Building Supply Chain Capital through Knowledge Management in Construction Industry

Khalfan, M.M.A
School of Property, Construction, and Project Management, RMIT University, Melbourne, VIC Australia
(email: malik.khalfan@rmit.edu.au)

Maqsood, T.
School of Property, Construction, and Project Management, RMIT University, Melbourne, VIC Australia
(email: tayyab.maqsood@rmit.edu.au)

Abstract

For last few years, researchers and people in construction practices have adopted different concepts and theories from other industries to bring improvements within the construction industry. Supply chain management is one of those concepts adopted and being translated to suit the construction industry. The recent emphasis is on the integration of the whole supply chain because of the fragmented nature of the industry, and also because of the large number of participants involved in a project. One of the aspects to achieve integration is by managing both tacit and explicit knowledge existed within a project supply chain through IT systems and social interaction. The main purpose of this paper is to develop a link between construction organisations and their learning activities as part of a supply chain of a project, resulting not only creating a learning organisation but also to create a learning supply chain. These learning supply chains, consist of learning organisations will create supply chain capital in order to promote innovation and creativity by managing knowledge in supply chains on long term basis. In addition, these learning organisations involved would also establish a virtual knowledge transfer between organisations and the supply chains they are involved. The paper also suggests that, as unit of competition changes from organisation vs organisation to chain vs chain under supply chain management, supply chain capital will become increasingly important for sustaining competition with construction industry. Therefore, supply chain capitals are to be created through managing knowledge in supply chains on long term basis that will facilitate innovation and creativity essentially required to thrive in the downturn business environment of today in many countries.

Keywords: supply chain integration, knowledge management, construction industry
1. Introduction

This changing face of the industry is giving an impetus to the proliferation of business philosophies such as organisational learning (OL) and knowledge management (KM) and supply chain management (SCM) which have their principles solely founded on the notion of trust, commitment and collaboration. Dodgson (1993, p. 377) describes learning organisations as purposefully constructing structures and strategies to enhance and maximise the way that they learn from their experiences and the experiences of others outside their organisations. He claims that they continually transform themselves through facilitating a climate where members are encouraged to learn and share knowledge, linking learning opportunities across the supply chain as well as with clients/customers, and creating development strategies for people and the business centred upon learning. This involves more than KM or SCM. The premise is that as SCM reinforces the concept of whole supply chains working collaboratively to obtain business benefits, KM principles adopted for the whole supply chain can unleash immense creativity and innovation providing significant competitive advantage to supply chain partners. The purpose of this paper is to develop a synergy between the approaches of knowledge management in a learning organisation and supply chain management so that learning chains and supply chain capital can be created in order to promote innovation and creativity by managing knowledge in supply chains on long term basis. This would result in the formation and building of what we would like to term as “supply chain capital”. A capital which trading partner can look to and rely upon in order to improve their combined performance and productivity and ensuring the project success at the same time.

2. Knowledge Management and Supply Chain Management

Both Knowledge Management (KM) and Supply Chain Management (SCM) have taken more than a decade to facilitate mature disciplines where they can be exploited for enhancing business profitability and value. KM is primarily concerned with the capture, codifying, transfer and sharing both tacit and explicit knowledge. Tacit knowledge is embedded in organisational routines and processes and employees heads. It is a very complex type of knowledge. The challenge of knowledge management is to make it explicit through the balanced use of technology, and soft human-related factors like leadership, vision, strategy, reward systems and culture. Explicit knowledge is the type of knowledge that is readily available in the organisation in the form of books, procedures and can be appropriately archived for use when required. An effective knowledge strategy is required to manage both tacit and explicit knowledge in the organisation. KM is about the processes by which knowledge is created, captured, stored, shared, transferred, implemented, exploited and measured to meet the needs of an organisation (Egbu et al., 2001).

The role of effective management of knowledge is evident in producing innovation, reducing project time, improving quality and customer satisfaction (Kamara et al., 2002; Love et al., 2003). Through knowledge management an organisation’s intangible assets can be better exploited to create value, with both internal and external knowledge being leveraged to the
benefit of the organisation. In projects, knowledge management can improve communications within teams, and provide more informed knowledge by sharing best practice documents, lessons learned, project management and system engineering methodologies, examples of review packages, and the rationale for strategic decisions. The failure to capture and transfer project knowledge leads to the increased risk of reinventing the wheel, wasted activity, and impaired project performance (Siemieniuch and Sinclair, 1999).

SCM is an evolved form of purchasing and logistics-related activities (Croom et al., 2000; Tan, 2001). For over a decade and half, the SCM literature shows a confusion of terminologies and definitions (New, 1997). Some of these include; integrated purchasing strategy, supplier integration, supply base management, buyer-supplier partnership, supplier alliances, supply chain synchronisation, network supply chain, value added chain, logistic integration, lean chain approach, supply network, value stream, etc. (Dyer et al. 1998; Nassimbeni, 1998; Ellinger, 2000) (Tan et al., 1998). While each term addresses elements of a phenomenon, typically focussing on immediate suppliers of an organisation, SCM is the most widely used (but often abused) term describing this process (Tan, 2001). The most realistic and comprehensive definition is provided by the Global Supply Chain Forum (GSCF), a group of non-competing firms and a team of academic researchers dedicated to improve the theory and practice of SCM. According to this group SCM is the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders (Lambert and Cooper, 2000). This sort of integration reduces the product delivery time, reduces waste, minimizes errors and saves on transactional costs thus increasing productivity.

3. Learning and innovation and their link with knowledge management

Love et al. (2000) noted that for learning to occur, there is need for processes and structure to be in place to help people create new knowledge, allowing them to continuously improve themselves and the organisation. Garvin (1998) identified the following five activities that an organisation in construction should be skilled at: (i) Systematic problem solving;

(ii) Experimentation with new approaches; (iii) Learning from their own experiences and past history; (iv) Learning from the experiences and best practice of others; and (v) Transferring knowledge quickly and efficiently through out the organisation.

Organisations that develop the capabilities to foster learning are referred to as Learning Organisation. Mirvis (1996) stated that the learning organisation focuses on managing chaos and indeterminacy, flattening hierarchies, and decentralisation. It also encourages the empowerment of people, teamwork and cross-functional teams, network relationships, adoption of new technologies and new forms of leadership and mentoring. Knowledge management is a key to learning organisation. It creates an environment of trust and commitment in the organisation which his helpful in creating and sharing new knowledge. The continuous change
in the organisation once it foster a learning environment through knowledge management would lead to an innovative output (Maqsood et al., 2002).

Innovation is a pre-requisite for competitive advantage (Egbru et al., 2001). Product innovation is a form of innovation where a new product is created, while process innovation is the exposition of the process to new ideas leading to an efficient method of production. Innovation can also be radical and incremental. Radical innovation results in total and sudden change of modus operandi while incremental innovation deals with step-by-step improvement. The unique tacit knowledge of individuals is a fundamental source of innovation (Stewart, 2000). People are the “champions” and “change agents” (Maidique, 1980; Rogers, 1995). They bring the change through social interaction and networking within and across organisations. (Egbru et al., 2001). Hence regulating this phenomenon through knowledge management and continually striving to convert their tacit knowledge into explicit will facilitate innovation. Such activities occur seamlessly if organisation is a learning organisation.

Figure 1 suggests that KM initiatives have the capacity to facilitate organizational learning and help it transform into a learning organizations. Such an organization will continually change and improve its capabilities leading to an innovative output every time thus maintaining its competitive advantage. This resonates with Cavaleri et al. (2005), who suggested that the simplest way to achieve the vision of a learning organisation is to integrate organisational learning processes with KM initiatives.

Figure 1: Link b/w KM, learning organization and innovation

4. The learning chain

In the construction industry, organisations come together with their specialities and knowledge to complete a construction project. Each organisation contributes its knowledge in a form of people, processes and technologies, to the construction process as shown in Figure 2. Traditionally, the selection of these organisations or trading partners is based upon a spot rate basis. This makes transactional exchange the dominant form of business in the construction industry (Dubois and Gadde, 2000). The suppliers’ competition in each transaction is assumed to be the most appropriate means of securing efficiency of operations. Therefore, actor constellations change all the time, making it difficult to utilise the experience gained in previous projects (Dubois and Gadde, 2000). Cox and Thompson (1997) observe that this creates inefficiencies as the supplier climbs a new learning curve for each project. SCM deals
with these problems by promoting relational contracting, long-term commitment and an atmosphere of high trust and commitment.

Through systematic knowledge management, trading partners are able to minimise wasteful activities and improve productivity and efficiency. Knowledge management, together with SCM, will ensure that knowledge, not information alone, is shared with the trading partners. Whereas the information may simply specify what is required of the trading partner, knowledge management can help to determine how best to deliver that product or ensure the swift availability of the related knowledge. Figure 3 gives the graphical description of two such trading partners who are bound together by trust and committed for long term relationship and have their key business process integrated under SCM. Each process gets assistance from a knowledge layer set under KM on the top of these processes.

The mechanism of this nature would ensure that best available knowledge is utilized to deliver the product and service and experiences gained on the projects would be efficiently stored and utilized throughout the supply chain. Spekman and Kamauff (1998) have presented another point of view based on which a trading partner can decide how much knowledge it wants to share with other trading partner. They distinguished between three modes of interaction, cooperation, coordination and collaboration with cooperation being the starting point of knowledge sharing while collaboration leads to maximum sharing of knowledge.

![Diagram](a)

Source: O’Brien et al. (2002)

Figure 2: (a) Construction process; (b) Supply chain in construction
Spekman and Kamauff (1998) argue that “cooperation” is the threshold level of interaction where firms exchange essential information and engage some suppliers/customers in longer-term contracts. The next level of intensity is “coordination” where specified workflow and information are exchanged in a manner that supports seamless linkages between and among trading parties. The final stage is “collaboration” whereby partners engage in joint planning and processes beyond levels that reaches in less intense trading relationships. Collaboration requires high levels of trust, commitment, and information sharing based upon partners who share a common vision of the future. An organisation may work at any of these three levels of trust and commitment with other trading partner to facilitate SCM, and may modify its selection after monitoring the interaction to observe change in the effecting factors. These various modes of interactions are in fact, limiting the magnitude of knowledge that can be shared with a specific trading partner. Knowledge management in this context would be helpful to provide detailed guidelines as to what sort of knowledge is appropriate to share in a certain mode of interaction. A supply chain exhibiting such characteristics can be termed as a Learning chain.

Figure 3: Trading partners adopting SCM and KM (Maqsood et al., 2007)

5. Creating Supply Chain Capital

As discussed above, bringing trading partners together on a long term basis in a relational contracting would result into an integrated supply chain which is learning from their previous jobs and cutting wasteful activities on their current jobs based on their past experiences. Since these organisations are working together with each other, their level of trust and commitment to each other grow stronger. They are continuously learning how to deliver the best value to their clients and on the other hand they better understand the culture and working practices of all their trading partners. The above discussion on a learning curve now start making sense because if they were to start all over again with new trading partners, it would take them another few years to reach their current level in understanding their trading partners, their way of working and expectation. Therefore, a contractor, who sticks to the same trading subcontractors on many projects, is not only building a better relationship with his trading
partners into an integrated supply chain but also creating a supply chain capital; a capital which has resulted from many years of collaboration and many years of knowledge & experience in a specific sector. This brings a competitive edge to the contractor and his integrated supply chain for future work because it would be an added advantage for a client to hire the contractor bringing integrated supply chain because they would not need time to settle down in terms of building understanding and relationship with each other and secondly, they have been doing similar projects for many years and already eliminated wasteful activities from their processes. We authors believe that the clients within the construction industry are now moving towards hiring well performing integrated supply chains which can save them higher construction costs and deliver projects on time and with required specification. In addition to this, clients are also looking for best value which comes through the knowledge capital, human capital of such integrated and learning supply chain thus resulting into supply chain capital – the added value which distinguishes them from all other service providers.

There are many examples especially from the UK construction industry. In general, the main contractor is the one who manages the relationship with trading partners in traditional contracting system. Moving away from traditional and adopting relational contracting scenarios, we would see Design and Build as one of those arrangements where client is establishing the requirement of having an integrated first tier supply chain with a single point of contact and responsibility. In last few years, we have seen many examples of Framework Agreements in the UK, where clients are making it mandatory for service providers to bid as an integrated supply chain for a programme which consist of many projects over a few years, thus creating the foundation of an integrated and learning supply chain. We have also seen in the case of NHS Procure 21 programme, the integrated supply chains which got the projects in the first cycle to deliver hospital projects, kept on getting projects one after another. The sole reason was that these supply chains were not only integrated but they were learning as well. Over a period of time, these supply chains had developed human capital, resource capital, knowledge capital in building/extending/refurbishing hospitals – hence created supply chain capital which served as added competitive edge for them to win more work and was seen by NHS as achieving best value through their experience and expertise.

5.1 Example: Local authority Framework Agreement for construction of schools

The case study was done with a public sector client, a local council in the UK, having a portfolio to deliver new and/or refurbished public facilities to the residents. This includes refurbishments of social housing stock, building primary and secondary schools within the area, etc. through its in-house development team which act as client by developing the specifications and allocating budget for different facilities. The council had developed a Framework Agreement (called framework 1) to construct educational buildings (primary schools) in the value range £500,000 to £5 m. For this client-led innovative and new way of developing educational infrastructure, which basically aimed at the process of getting product developed, three Constructor Partners with their integrated first tier suppliers were appointed in 2004 for three years initially, with further two more years of work after initial period. The council’s
vision was that this framework agreement would deliver good quality school buildings that will lead to (Khalfan and McDermott, 2006) better educational results; greater inclusion within the community; better safety and environmental performance; and reduced demand on future school budgets by addressing whole life cycle costing at the inception of the projects.

**Partner selection**

The council had changed the mechanism for selection of contractors and sub-contractors. It used to be the case that the small companies were rejected based on their turnover. Now the turnover figure was not used as part of the selection criteria for the above programme and was considered afterwards when the percentage of the work was allocated. Therefore, those companies, which used to be left out (specially the SMEs) because of their small turnover, were now able to pass through the initial two-stage selection process of the council, and then they were awarded work which was equivalent of 25% of their turnover (irrespective of how much it was). On the other hand, the selection was moved from traditional to Quality-Price Mechanism. The council used 70% - 30% respectively to select the companies for the framework agreement during the selection process.

**Specification and design**

The client procured main contractors in early stages through call offs within a framework agreement. The reason for this was so that the client could seek main contractors’ contributions in the design stage. All three contractors also brought along an integrated supply chain for the 1st tier, including the Design teams (both architectural and structural) and M & E Contractors. Hence, they all involved with the client to develop the plans for the school development.

**Selection of subcontractors**

For the lower tiers, the main contractors selected subcontractors from their lists of preferred suppliers. Selection was again done based on quality-price mechanism, but in many cases, lowest cost played primary role in the selection. In most of the cases, these lowest bidders were those trading partners, who had worked with the main contractors in the past on several projects and had knowledge regarding the organisational culture of main contractor, expectations, way of approaching projects, etc. These actors were not procured in early stages and they did not take part in planning and design for the above mentioned clients.

**Collaboration**

The core values of framework agreement, which are based on the partnering concept, agreed by the client and all other participants, include: Trust, Honesty, Openness, Commitment, Co-operation, and Respect. It was a client driven initiative, which involved all the parties (including three main contractors), resulting into sharing of knowledge and experiences on different platforms including project meetings. Unseen before in the construction was that representatives of all three contractors sat down together for selecting the standardised material
(e.g. windows, doors, etc), architects of all contracting organisations worked together to learn from each others’ design, and the learning from one project within the framework was taken back to the new projects through capturing the experiences and feedback of the people involved. There were also different Special Interest Groups (SIG’s) within the framework. They were designed to address issues that were impacting framework and project delivery across a global basis, i.e. impacting all or many projects within the framework. The special interest groups covered the following areas: IT; Contracts and admin; Design; Procurement and materials; and Operations.

**Payments and benefits**

The major benefits achieved in by adopting the strategic partnering framework for the development of Primary Schools were: Improved design by involving all “project knowledge” in early stages; Less waste and duplication; Improved delivery and quality; Greater certainty of cost and better whole life cycle costing; The framework agreement enhanced long-term collaboration among supply chain actors and knowledge retention between projects and actors; and Continuity of work for both main contractors and subcontractors was an attraction. They did not have to look for work because they got to know upcoming work around 12 months in advance.

**Performance evaluation**

The client used several performance measures in order to evaluate the efficiency of the relationships. The on-time delivery of material onsite, material ordering through e-procurement system in some cases, targets to reduce waste on site, client and user satisfaction surveys, smooth handover to the client and their representatives, and forecast accuracy in spending during the school development, were utilized as performances measuring factors for the involved organizations and their supply chain partners. A further service-related measure had been introduced by the client during the maintenance phase of the school. Introduction of post-construction Snag Period (12 month) would reduce the complaints from the end users (head and building in charge of the schools), resulting into much better response and solution to any problems occurring in the school building.

**Creation of supply chain capital**

In the above example, we saw, it was the client who took initiative to create learning and integrated supply chains (three of them), creating human and knowledge capitals within those supply chains resulting into formation of supply chain capital. So what happened next – after five years of framework 1, the client went out again to procure for more work than before in developing and refurbishing primary schools. This time the client hired five main contractors with their first tier supply chain partners integrated and guess what, two of them were the ones who had worked with the client on framework 1 programme! (the third contractor of framework 1 was going through merger with a bigger company in the UK at the time of selection). The client retained two previous main contractors and their supply chains because of various
reasons – obviously their past performance. But one of the major reasons was the supply chain capital which these two main contractors and their teams were bringing – the human and knowledge capital integrated in these supply chains – it took five years for both the client and supply chain partners to understand each other and develop professional relationship; developed learning curve; practices based on experiences where the wasteful activities were no longer part of processes; a substantial amount of knowledge which was gained while working on similar projects over last five-year period; matured and performance based delivery of projects; therefore, these supply chains were bringing best value for the client – the integration, the knowledge and the learning – i.e. supply chain capital.

The client now has several framework agreements across the board – in construction they have one for secondary school development and one for the material supply; the client itself is a learning organisation, learning from their experiences on framework 1 and building it into it another new and ongoing frameworks – creating and re-using supply chain capital for delivering public projects.

6. Conclusion

The development of supply chain capital is in itself an answer to the challenges of the growing complexities and dynamics of the construction world. For an organisation to maintain its competitive edge and continually innovate it has to not only focus on transforming itself into a learning organisation but also to facilitate learning throughout the whole supply chain (of which it is part) to become a learning chain. And over a period of time this learning chain would result into supply chain capital which brings competitive advantages to the trading partners involved in the supply chain.

SCM and KM emerging business philosophies, which place a great emphasis on trust and commitment, are becoming a pre-requisite to achieve this aim. SCM would ensure that key business processes of the trading partners in a supply chain are seamlessly integrated and an environment of trust and long term commitment is generated and fostered within the supply chain. This will create the appropriate environment to implement and harness KM principles. As a result, it can be ensured that best available knowledge is utilized by each trading partner depending on its position in a supply chain and contribute its best towards a better and improved project outcome by creating and utilising supply chain capital over a period of time, resulting into efficient and effective way of project delivery.

References


