate and traverse. By establishing connections that other firms may not have developed, the GA practice can be a prevailing source for attracting innovative ideas from various disciplines to be incorporated into the design process. Therefore we posit that the effectiveness of the design strength capabilities of a GA practice is manifest through its between-ness centrality in the network:

***Proposition 1*:** The design capability of a global architectural practice is associated with its between-ness centrality in the mega project.

Local centrality and Technical Capabilities

Local centrality is a measure of the number of direct connections to a node (Freeman 1979). Local centrality (LC) reflects how "well connected" a node is to its surrounding. Scott suggests that a node has high LC if it is in the "thick of things in the network" (Scott 1991) and is "deeply involved in network relations" (Bell 2005; pg 191). In Figure 1, node 7 carries the highest level

of LC since it is best connected to the most direct number of nodes in the system. As compared to other forms of centrality, local centrality relies on direct ties that can carry less interrupted, more frequent and richer information between network firms. Our pool of respondents' comments on their communication with other members of the network provides a synopsis of how GA practices interacted with other constituents:

> **Informant:** *….Architects have this huge communication role. So every project with maybes 30 different companies working on it and they all have to communicate with each other* (Principal, San Francisco)

> **Informant:** *One of my strengths has been my ability to communicate both internally and with clients, that is a huge aspect of our business that a lot of people don't think about.* (Architect, San Francisco)

A node with high centrality tends to have preferential attachment (Barabasi et al. 2002). Preferential attachment may be as a result of certain capabilities that others are in need of, such as one's technical expertise. When a GA practice is able to suggest and implement viable technical solutions, it becomes more attractive to other members of the network. Expertise and understanding of the technology behind many of the possible alternatives allow for the GA practice to be considered as a source for remedying project problems. GA practices that are able to effectively resolve problems can attract clients and other service provider firms (such as construction firms and engineering consulting firms) to have more knowledge exchange with them. As such, we would expect for GA practices to consider technical expertise as an important aspect of their capabilities. An informant notes about how technical abilities are determinants of design:

> **Informant:** *Well typically technical advances frequently sponsor aesthetic transformations. So we are always looking to the latest of whatever is available. Mechanical advances are the same and I think there's a current transformation or*

> *whatever taking place having to do with sustainable design principles, which currently run again that are being occasion of transformation of a former approach to building, massing, hierarchy, strategies with adding things on to deal with solar shading.*(Architect, New York)

When asked about the importance of technical issues and the role of the architect in prioritizing them as compared to other disciplines, an informant answers as follows:

> **Interviewer:** *So when do technical challenges inform the process?*
> **Informant:** *They influence it constantly throughout all phases of the design really. … And a lot of our projects have used that rationale and we do a lot of scripting here without modeling. So the form is developed from the scripted geometry and there's a mathematical rigor behind that which usually always informs the structure and how the building's supported…If you just left engineers to design those things you'd have pipes and switches all over the place.* (Architect, London)

Given that technical information carries a richer context, sharing technical information can benefit from a medium that allows for less interrupted, more frequent and richer information exchange. As such, direct connections provide a well suited mean for transferring technical information. As a result, GA practices with higher local centrality are able to better send and receive technical information with their adjacent members of the network.

> **Informant:** *I have to be able to converse with reasonable assurity about a code issue in [country x] and be able to do the same thing in another country. But then also need to be able to discuss aesthetics of the building, or talk to the mechanical engineer.* (Architect, New York)

Such familiarity with technical capabilities allows for clients to consider the GA as more than a mere provider of design solutions but to approach the practice for answering to other technical issues. An informant notes:

> **Informant:** *Most of them [clients] come not only for the design or style but they want us to be a workplace consultant as well as a designer. So they want our recommendations and consultation about the design.* (Architect, Tokyo)

By being fully aware of the technical aspects of the project, the GA practice is able to be directly connected to the client, to other professional entities and to the local constituents of the project. Literature also suggests that technical capabilities such as access and awareness of new technologies (Bossink 2004) and effective information gathering (Kangari and Miyatake 1997) allow for performance improvement in the construction industry. Slaughter (2000) considers the ability to identify, evaluate and commit to the use of new technologies as key considerations in technical capabilities of firms in this industry. In sum, enhanced technical abilities allows for the GA practice to maintain connection with its immediate surroundings, which in turn may enhance its technical abilities. Therefore:

> ***Proposition 2*:** The technical capability of a global architectural practice is associated with its degree centrality in the mega project.

Project management Capabilities and Global centrality

Global centrality (GC; Freeman 1979) is a measure of all connections to a node be they direct or indirect. GC results from being able to reach a large number of nodes more easily than others can. Alternately stated, nodes with high GC are able to maintain links that directly or indirectly connect them with more numerous nodes in the network. In Figure 1, nodes 4 and 5 carry the highest level of GC since they are connected to the most number of nodes in the system. There are several benefits to GC. First, GC allows for better visibility of the entire network. As such, those with higher GC have better awareness and recognition (Walker 1985) of the activities in

the network. Second, GC allows for quicker access to others, which allows for the node to more effectively implement changes to a network (Kilduff and Tsai 2003). Nodes with high GC carry more direct and shorter paths to other nodes than those with lower closeness centrality. As a result, nodes with GC are able to swiftly recognize the need for change and more effectively implement such changes across the network. Moreover, GC permits the node to be less dependent on other firms, since it can access more nodes with less need for intermediaries. In sum, GC provides awareness while reducing dependence to a node.

What distinguishes GC from local centrality is the importance of indirect connections. We know that indirect connection are suited for indirect and looser ties (Granovetter 1973). As such, whereas local centrality is based on direct and thereby strong ties, GC emphasizes the importance of indirect and weaker ties. However, unlike direct links, indirect links do not allow for frequent and rich information exchange. The benefit of indirect links is in sharing lower levels of content from farther distances. As such, GC allows for monitoring or "keeping tabs" on network activities. Another informant details how being aware of these various aspects of the project essentially becomes the responsibility of the architect:

> **Informant: …***we manage the construction process, we manage the designers, we manage the contractors who build it. So we may contact them to ask for ideas on how we can actually deliver things. ….. and we also work with a supply chain. So if we have a particular problem we'll actually involve some of the contractors who are actually going to build them because we don't actually build anything,* (Architect, London)

An organization with a globally central position is able to better identify information related to the "positioning of the other companies in the network" which can assist in better identifying its course of action (Hagedoorn et al. 2006). This awareness of the network also allows for

correcting misallocated resources and developing new ideas and innovations. The increased awareness allows for the firm to make decisions more efficiently. Becker for example, shows how firms in central positions are able to adopt innovations faster than others (Becker 1970). GA practice's global awareness of the project comes from developing skills that can recognize the importance of all aspects of the project and balance places them in context as to how important they are to the project. Centrality through indirect ties is likely to provide access to complementary knowledge as a result of its alliances (Salman and Saives 2005). An informant comments on how linking information from different constituents allows for the GA practice to be aware of the project status:

> **Informant:** *It is almost as if we are jugglers. We integrate and disseminate information from diverse sources.*

This iterative process of recognizing and managing needs, allows for the GA practice to know where and who to access, to gather and to share information that may be useful on executing the project.

> **Informant:** *Architects are generators of consensus, creating solutions that no engineer, no developer, no public artist, no banker on their own would necessarily bring to a particular project* (Director, Professional Association, New York)

Moreover, such collaborative links allow for facilitating the accumulation and combination of complementary skills within the network. In turn, the awareness of the broader scope of the network allows for better management of the project. A New York based informant comments on how their awareness of the network provides a competitive advantage to their practice:

> **Informant:** *Why do people hire US architects? Novelty and attention to detail… kind of attention to efficiency and economy with a kind of innovative design ideas that are also about the attention to detail all the way through to the final constructions also you need because many firms working abroad are doing schematic design level work and then*

having it executed locally and the result is <u>not</u> something that you can typically be proud of. (Architect, New York)

Literature supports the link between strong project management skills and network centrality in mega projects. For example, Lampel et al. (1996) how strong internal project management capabilities by the "hub" in large engineering construction projects lead to more innovative outcomes. More recently Liaquat (2009) shows how highly centralized individuals are better able to coordinate activities than those with higher organizational positions. Based on the theoretical arguments, our empirical evidence and past literature, we posit that through global centrality a GA practice can access more information on a broader range of items as related to the mega project. Such awareness is associated with project management capabilities. Therefore:

<u>Proposition 3:</u> The project management capability of a global architectural practice is associated with its global centrality in the mega project.

Mutual Reinforcement of Design, Technical and Project Management Capabilities

When asked about success in architecture, our informants alluded to the multidimensionality of how success is achieved. Accomplishing only a few of a long list of expectations from different project constituents does not make it a success In contrast, it seems that in mega projects, success is defined through the amalgamation of several concentric goals. An informant highlights this combinatory aspect of success as follows:

Interviewer: *What makes a successful project?*
Informant: *It's a combination of many things, a kind of strong set of design, ideas or an arsenal of approaches, familiarity with what has worked or what hasn't worked, what is applicable, what isn't, along with a sensitivity to new environments, cities, clients and expectations.* (Director, New York)

In a large sized project effectively accomplishing the various aspects of the project are impossible to do without certain level of specialization. At the same time, coordination and management of the various tasks becomes critical to ensure that the entire project is focused in one direction. Synergy between the creative aspects of the project and ensuring that the project is financially beneficial is difficult. Another informant clarifies:

> **Informant:** *We work in teams and the firm has a very strong design focus and also a very strong management and business focus ….. It is one of the great things about the firm that we are both a design firm and a business, … So I think the way clients benefit from our structure is having people who watch the money, project managers who focus on that and then we have the creatives, conceptualising the project those people are together on one team and it is the push pull between them that ultimately makes the projects look as though they should and also perform financially and on schedule. It is not easy, you have very different personalities in those camps, left brained people and right brained people and they don't always communicate using the same languages but I think it is a healthy friction for the client because somebody is looking at both sides of the project.* (Architect, San Francisco).

An informant highlights how the delegated tasks among the various project groups are divided and coordinated:

> **Informant:** *An analogy is the Mongolian army as opposed to a Western army. The Mongolian army is hugely successful because it had an implied hierarchy but it didn't go in ranks. Everybody just improvised in the field. And somewhere there was a commander but everyone sort of just did their jobs. ….. The thing is its teamwork.* (Partner, London)

Another informant points out that although a successful mega project may require different specializations to pursue their tasks separately, for the result to be effective a cohesive synergy needs to be developed.

> **Informant:** *… people have different levels of experience in the office, so a different level of synthesis, even people with the same level of experience will be able to zoom into a*

> *question with different speed and again, depending on the relationship they have, the client they will enforce this action. So a firm that has all these resources will try to combine all these different skills* (Architect, San Francisco).

These comments suggest that for the architectural firm and the mega project carry all three of these capabilities gain further benefits from their mutual reinforcement While tasks and responsibilities they may be separated different capabilities of GA practices need to be mutually complementary for a GA practice to be able to play a central role in managing mega projects.

***Proposition 4*:** Design, technical and project management capabilities of the global architectural firm positively enhance one another's association with the three measures of centrality.

CONCLUSIONS

The aim of this study is to leverage explanations from network theory as related to centrality to explain how global architectural firms involved in mega construction projects can enhance their power and influence on the process and outcome of the project. Our discussion, based on narratives from informants and literature related to theoretical and empirical findings on centrality concepts, suggest that by carrying different sets of specialized organizational capabilities architectural firms can enhance their network position. Design, technical and project management capabilities are each associated with one of three forms of network centrality. Moreover, our observations suggest that the impact of the three capabilities are mutually reinforcing on one another.

At the core, our arguments are based on historically demonstrated literature on how specialization in one or more areas, and the integration of these specializations, provides firms

with competitive advantage (Lawrence and Lorsch 1967). As Postrel notes (2002), competitive advantage can be gained through "islands of shared knowledge" where mutual understanding of a series of specializations allow for the firm to benefit from integration of a multitude of knowledge streams. Here we note that such strategy also allows for the firm to place itself in a central location within the network.

We believe the work here provides a small contribution to the emerging research stream in supply networks (Choi and Dooley 2009) in general and in service supply networks in particular (Lewis et al. 2004; Li and Choi 2009). Much recent effort has been focused on better understanding of supply networks (Poulin et al. 2006; Pathak et al. 2007; Choi and Wu 2009; Li et al. 2009) and the inter-relationships among suppliers in such networks (Choi and Krause 2006; Choi and Kim 2008). Much less research has been focused on that of professional services (an exception is the work of Li and Choi 2009) or the understanding of services supply chain in general (Ellram et al. 2004). Here we focus on how capabilities and roles played by a specific type of service organization, namely that of an architectural firm, determine its placement and influence within a service network. We link different characteristics of the firm with different types of centrality it can establish and therefore different type of influence that the firm can have on the performance of the network.

LIMITATIONS

There are several limitations to this work. First, as related to networks, our theoretical arguments exclude many other network related factors. For example, we side-line discussions related to the density or reachability of the network (see Kilduff and Tsai 2003 for a discussion of these dimensions). There has also been some critique as to whether centrality is in fact an accurate

indicator of power. For example, Cook et al. consider dependence to be separate from centrality as a measure of power (Cook et al. 1983) and suggest that centrality may not always be an accurate predictor of power. Similarly, our work here focused on three prevalent measures of centrality. There are other suggested measurements for centrality such as that suggested by Bonacich (2007) which provide a combined hybrid measure that may be useful for a wider application. Clearly, our aim here was to distinguish the three measurements to better identify how they related to firm capabilities. Nevertheless, future studies may consider the inclusion of such hybrid forms of centrality as part of the theoretical development and empirical assessments.

FUTURE RESEARCH

Future research may test these propositions through network modeling of relationships among constituents of one or more mega projects. Prevalence of social network software (e.g. UCINet, Borgatti et al. 2002; and others such as Pajek and statnet) can make this extension of the work more feasible (Okoli and Oh 2007; Trier 2008). In selecting samples for analysis, care needs to be taken in making sure that the level of notoriety, capital expenditure and uniqueness qualifies it for a mega project. Another important consideration in social networks is the influence of formality and informality in communications across the network members (Morand 1995). Some suggest for formal and informal structure in communications to lead to different "premises and outlooks and… assumptions about the nature of interaction" (Hartmann and Johnson 1990; pg 127). Lastly, particular attention needs to be made to the interaction effects of these three forms of centrality. For example, recent research suggests for local centrality to have detrimental effect on global centrality (Whittington et al. 2009).

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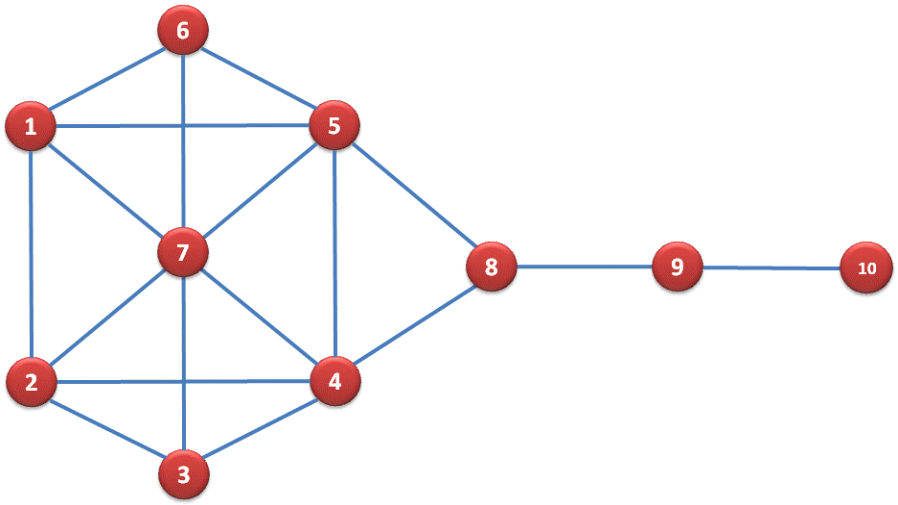

Figure 1 – Centrality Measures
Node 8 has the highest Betweenness Centrality
Node 7 has the highest Local Centrality
Nodes 4 and 5 have the highest Global Centrality

Table 1
List of Interviewees - Architects

Interviewee	City	Interviewee	City
Project Architect	London	Architect	Paris
Managing Partner	London	Architect	Paris
Associate Partner	London	Managing Partner	Paris
Managing Partner	London	Architect	San Francisco
Project Architect	London	Managing Partner	San Francisco
Associate Architect	London	Architect	San Francisco
Architect	London	Principal	San Francisco
Partner	London	Architect	San Francisco
Associate Architect	London	Architect	San Francisco
Principal	New York	Partner	San Francisco
Architect	New York	Principal	San Francisco
Principal	New York	Principal	San Francisco
Partner	New York	Architect	Tokyo
Architect	New York	Architect	Tokyo
Architect	New York	Managing Partner	Tokyo
Director	New York	Architect	Tokyo
Director	New York	Principal	Tokyo
Partner	New York	Architect	Tokyo

Table 2
List of Interviewees representing professional associations- Architects

Interviewee	City	Association
Director	London	Royal Institute of British Architects
Researcher	London	Royal Institute of British Architects
Director	New York	American Institute of Architects
National Council Member	Paris	L'Ordre des Architectes
Secretary General	Paris	International Union of Architects
Director	San Francisco	American Institute of Architects
Publicity Officer	San Francisco	American Institute of Architects
Board Member	Tokyo	Japanese Institute of Architects
President	Tokyo	Architectural Institute of Japan

Table 3
Propositional Support based on Interview Comments

Propositions	New York	San Francisco	London	Tokyo	Paris	Total
P1 – Design Strength	7	4	7	3	2	23
P2 – Technical Expertise	5	6	4	2	2	19
P3 – Management Expertise	3	4	4	3	1	15
P4 - Combination of three above	2	1	1	-	-	4
Number of Interviews	9	11	11	8	4	43
Transcribed Pages Per Interview	6.4	5.6	8.6	4.6	4	