

THE EVALUATION OF SOCIAL NETWORK ANALYSIS APPLICATION'S IN THE UK CONSTRUCTION INDUSTRY

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The Social Network Analysis (SNA) has been adopted in the UK construction management research and there is a trend to apply it in large scale. As an effective tool, social network analysis has been used to analyse information and knowledge flow between construction project teams which is considered as foundation for collaborative working and subsequently improving overall performance. Social network analysis is based on an assumption of the importance of relationships among interacting units. The social network perspective encompasses theories, models and applications that are expressed in terms of relational concepts or processes. Many believe, moreover, that the success or failure of organisations often depends on the patterning of their internal structure. This paper reviewed existing literatures on SNA applications in the UK construction industry. From the review, the research proposed some improvement in the application of SNA in the construction industry.

Keywords: integration, knowledge flow, project teams, social network analysis.

INTRODUCTION

Social network analysis has been adopted as an analytical tool in the research into construction industry to provide indications of knowledge integration, collaborative working and effective communication. Though it is generally agreed that this tool is effective, there are some challenges in applying it in consideration of the special characters of construction industry. Social network analysis provides a method to understand informal networks within and between organisations and manage the informal networks systematically (Cross and Prusak, 2002). Social capital makes an organisation, or any collaborative group, more than a collection of individuals' intent on achieving their own private purposes. Social capital bridges the space between people. Its characteristic elements and indicators include high levels of trust, robust personal networks and vibrant communities, shared understandings, and a sense of equitable participation in joint enterprise—all things that draw individuals together into a group. This kind of connection supports collaboration, commitment, ready access to knowledge and talent, and coherent organisational behaviour (Cohen *et al.* 2001).

The key difference that distinguishes social network analysis from other analysis and management methods is that social network analysis draw attention to informal

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network in working place. Basically, social network analysis is used to measure and visualise relationships and flows between people, groups, organisations, computers or other information/knowledge processing entities.

McCarty (2001) explains that Social Network Analysis (SNA) is both a theoretical perspective and a set of methods. In terms of theory, SNA extends and complements traditional social science by focusing on the causes and consequences of relations between people and among sets of people rather than on the features of individuals. In terms of method, SNA focuses on the measurement of relationships between people. In use of relational concepts, the following are important:

- Actors and their actions are viewed as interdependent (rather than independent) autonomous units. Relational ties (linkages) between actors are channels for transfer or "flow" of resources (either material or nonmaterial);
- Network models focusing on individuals view the network structural environment as providing opportunities for or constraints on individual action
- Network models conceptualise structure (social, economic, political, and so forth) as lasting patterns of relations among actors (Wasserman and Faust, 1994).

This paper evaluates the current application of social network analysis in construction context in terms of the research design, measurements selection and data presentation. Some suggestions and recommendations are made at the end in attempt to move the application forward in construction industry. The next section reviews relevant literature on social network. The third section introduces social network analysis in the UK construction industry.

NETWORK PERSPECTIVE

Traditionally the research into UK construction industry focused on to improve competitive advantages of individual organisations. Not surprisingly these researches paid close attention to the attributes of individual organisations. The individual organisations are analysed from a range of facets including overall strategy, human resource management in turbulent project process, leadership and team working etc.

Following two government reports in 1994 and 1998 calling for changes, the UK construction industry has been attempting to improve its overall performance by introducing some managerial concepts from manufacturing industry (Latham, 1994; Egan, 1998). These management frameworks include Supply Chain management in construction and later Lean Construction, Partnering, Quasi-firm, and Knowledge Management. In order to achieve the benefits from the different management approaches, all the participants in construction project process are expected to display cooperative and collaborative working patterns based on trust and mutual support. Following the introduction of the above management approaches, the research in construction industry started shifting from individual organisational attributes towards network perspective, which means the research and analysis into construction organisations shift from pure economic dimension towards research taking into account of social dimension. The organisational behaviours in construction project process are analysed in their social context rather than economic motivations.

Though the management approaches listed take into account the social dimension, their main emphases are still business transactions in order to maximum the economic benefits. Tichy *et al.* (1979) advocates the network perspective in the study of organisational behavior and emphasises the social dimension rather than business

benefits. According to Seufert *et al.* (1999), the term ‘network’ designates a social relationship between actors. Actors in a social network can be persons, groups, but also collectives of organisations, communities or even societies. The relationships evolving between actors can be categorised according to contents (e.g., products or services, information, emotions), form (e.g., duration and closeness of the relationship) and intensity (e.g., communication-frequency). Since the boundaries of networks are difficult to determine, blurred boundaries are constructed socially by the network members. Grandori and Soda (1995) considered networks as nexuses of integration mechanisms encompassing all the range of organisational inter-firms coordination and cooperation. Network perspectives build on the general notion that economic actions are influenced by the social context in which they are embedded and that actions can be influenced by the position of actors in social networks (Gulati, 1998).

Similarly, Powell (1990) asserted that a network is a form of organisation in business practice. Network relations are perceived as the most central feature in moving the industry forward in the perspective of the “network form” (Powell, 1990). The functional explanation for the emergence of the “network form” claims that the opportunities for innovation exist within firms as well as in their external networks, and the ability of an organisation to learn results from its capacity to utilise both its own internal capabilities and the opportunities within its network through various forms of collaboration. In the context of networking, “network forms” of organisation have been described as a source of value for the firm (Kogut, 2000). Network based industries can be expected to generate new forms of collaboration, in which network partnerships will be based on maximising resource utilisation subject to the equitable distribution of returns, rather than on individual firms maximising their profits (Miles, *et al.*, 1998). Some authors (Thorelli, 1986; Siebert, 1991; Sydow 1992) viewed networks as a hybrid form of organisation since networks have features of market and hierarchy. This form of organisation demonstrates stronger incentives and adaptive capabilities than hierarchies, but can offer more administrative control than markets (Williamson, 1994).

Due to the division of labour and accompanying fragmentation, specialisation and distribution of knowledge, it becomes a requisite to integrate and thus share the diversity of complementary knowledge in order to produce complex products and services. An organisational setting has just been implemented or has emerged since none of the actors involved could produce the collective outcome individually (Boer *et al.*, 2002). Therefore, Reich (1991: p.81) regards a firm as a facade, behind which an array of decentralised groups and subgroups exist continuously contracting with similar diffuse working units all over the world. There are five basic reasons for taking a network perspective on organisations (Nohria and Eccles, 1992, p. 4):

- All organisations are social networks and therefore need to be addressed and analysed in terms of a set of nodes linked by social relationships;
- The environment in which an organisation operates might be viewed as a network of other organisations;
- Organisations are suspended in multiple, complex, overlapping webs of relationships and we are unlikely to see the overall pattern from the point of view of one organisation;
- Actions (attitudes and behaviour) of actors in organisations can best be explained in terms of their position within networks of relationships;

- The comparative analysis of organisations must take into account their network characteristics.

By taking the network perspective, managerial concerns shift from the consideration and protection of the boundaries of a firm to the management of and care for relationships (Seufert *et al.* 1999). In the empirical study of strategic alliances, Gulati (2000) points out that network facilitate firms in the network in gathering superior information, thus reducing the informational asymmetries which otherwise may cause higher transaction cost. Networks can further mitigate transaction costs by making opportunism more costly because of reputational effects. Businesses take time to build reputations in society, but this reputation can be damaged overnight. Consequently, it is essential that firms exercise caution in protecting their reputation, and the network can help create a strong disincentive barrier against opportunistic behaviour (Wang *et al.* 2004). Wang *et al.* (2004) viewed inter-firm networks as recourses which enable business to sustain above-average performance because they meet three criteria established by Barney (1999): resources being valuable, resources being rare and resources being imperfectly imitable.

Lipnack and Stamps (1994) state that network organisations are characterised by five key organisational principles:

- Unifying Purpose: common views, values, and goals hold a network together. A shared focus on desired results sustains synchronised operations and network directionality;
- Independent Members: each member of the network, whether an individual, company, or country, can continue to sustain its independent existence while benefiting from being part of the whole;
- Voluntary Links: the distinguishing feature of networks is their links, partners join forces voluntary;
- Multiple Leaders: fewer bosses, more leaders. Each person or group in a network has something unique to contribute at some point of the process. With more than one leader, the network as a whole has greater resilience;
- Integrated Levels: networks are multilevel, not flat. Networks operate on different levels, i.e. co-operation between organisations, departments and people.

Though the five principles are useful for identifying networked organisations, they fail to explain how to create a successful networked organisation, as most of the features concluded above are developed without formal organisational management intervention. At organisational strategic level, inter-firm relationships have increasingly become a core component. They constitute valuable capital because they provide access to capabilities and resources that may otherwise be unavailable (Koka and Prescott, 2002). Regarding organisations in projects, Jones (1999) noted that the project organisation is best thought of as a project network, because projects are normally produced through a dynamic network of transactions involving specialised firms, subcontractors and freelancers. Therefore, the social network analysis has been introduced into construction project management discipline.

SOCIAL NETWORK ANALYSIS IN THE UK CONSTRUCTION INDUSTRY

Basic concepts

The social network model was created based on criticisms of neo-classical economics models proposed by Williamson (1994), in which transaction activities are directed by bounded rationality and opportunism (Gordon and McCann 2000). The ‘social-network model’ proposes that there is more order to inter-firm interactions and less order to intra-firm interactions than the economic models would imply (Granovetter, 1985). Social networks of certain strong interpersonal relationships can be stronger than firm boundaries, with the result that many inter-firm social interactions may be stronger than their intra-firm counterparts (Gordon and McCann 2000). People use their social network as important resources for information and knowledge to accomplish their job. Freeman (2005) suggests that social network analysis focus on two structural patterns of the ties that link social actors. The patterns can: reveal subsets of actors that are organised into cohesive social groups and divulge subsets of actors that occupy equivalent social positions, or roles. Therefore, the actor-by-actor ties provide basic data for social network analysis.

The broad majority of social network studies use either “whole-network” or “egocentric” designs. Whole-network studies examine sets of interrelated objects or actors that are regarded for analytical purposes as bounded social collectives, although in practice network boundaries are often permeable and/or ambiguous. For example, supportive connections in a group of researchers, helping activities in a classroom of people, by measuring relationships between all units, the analysis reveals the properties of relationships in the whole network. The boundary of “whole-network” analysis is pre-set by researchers. The second one is the “ego-centric” approach. Starting from a specific unit for research, this method collection relational connections with other “alters” (chosen according to the research aims), which later determine the final boundary of the whole network. It is a method to study how relational influences produce efforts on the individual.

Applications in the construction Projects

The application of social network analysis is relatively new in the UK construction industry (El-Sheikha and Pryke, 2010), and the research from a social network analysis approach has favored whole-network method by which the relationships are measured by cohesion, density and distances. In an attempt to create social network model in project teams, Chinowsky *et al.* (2008) viewed engineering projects as unstable networks that get reinitiated for each project, subsequently change the focus on what constitutes a successful network team. Chinowsky *et al.* (2008) suggested that in applying social network analysis in project teams, projects should be viewed from a social collaboration perspective. Subsequently projects need to be managed as social collaborations to achieve higher overall performance. This is different from traditional project management which focuses on efficiency by making decisions on project constraints. Social network analysis place more emphasis on developing teams which share common values and trust among the participants. In this team climate team members actively support others by their own expertise as they are motivated to excel. But on the other hand, Chinowsky *et al.* (2008) also pointed out that the networks in construction industry less cohesive as the connected participants have individual criteria to measure their success which can be different from overall project and network success. The density of the network, which is measured by the overall

connections between all participants, becomes an important indicator to evaluate the network's performance. Chinowsky *et al.* (2008) presented their thoughts on project teams from a social network perspective as a model which is discussed below.

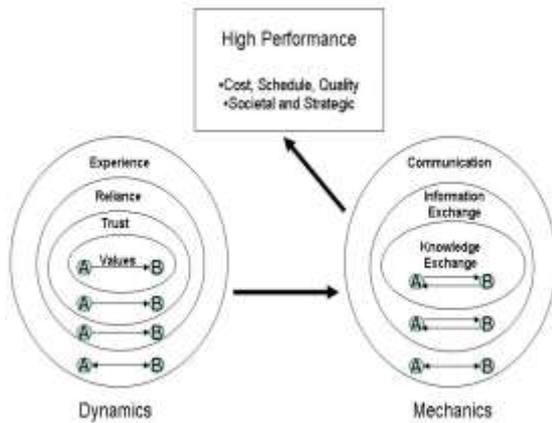


Figure 1: The Social Network Model for Construction, Chinowsky *et al.* (2008)

This model starts with a dynamic component with several layers. A project team, as temporary social connections, can progress from sharing experience to sharing value to become closely connected social network. The mechanics part focuses on the information and knowledge that is exchanged during the completion of the project. Chinowsky *et al.* (2008) consider that the latter component is one step closer to achieve high performance project outcome. Social network at this component progresses from basic communication towards knowledge exchange. Though Chinowsky *et al.* (2008) established a model to assess the strengths and weaknesses of the project team as a social connection, it is difficult for the participants to separate these concepts in the two components. A conversation as a communication can convey information and knowledge. A piece of information can become knowledge where the information can provide a specific answer to a question which leads to a subsequent solution.

The study by Chinowsky *et al.* (2008) focuses the interrelationships between project team members and the social network analysis is used to evaluate the ties between individual team members. In fact, social network analysis can also be applied to analyse the relationships between groups, organisations, or even countries. In order to compare the difference of the organisational social interactions between traditional and innovative project procurement systems, Pryke (2004) applied social network analysis in the construction project context with special emphasis on project coalition. Different from the study by Chinowsky *et al.* (2008), Pryke (2004) examined social ties between project organisations. According to Pryke (2004) the analysis of construction project governance at the interpersonal level sacrifices the opportunity to understand the impact of institutional relationships derived from performance incentives and contractual relationships.

Pryke (2004) considers degree centrality as an effective means to measure power and influence of an organisation. The degree centrality can be understood as in a given network, an organisation has higher degree centrality if it has more ties than other organisations. Pryke (2004) suggested that a multi-layer of interdependent networks within project coalitions should be explored as the following:

- Networks of contractual relationships;
- Networks of performance incentives;
- Networks of information exchange, sub classified

into:

- Client requirements;
- Design activities;
- Progress management; and
- Financial management. (p.795, Pryke, 2004)

However, Pryke ignored the fact that the effective application of social network is to look into social interactions based on informal relationships. For example, social network can analyse how some people can become powerful with their social ties, even they do not have any formal authority can be found from organisational chart. These kinds of informal relationships, which social network analysis investigates, do not follow the formal relationship channels such as organisational chart and business contracts. Networks contractual relationship and performance incentives should be applied to determine the whole network boundaries rather than to establish the ties between firms as those relationships can be defined by traditional analytical methods. In a similar research which also examined collaborative working in the construction sector, Songer *et al.* (2009) adopted another measurement from social network analysis which is density. Density is the percentage of all actual ties out of all possible ties in a given network which describes how dense a network is. In their study, the company with least people (26) has the highest trust and monthly communication density which can be understood as this smallest company has more flat structure and more people are involved into communication process, rather than its employees are more closely connected.

In a recent research into project success in the UK construction industry, El-Sheikha and Pryke (2010) adopted social network analysis to map the communication pattern which has significant impact on client satisfaction and subsequently project success. El-Sheikha and Pryke (2010) considers the application of social network analysis can analyse the systems associated with delivering project through:

- Addressing problems at early stages and thus minimising any client surprises;
- Identifying and improving information exchange networks (Pryke, 2004b) and reducing any possible discontinuity in financial incentives; and
- Achieving a balance between social and scientific aspects in management of projects.

However, social network is analytical in nature which can indicate the social network pattern and attributes under investigation, but it can be questioned how this analytical tool can be used to 'improve information exchange networks' and 'reducing discontinuity in financial incentives' as social network analysis by itself does not provide any control methods. El-Sheikha and Pryke (2010) constructed information exchange networks between a range of project actors comprising of Architect, Construction project manager, Employer's agent, Quantity surveyor, Contractor, Service engineer, Structural engineer. Not only are the networks are differentiated the foci on project time, cost and scope, but also the informal and formal discussions are distinguished to construct two networks. Nevertheless, it is not clearly explained in their research what kind of discussion should be considered 'informal' if the

discussions are about project delivery which is directly associated with contractual relationships and responsibilities. Meanwhile, the density of communication in this review is considered as a major means to evaluate the relationships between different actors, without acknowledging that communication frequency is not always directly linked with support and close relationships. Some actors in a network can communicate less than others due to closer relationships and shared understanding.

SOCIAL DIMENSION MATTERS: THE WAY FORWARD

The paper has reviewed relevant concepts in social network analysis and its application in the UK construction context. The UK construction industry has adopted a number of management methods and analytical tools from other disciplines and industries, such as Total Quality Management, Supply Chain management. Not surprisingly, it takes some efforts to apply those methods in the construction context due to the special characters of construction management. It is generally agreed that social network analysis provides a quantitative tool to analyse interactions between actors in project management process in construction industry; the actors can be either individual persons or organisations. The connections of the social network between all the participants are established by the participant themselves in the context of project process and there is no exploration of 'social' dimension in larger social context, where participants establish or reinforce their social ties in social interactions. It can be said that the analysis of social networks in construction industry merely measures relations at the micro level where the ties of individuals are examined, the macro structure, such as subgroups of special interests, cannot be revealed.

This reflects that the current applications of social network analysis are limited to one-mode social networks, where a set of actors are linked by predefined ties. From the studies reviewed, the ties can be information, discussion, supportive activities etc. The application of two-mode social network analysis has not been explored in construction industrial context. Basically the two-mode social network analysis has two sets of actors and the ties between actors in one set are created by investigating their relationships to the other set. For example, a group of people can be considered as one set of actors and a range of social events can be considered as the other one. The ties between people are created by whether they are present at those events. The reason behind this approach is that 'individuals, by their agency, create social structures while, at the same time, social structures develop an institutionalised reality that constrains and shapes the behavior of the individuals embedded in them' (Hanneman and Riddle, 2005). Therefore, data like these involve two levels of analysis (or two "modes"). Normally, the term "affiliation" is used to describe which actors are affiliated (present, or members of) which macro structures. This approach can look into the social dimension and how individuals make meanings of the events or groups in a social context.

CONCLUSION AND RECOMMENDATIONS

Though the social network analysis is considered as a relatively new approach in construction industry, it meets the trend that the research foci in construction discipline is shifting from economic activities to a larger extent to include some social dimensions. However, this paper reveals that the application of the social network analysis in construction industry needs more considerations in research design. Moreover, the current application of social network analysis in construction industry is limited on ties established within workplace, the ties created or reinforced in social context remain unexplored. The advantages of social network analysis are not fully

realised. Therefore, further researches are needed to realise the full potential of social network analysis in construction industry.

REFERENCES

- Chinowsky, Paul S. Diekmann, James, and Galotti, Victor (2008), "The Social Network Model of Construction," *Journal of Construction Engineering and Management*, **134**(10), 804-810.
- Cross, R., Parker, A., Prusak, L and Borgatti, S. (2001), "Knowing What We Know: Supporting Knowledge Creation and Sharing in Social Networks", *Organizational Dynamics*, **3**(2), 100-120. (Re-printed in Darden Learning Primer and Creating Value with Knowledge: Insights from the IBM Institute for Knowledge-Based Organisations.)
- Cross, R. and Prusak, L. (2002), "The People That Make Organisations Stop – Or Go", *Harvard Business Review*, **80** (6).
- Egan, J (1998) *Rethinking construction: the report of the Construction Task Force to the Deputy Prime Minister, John Prescott, on the scope for improving the quality and efficiency of UK construction*, London: Department of the Environment, Transport and the Regions Construction Task Force.
- Freeman, L. C. (2005), "Graphic Techniques for Exploring Social Network Data", in Carrington, P. J., Scott, J. and Wasserman, S. (Eds), *Models and Methods in Social Network Analysis*, Cambridge University Press, NY, USA.
- El-Sheikha, A and Pryke, S (2010), "Network Gaps and Project Success", *Construction Management Economics*, **28** (12), 1205-1217.
- Grandori, A. and Soda, G. (1995), "Inter-Firm Networks: Antecedents, Mechanisms and Forms", *Organization Studies*, **16** (2) 183.
- Granovetter, M. (1985), "Economic Action and Social Structure: The Problem of Embeddedness", *American Journal of Sociology*, **91** (3), 481-510.
- Gordon, I. R. and Mccann, P. (2000), "Industrial Clusters: Complexes, Agglomeration and/or Social Networks?", *Urban Studies*, **37** (3), 513-532.
- Gulati, R. (1998), "Alliances and Networks", *Strategic Management Journal*, **19** (4), 293-317.
- Gulati, R., Nohria, N. and Zaheer, A. (2000), "Strategic Networks Strategic", *Management Journal*, **21**(3), 203-216.
- Hanneman, R. A. and Riddle, M. (2005), *Introduction to Social Network Methods*, University of California, Riverside, Riverside, CA, USA.
- Kogut, B. (2000), "The Network as Knowledge: Generative Rules and the Emergence of Structure", *Strategic Management Journal*, Special Issue, **21**, 405-425.
- Koka, B. R. and Prescott, J. E. (2002), "Strategic Alliances as Social Capital: A Multidimensional View", *Strategic Management Journal*, **23**, 795-816.
- Latham, M (1994) *Constructing the team: final report of the government/industry review of procurement and contractual arrangements in the UK construction industry*, HMSO, London, UK.
- Lipnack, J. and Stamps, J. (1997), *Virtual Teams : Reaching across Space, Time, and Organizations with Technology*, J. Wiley, Chichester, New York, USA.
- Miles, G., Miles, R. E., Perrone, V. and Edvinsson, L. (1998), "Some Conceptual and Research Barriers to the Utilization of Knowledge", *California Management Review*, **40** (3), 281-288.

- Nohria, N., Eccles, R. G. and Harvard Business, S. (1992), *Networks and Organizations : Structure, Form, and Action*, Harvard Business School Press, Boston, Mass, USA.
- Pryke, S. D. (2004), "Analysing Construction Project Coalitions: Exploring the Application of Social Network Analysis", *Construction Management and Economics*, **22**, 787-797.
- Powell, W. W. (1990), "Neither Market nor Hierarchy: Networks Forms of Organization", in Staw, B. M. and Cummings, L. L (Eds), *Research in Organizational Behavior*, **12**, JAI, Greenwich, Connecticut, 295-336.
- Reich, R. B. (1991), *The Work of Nations: Preparing Ourselves for 21st-Century Capitalism*, New York, USA.
- Seufert, A., Von Krogh, G. and Bach, A. (1999), "Towards Knowledge Networking", *Journal of Knowledge Management*, **3** (3),180-190.
- Siebert, H. (1991), "Konomische Analyse Von Unternehmungsnetzwerken" in Staehle, W. H. and Sydow, J. (eds), *Managementforschung*, 1, DeGruyter, Berlin, New York, 291-311.
- Sydow, J. (1992), *Strategische Netzwerke. Evolution Und Organisation*, Gabler, Wiesbaden.
- Thorelli, H. B. (1986), "Networks: Between Markets and Hierarchies", *Sloan Management Review*, 737-751.
- Tichy, N., Tushman, M. and Fombrun, C. (1979), "Social Networks Analysis for Organizations", *Academy of Management Review*, 4, 507-519.
- Wang, Y., Ahmed, P. K. and Worrall, L. (2004), "Understanding Inter-Firm Network: A Theoretical Review", *International Journal of Management Concepts and Philosophy*, 173-98.
- Wasserman, S. and Faust, K. (Eds.) (1994), *Social Network Analysis: Methods and Applications*, Cambridge University Press, Cambridge, UK.
- Williamson, O. E. (1994), *Comparative Economic Organization: The Analysis of Discrete Structural Alternatives Occasional Papers*, International Center for Economic Growth, ALL.