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Social network analysis of international construction joint venture project: a case study in Thailand
SOCIAL NETWORK ANALYSIS OF INTERNATIONAL CONSTRUCTION JOINT VENTURE PROJECT: A CASE STUDY IN THAILAND

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ABSTRACT

‘International Joint Ventures’ (IJVs), which are a specific type of strategic alliance between contractors from developed and developing countries, have been increasingly used. IJVs between multinational organisations are considered to be a successful strategy in order to benefit from international market opportunities in the globalised world. International Construction Joint Ventures (ICJVs) have become of significant interest as the global construction market continues to be integrated into the more competitive business environment. The aim of this paper, which is part of a Ph.D. study, is to uncover the knowledge transfer practices in an ICJV using Social Network Analysis (SNA). The case presented here is the pilot study. A total of 19 questionnaire surveys were undertaken with selected team members. UCINET 6.0, an SNA package, was used to analyse the collected data. NetDraw was used to visualise the sociogram. This paper first presents the Actors’ Attributes Then, Social Network Characteristics that consist of Network Structure, Network Density and Degree of Centrality, and Cliques of actors are presented. This analysis will be used to identify the key actors that influence the knowledge transfer processes in this pilot case study.

Keywords: international construction, joint venture projects, key actors, social network analysis, ucinet.

INTRODUCTION

Globalization has particularly strengthened over the last two decades. Strategic alliances have been widely discussed in the context of international businesses (Carrillo, 1996). The Joint Venture Company (JVC) is the most ordinary form of organizational structure where the parties wish to establish and operate a jointly owned business (V.V. et al., 2000). In recent years, companies around the world are trying to expand internationally through a collaborative agreement. International Joint Ventures (IJVs) are considered to be a business arrangement for companies to enlarge their international activities and business. The trend towards forming IJVs has become increasingly common since the 1970s (Ozorhon et al., 2007, Ozorhon et al., 2008). It is clear that construction firms are able to exploit business opportunities and enter new markets abroad through the formation of IJVs. International Construction Joint Ventures (ICJVs) have become of significant interest as the global construction market...
continues to be integrated into a more competitive and turbulent business environment. The number of ICJVs is growing worldwide, especially in developing countries (Mohamed, 2003). A critical review carried out by Grimschseid and Brokmann (2010) highlighted that an ICJV often faces a highly complex and dynamic environment. They have increasingly become a notable form of international market growth for multinational organisations attempting to exploit opportunities in both developing and developed businesses (Gale and Luo, 2004, Abdul-Aziz and Cha, 2008). Moreover, the number of ICJVs is growing worldwide, especially in developing countries. The aim of this paper, which is part of a Ph.D. study, is to uncover the knowledge transfer practices in an ICJV using Social Network Analysis (SNA). The pilot study is presented here. The findings will reveal the relationships between each actor in the network and the key actors within ICJV project in the context of knowledge transfer.

LITERATURE REVIEW

In this new era of globalization, it is undeniable that many more firms have come to rely on alliances as a strategic necessity for sustaining competitive advantage and creating customer value through knowledge sharing and transfer. Many organisations have successfully shared and transferred expertise between individuals and units. Individuals share their knowledge in order to generate new knowledge. Actor attributes and interpersonal relationships among actors represent the individuals and the links between them. These interpersonal relationships affect the exchange of information and knowledge in projects. In this study, the Social Network Analysis (SNA) was carried out in order to map the ties that exist between the local company and the IJV partner, analyse them to establish how knowledge is transferred within ICJV projects and to identify the experts involved in knowledge transfer. Thus, it was considered important to collect data on actor attributes such as the age, nationality, qualifications, job position, work experience, and attitude of the participants before referring to other information such as their nationality, educational background, and expertise to explore the influence of these attributes on the knowledge transfer processes in ICJV projects.

To understand how successfully a team transfers knowledge, it is important to examine the process in more detail. Efficient knowledge flow in a team’s development cycle frequently requires overcoming problems which affect the team, the relationship between the team and other functions inside and outside the organisation. Social networks among knowledge actors can be defined as ‘knowledge networks’. Therefore, the social network perspective should allow analysing the knowledge transfer between actors and groups. SNA has been used to generate, visualise and analyse networks of research collaboration. It focuses on the characteristic of ties within a set of social actors, e.g., persons, groups, organisations, activities and so on. It is linked to the significance of relations among social actors to their behaviour, opinions, and attitudes. Characteristics of the social actors, for instance, actors in the network, and the intensity, frequency, valence, or type of social-relation are represented by line weights, line values, line signs, or line types (Wasserman and Faust, 1994). Wasserman and Faust (1994) pointed out that there are two key measures of social networks e.g. network density and network centrality that affect performance and can derive from using social network analysis. One of the keys extensively used social network measures is network density. ‘Network density’ is a
measure of cohesion and shows the strength of relations between network members. It represents the extent of how densely and cohesively nodes in a network are interconnected (Pryke, 2012). Likewise, network density is the total number of links between the nodes of a network. Density is calculated by dividing the number of existing ties by the number of maximum possible ties. The density varies ranging are between 0.0 (no connection in a network) and 1.0 (every node is interconnected). A high-density network with 1.0 represents a cohesive organisation and means all nodes are linked to each other in the network (Park et. al, 2011). A person’s degree centrality is a second measure which shows whether that person is in a gatekeepers or knowledge broker’s position between two subsets of members, and therefore can be used to provide needed knowledge for one of the subsets. ‘Degree centrality’ is an indicator that describes the social power and the influence of node based on how well connected the node is in the network. Degree centrality can be divided into out-degree and in-degree centrality. Out-degree centrality is the number of the links initiated by a node (actor) and also decided by an actor’s subjective opinion. In-degree centrality refers to the number of links received by a node (actor) and shows how an actor is recognised by others (Tan, 2014). In the SNA literature, authors suggest that in-degree centrality would be more appropriate to measure the centrality of an individual in terms of retrieving knowledge or information. Furthermore, centrality tends to be viewed as a positive aspect of nodes, providing actors with the opportunity to influence others and receive flows (including information, material, and support) (Park et al., 2011). It also indicates the important because a large number of ties in the network are linked to it. A node may be highly central in terms of being well positioned to bridge different nodes, or it may be central to being able to control the flow of the information in its way. Moreover, a group of project members who have all possible direct ties among themselves and create a maximum complete subgroup can be seen as a clique. ‘A clique’ is a subset of actors in the network whereby every actor is close to another in the subset. In addition to analysing the factions, a clique analysis was conducted to identify the informal subgroups that exist in the team (Borgatti, Everett and Johnson, 2013). Thus, network density, degree centralisation and clique in the network were selected as the key indicators in this pilot study.

METHODOLOGY

Data collected during the pilot case study will be analyses and presents in this paper. Data collection was undertaken in a construction company which has joint-venture agreements in THAILAND with other foreign companies. A pilot questionnaire survey was administered to a sample of managerial and professional staff of the ITD-ETF Joint Venture Company, which is the cooperation company between the Italian-Thai Development Company Limited (ITD) (65% of holding) and Eurovia Travaux Ferroviaires (ETF) (35% of holding). This ICJV project is the Track Rehabilitation Project (Phase 5) worth £170 m. It was completed in 2014. The participants in this research were recruited by the project manager using a project organisation chart. The selected team members included project directors, managers, senior engineers and those responsible for the day-to-day delivery of this project. A total of 19 questionnaire surveys were undertaken with selected team members from a local and a foreign company. Data was collected from April 2016 to July 2016. It was mostly collected in an office on the construction site. UCINET 6.0, Social Network Analysis (SNA) package (Borgatti, Everett and Freeman, 2002) was used to analyse the collected data. NetDraw was used to visualise the sociogram (Borgatti, 2002). This
pilot study yielded context-specific findings on the impact of three SNA metrics, i.e. density, centrality and clique, on knowledge transfer practices. It has also enabled the PhD researcher to refine the approach to data analysis.

CASE STUDY RESULTS/ ANALYSIS AND DISCUSSION

Actors’ Attributes

Managerial and professional staff from two different countries participated in this study, 5.26% of participants were French from the foreign company and 94.74% Thais from the local company. 42.11% of the participants were aged between 26 and 30, 15.79% between 31 and 40 and 41 and 50, and 26.32% between 51 and 60. Teerajetgul et.al (2009) and Piyanut et al. (2009) pointed out that individuals’ educational background and job position have an effect on their perception of knowledge and experience. Educational background of the research participants fluctuated between 10.53% with a certificate, 15.79% with a postgraduate degree and 73.68% with an undergraduate degree. Survey results reveal that different stakeholders’ expertise lies in various fields i.e. senior engineer (5.26%), warehouse staff (5.26%), vice president (5.26%), project engineer (10.53%), supervisors (10.53%), project manager (21.05%) and engineers (42.11%). Their experience in the construction industry ranges from less than 5 years to more than 20 years, i.e. <5 years and 6-15 years (36.84%), 15-20 years (10.53%) and >20 years (15.79%). Most of them have <5 years and 6-15 years’ experience. This project is a Track Rehabilitation Project (Phase 5). Perhaps as a result of the nature of the project, most of the participants belong to the Mechanical engineering discipline (52.63%), reflecting the knowledge, skills, and experience required for the project. The second highly represented discipline is Civil engineering (26.32%) and the third is Electrical engineering (10.53%).

This section collected the data on actor attributes of project participants. The actors’ attributes examined their nationality, age, education background, job position and their experience. There was only one participant from a foreign company and holding a position as a project manager in this ICJV project. Most of the research participants were aged between 26 and 30. Most of the participants held an undergraduate degree and a position as an engineer in this project. One of the engineers and two project managers have postgraduate degrees. Additionally, the results show that most of the managerial staff in this case study have <5 years and 6-15 years’ experience in the construction projects and mechanical engineering is the bulk of respondents in this ICJV project because they have more knowledge, skills, and experience of how to manage and construct in this kind of project. Based on the data gathered for this paper, it seems that ‘educational background’ was not related to their ‘job position’.

Social Network Characteristics

Network Structure, Network Density, and Degree of Centrality

This network is comprised of 71 nodes, but only 19 of them are research participants. The other 52 were named by them. The network boundary is defined as all the participants from the organisation chart of this project. As a result, there are 19 participants in this case study. The networks are illustrated in Figure 1-2. The network structure in this case study consists of one main component, which includes people in
the following positions: Asian Director (AD), Senior Vice President (SVP), Project Managers (PM), Manager (M), Project Engineers (P Eng), Senior Engineer (S Eng), Engineers (Eng), Supervisors (Sup), Technician (Tech), Operation (OPT), Administration (Admin), and Heads of Warehouses (HW).

Figure 1: Sociogram showing network density according to SNA restricted to a position.

Figure 1 presents the network structure and the strength of the ties between nodes (actors) in this project. It shows that there are strong links between engineers, project engineers, project managers, and supervisors. They seek to acquire knowledge from each other every day or more than once a day.

Density refers to the number of links that exists in the network and helps to define the clusters. The network density of this network is 0.005 with the standard deviation of 0.068. The network density would be 1.00 if every actor within the team were connected. As the network density is 0.005, it can be deducted that all possible connections have not been made in this network. It is important to analyse centrality measures in order to examine which actor is more central and more strongly linked than others with regard to knowledge transfer in ICJV projects. Knowing who is central is important (Borgatti, Everett and Freeman, 2002), and centrality is interpreted in a wide variety of ways. Actors refer to central nodes as a key person, or influence, leaders, gatekeepers, knowledge broker, or as having great control, involvement, power, and so on. A node may be highly central in terms of being well positioned to
bridge different nodes, or it may be central to being able to control the flow of the information in its way (Park et al., 2011).

Figure 2 shows the network map with different node sizes. The node sizes are in accordance with the average degree of centrality of the actors. The larger nodes are the more central ones in term of knowledge transfer within the team. Most of the larger nodes are the local staff involved in this ICJV project. The most central actors for out-degree and in-degree centrality are shown in Table 1. Degree centrality immediately links the distance from each actor to all others in the network.

![Network Map](image.png)

Figure 2: Sociogram showing network centrality in this project

<table>
<thead>
<tr>
<th>Actor</th>
<th>Position</th>
<th>Years of experience</th>
<th>Out-Degree</th>
<th>In-Degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>P Eng2</td>
<td>Project Engineer</td>
<td>6-15</td>
<td>45 (1)</td>
<td>23 (2)</td>
</tr>
<tr>
<td>PM5</td>
<td>Project Manager</td>
<td>15-20</td>
<td>15 (2)</td>
<td>21 (4)</td>
</tr>
<tr>
<td>Eng08</td>
<td>Engineer</td>
<td>6-15</td>
<td>14 (3)</td>
<td>3</td>
</tr>
<tr>
<td>S Eng1</td>
<td>Senior Engineer</td>
<td>15-20</td>
<td>13 (4)</td>
<td>22 (3)</td>
</tr>
<tr>
<td>Sup2</td>
<td>Supervisor</td>
<td>&gt; 20</td>
<td>12 (5)</td>
<td>24 (1)</td>
</tr>
<tr>
<td>Eng06</td>
<td>Engineer</td>
<td>6-15</td>
<td>12 (5)</td>
<td>15</td>
</tr>
<tr>
<td>Sup1</td>
<td>Supervisor</td>
<td>&gt; 20</td>
<td>12 (5)</td>
<td>3</td>
</tr>
<tr>
<td>Eng09</td>
<td>Engineer</td>
<td>6-15</td>
<td>10</td>
<td>19 (5)</td>
</tr>
<tr>
<td>PM4</td>
<td>Project Manager</td>
<td>15-20</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td><strong>PM1 (Foreign actor)</strong></td>
<td>Project Manager</td>
<td>6-15</td>
<td>6</td>
<td>18 (6)</td>
</tr>
<tr>
<td>P Eng1</td>
<td>Project Engineer</td>
<td>15-20</td>
<td>5</td>
<td>21 (4)</td>
</tr>
<tr>
<td>SVP1</td>
<td>Senior Vice</td>
<td>&gt; 20</td>
<td>2</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 1: Degree of Centrality in the pilot case study
The out-degree is the total number of other nodes to which a node is directly tied, while the in-degree of an actor is the total number of other nodes which ties to it. The out-degree presents how many other actors a node seeks knowledge from this ICJV project, while the in-degree shows the number of people who ask a particular actor for advice. Individuals with high in-degree centrality in Table 1 are regarded as experts in this project. Actors with high in-degree and out-degree centralities are considered to be knowledge brokers or experts. As a result, Sup 2 and P Eng2 are regarded as overall experts who can answer any questions. S Eng1, PM5, P Eng1, Eng09, and PM1 have slightly lower in-degree centralities than Sup 2 and P Eng2. Given the demographic characteristics and the centrality results in Table 1, it could be argued that becoming a gatekeeper or a knowledge broker not associated with hierarchical position, years of experience or age.

Based on the data gathered in this study, this outcome could indicate that supervisor (Sup 2) and project engineer (P Eng2) is knowledge holder who their colleagues ask for advice in this project. Sup 2 has the highest in-degree centrality. It means that he is getting a lot of enquiries from his colleagues. It could be argued that Sup 2 is an expert in this project. However, project engineer (P Eng2) has the largest out-degree centrality. P Eng2 is receiving a lot of knowledge. P Eng2 is not only regarded as a knowledge broker but P Eng2 is also regarded as a gatekeeper in receiving and disseminating knowledge to contact with any queries. This outcome could be argued that P Eng2 is also an expert in this project. Moreover, this research established that Sup 2 is disseminating the knowledge to Senior Vice President (SVP1), Project manager (PM1) of a foreign company and Project manager (PM5) of a local company. He is sharing the knowledge and experience on construction techniques and equipment, investment in the construction sector, financial backing and support, local business practice and product process and development to PM1. On the other hand, Sup 2 is receiving the knowledge and experience of construction resources such as materials, equipment and tools from PM1. P Eng2 is receiving the knowledge of management expertise i.e. project planning and control, project resource management, human resource management and development, organisational management, and construction resources i.e. product process development from PM1.

Teerajetgul et.al (2009) stated that the project manager must take the initiative in the knowledge management culture for knowledge sharing and creation in the construction project. In contrast, project managers from both local and foreign partner do not appear to play a significant role in terms of knowledge transfer in this ICJV project. This is despite the expectation that staff from a foreign partner (originally established in a developed country) would be expected to have significantly more experience and knowledge than local staff (Evangelista, 2007).

**Cliques of the network**

A clique is a subset of actors in the network whereby every actor is close to another in the subset and it is defined as a maximum complete subgraph (Borgatti, Everett and Freeman, 2002). Moreover, the clique co-membership matrix is a proximity matrix in which larger values indicate a stronger link (Borgatti, Everett and Johnson, 2013). In addition to analysing the factions, a clique analysis was conducted to identify the informal subgroups that exist in the team. However, cliques can overlap so that
individual actors can be in more than one clique. Table 2 indicates that 24 cliques exist in the network, each of which consists of three or more members.

Table 2: Results of Clique Analysis Showing Members of Each of the 24 Cliques

<table>
<thead>
<tr>
<th>Cliques</th>
<th>Actors</th>
<th>Cliques</th>
<th>Actors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Eng06 SEng1 Sup1 Sup2</td>
<td>13*</td>
<td>Eng09 PEng1 PEng2 PM1</td>
</tr>
<tr>
<td>2</td>
<td>Eng07 SEng1 Sup2</td>
<td>14</td>
<td>Eng09 F2 PEng2</td>
</tr>
<tr>
<td>3</td>
<td>Eng04 SEng1 Sup2</td>
<td>15</td>
<td>Eng09 F3 PEng2</td>
</tr>
<tr>
<td>4</td>
<td>M15 Sup1 Sup2</td>
<td>16</td>
<td>Eng09 F1 PEng2</td>
</tr>
<tr>
<td>5*</td>
<td>PM1 PM5 Sup2</td>
<td>17</td>
<td>Eng06 F4 PEng2</td>
</tr>
<tr>
<td>6</td>
<td>Eng06 PM5 Sup2</td>
<td>18</td>
<td>Eng04 OPT4 SEng1</td>
</tr>
<tr>
<td>7</td>
<td>PM5 PML Sup2</td>
<td>19*</td>
<td>PEng1 PEng2 PM1 PM5</td>
</tr>
<tr>
<td>8*</td>
<td>AD PM1 SVP1</td>
<td>20</td>
<td>PEng1 PEng2 SEng1</td>
</tr>
<tr>
<td>9*</td>
<td>Eng2 Eng08 PEng2 PM1 PM5</td>
<td>21*</td>
<td>PEng2 PM1 PM5 SVP1</td>
</tr>
<tr>
<td>10</td>
<td>Eng03 Eng10 PEng2</td>
<td>22</td>
<td>Eng06 PEng2 PM5</td>
</tr>
<tr>
<td>11</td>
<td>Eng05 PEng1 PM5</td>
<td>23</td>
<td>Eng06 PEng2 SEng1</td>
</tr>
<tr>
<td>12</td>
<td>Eng09 Eng10 PEng1 PEng2</td>
<td>24*</td>
<td>PM1 PM2 SVP1</td>
</tr>
</tbody>
</table>

*Mixture of local and foreign partners

According to Table 2, actors P Eng2 and Eng09 are in five different cliques together, indicating that this pair is important within the group and are possibly taking on some kind of leadership role. Actors PM1 and PM5 are similarly highly active and also taking on some kind of leadership role. In addition, Figure 3 and Table 2 indicate that a clique 9, 12, 13, 19 and 21 are a strong link in this project. Nevertheless, cliques 5, 8, 9, 13, 19, 21 and 24 are a mixture between local and foreign partners in terms of transferring and acquiring knowledge. It should be noted that Clique 8 is formed of the foreign partner (AD), his Project Manager (PM1) and the Senior Vice President (SVP1) of the local partner. It seems clear that SVP1 must be knowledgeable enough to close a knowledge gap between partners. As a result, it can be assumed that SVP1 is regarded as a gatekeeper in receiving and disseminating knowledge to contact with foreign partners.
Based on the data gathered in this study, the results reveal that supervisor (Sup 2) has the highest in-degree centrality. This outcome could indicate that Sup 2 can be regarded as a gatekeeper or knowledge broker in disseminating knowledge in this ICJV project. Project Engineer (P Eng2) has the largest out-degree centrality and P Eng2 is receiving a lot of knowledge. P Eng2 is also regarded as a gatekeeper or knowledge broker in receiving and disseminating knowledge to contact with any queries. This outcome could be argued that Sup 2 and P Eng2 are regarded as an expert in this project. Moreover, this research established that Sup 2 is often disseminating the knowledge to SVP1 and the Project managers from a foreign company (PM1) and a local company (PM5). Furthermore, the SVP1 and the Project Manager of the business unit (PM2) also occupy a position in the network where they are closely related to the foreign partners. It could be assumed that SVP1 is regarded as a key player in this project. Teerajetgul and Charoenngam (2006) noted that project manager is the ability to initiate and implement knowledge sharing to encourage team members. As a result, it can be assumed project managers (PM1, PM2 and PM5) are defined as a key player in this project.

CONCLUSIONS AND RECOMMENDATIONS

In summary, SNA was carried out in order to map the ties that exist between the parent company and the IJV partner. These ties were analysed to establish how knowledge is transferred within this ICJV project and to identify the experts involved in knowledge transfer. Evangelista (2007) states that the process of transferring knowledge between partners certainly involves two key players; the local and the foreign partner. The result of knowledge acquisition depends on the effort of both partners. In order to close the knowledge gap between partners, the local and foreign partner should aggressively seek to acquire knowledge from their partner.

The most likely explanation for this pilot study is that the actors from developing country (local partner) may be significantly less knowledgeable and experienced than a developed country. Thus, the local partner should aggressively seek to acquire knowledge and skills from their partner. Cultural distance (i.e. languages, norm or meanings) can be defined as one contextual factor that influences knowledge transfer between them. A foreign partner that comes from different cultures will also have different mother tongues which may cause communication difficulties. It seems clear that linguistic misunderstanding impacts on the flow of knowledge and communication. It also raises barriers to understanding and identifying the meaning of the foreign’s members. Furthermore, the effectiveness of transferring and acquiring knowledge through ICJV projects does not entirely rest on the learning capabilities of local actors. It also depends on the source of knowledge from foreign personnel who work at the contact point with the local partner. There are only two representative actors from the foreign partner involved in this ICJV project and only one foreign actor worked at the contact point with a local partner. The reason for this might be probably that project manager (from foreign partner) might not be known enough to close a knowledge gap between actors in this ICJV project.

The aim of this Ph.D. study is to uncover the processes of transferring knowledge in an ICJV project using Social Network Analysis (SNA). The results presented in this paper went someway to illustrate the key characteristics of knowledge transfer in this
ICJV project. In-depth interviews with key actors will be carried out in order to identify key enabling and inhibiting factors that influence knowledge transfer process in ICJV projects in the next phase of this research.

REFERENCES


