NETWORK CENTRALITY IN CONSTRUCTION MEGA PROJECTS
THE ROLE OF GLOBAL ARCHITECTURAL PRACTICE

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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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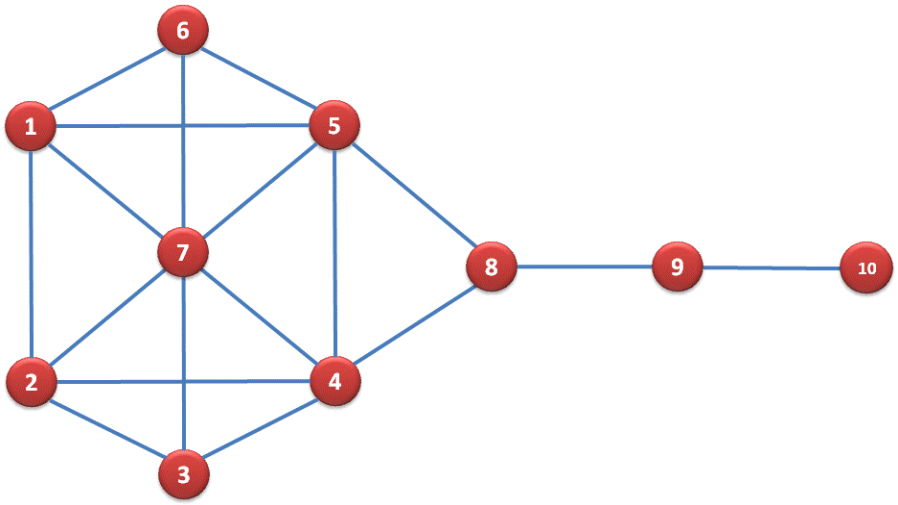

Figure 1 – Centrality Measures
Node 8 has the highest Betweenness Centrality
Node 7 has the highest Local Centrality
Nodes 4 and 5 have the highest Global Centrality

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	