

## **Investigating the Role of ICT in Improving Productivity in Construction Supply Chains in Australian Construction Industry**

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### **Abstract**

The Australian construction industry is a fragmented and profoundly competitive industry with high levels of subcontracting resulting in complex supply chain formations. Traditional methods and forms of communication are being proven as inefficient and losing their charm while participants face heavy volumes of communications that often occurs on a daily basis between trading partners in a supply chain on projects. Information Communication Technologies (ICT), due to their robustness and the ability to quickly disseminate data/information, have the capacity to address highlighted communication issues in a structured and an efficient manner. Timesavings produced by these can be directly translated in terms of productivity gain. This paper presents perceptions of subcontractors working in the construction industry in Melbourne Australia on the use of ICT obtained through an exploratory study.

### **Keywords**

Information and Communication Technology (ICT), Outsourcing, Subcontracting, Supply chain

### **1. Introduction**

Subcontracting has become an essential component of the construction process, and is on rise, since 1980's (Harris and McCaffer, 2001). The Australian Construction Industry is notorious for heavily subcontracting the work by the main contractor. Subcontracting as large as up to 95% has been observed on certain projects in Australia (Crowley *et al.*, 2000). Where as subcontracting brings economic benefit, it is more likely to be offset by the problems arising out of co-ordinating large number of subcontractors. Contactor's ability to effectively communicate and coordinate its subcontractors' base is, therefore, becoming decisive in deciding the fate of the project. The complex construction process aggravates this problem of coordination and communication and the traditional medium of communications like

telephone, facsimile etc are becoming less effective to manage the increased information needs of a huge base of various parties involved in a construction project.

Information Communication Technologies (ICT) due to their robustness and the ability to quickly disseminate data/information have the capacity to address the communication issues in a structured and an efficient manner. Time savings produced can be directly translated in terms of gain in productivity. The objective of the research is to investigate this ability of ICT with subcontractors' organisations and to obtain their perceptions on the use and subsequent benefits arising from ICT use and possible barriers/threat that may restrict the use of ICT. This paper presents the perceptions of subcontractors working in the construction industry in Melbourne Australia on the use of ICT obtained through an exploratory study. Investigation was made through in-depth qualitative interviews with fifteen respondents belonging to different subcontractors organisations. The research is built upon the research project being carried out by CRC (Co-operative Research Centre) for Construction Innovation at RMIT University, to investigate the potentials of ICT for Contractors companies in Australia titled as "Delivering Improved Knowledge Management and ICT diffusion in Australian Construction Industry".

## **2. Outsourcing & Subcontracting: Formation of Supply Chains**

Outsourcing, commonly known as subcontracting in the Construction Industry has become a common practice in most industries. The outsourcing occurs as result of strategic decision after an organization has decided what are things to make and what are to buy. Parahalad and Hamel (1990) explored different factors cause of the buying decision mentioning that firms are trying to concentrate on their core competence as a means of winning competitive advantage amid fierce competition and rapid changes in the global economy. So it does not make any economic or managerial sense for a manufacturing firm to do every production in house since doing so effectively prevents the firm from focussing on its core competence. Hence outsourcing part of the internal production process to outside suppliers seems a viable option to the manufacturer who is aiming to develop strong competences (Deavers, 1997). The supply chains start building up as soon as an organization enforces sourcing decisions

### **2.1 Benefits of Subcontracting**

Through subcontracting, a contractor can transfer some of the financial risk and is able to reduce overhead costs, including labour and plant (Harris and McCaffer, 2001). Goldfayl (1999), in an analysis of the contractor's use of subcontractors, highlights four key advantages as follows:

- Greater expertise existing within the subcontractor market that usually restricts their activities to a very limited range of speciality works.
- Reduced fixed overheads of the contractor that would otherwise be incurred in maintaining permanent expert workforce that may be underemployed.
- Improvements in productivity achieved from both items above.
- Financial advantages for the contractor from improved cash flow and the effective financing of the bulk of a project by the subcontractors.

### **2.2 Problems with Subcontracting and role of ICT**

Outsourcing of components formerly made internally can result in an unexpected cost increases if the companies failing to integrate the make or buy decision into the overall manufacturing strategy (Probert, 1996). This usually happens where patches of manufacturing processes are dispersed at random throughout a company's operations and the company becoming unduly dependent on a much wider range of suppliers (McIvor, 2000).

The construction industry, especially the Australian construction industry, is currently characterised by heavy use of subcontracting. For this reason the tedious task of coordinating and communicating to a huge subcontractors base, becomes critical to the fate of the project. By adopting efficient means of communication, contractors increase the chances of enjoying the project success. With construction projects getting more highly complex and the construction industry becoming profoundly competitive, traditional medium of communication like telephone, facsimile etc are becoming less effective to cope with the huge volume of communications and information generated in a typical construction project. The problem is aggravated significantly when trying to coordinate multiple number of organisations involved with completing a project tasks.

### **2.3 Role of ICT in facilitating coordination and communications among subcontractors**

Information Communication Technologies (ICT), have been recognized as an emerging technology because of its robustness, and has the capacity to deal with a multitude of communication problems between contractors and its subcontractors. As such it becomes a good means of quality assurance by providing a facility to record and track all correspondence carried out on a construction project. It reduces the extent of fragmentation by effectively connecting; coalescing and enmeshing the construction industry supply chain consisting of subcontractors and suppliers (Goldsmith *et al.*, 2003).

## **3. Research Methodology**

This research has drawn its direction from the broad research project “Delivering Improved Knowledge Management and ICT diffusion in Australian Construction Industry” being executed by CRC (Co-operative Research Centre) for Construction Innovation at the RMIT. The research reported here constitutes a preliminary exploratory study that highlighted various issues concerning ICT utilization and diffusion within subcontractors’ organisations before a detailed research endeavour will be undertaken in a more extensive individual research project. Because of the exploratory nature of this research, the theme of research is predominantly qualitative and the data was obtained through In-depth interviews with personnel of the subcontractors’ organizations.

### **3.1 Design of the Research Instrument**

The research instrument was prepared to conduct in-depth interviews with open-ended questions. The research approach used in this research was based on one developed by the research team of CRC for Construction Innovation at the RMIT University mentioned above. The research instrument was divided into five sections as follows:

- Background Information and Use of ICT
- Professional Development and Technical Support
- Advantages of ICT
- Subcontractor Communication
- Reluctance to use ICT

This research design is based on the study of ICT by Peansupap *et al.* (2003), which focused mainly upon main contractors. The challenge now is to extend the study to include subcontractors also.

### **3.2 Sample**

Convenience sampling was adopted as an approach towards the selection of the respondents. Frey *et al.*, (1991) described that it is a type of sampling where the researcher uses cases that are most convenient and available. It is made up of whoever/whatever is willing and available to participate. This is a potentially dangerous form of sampling and there is tremendous potential for bias in this design (Frey *et al.*, 1991).

Considering the objectives of the study (to carry out preliminary exploration of the use and diffusion of ICT with in subcontractors organisations), convenience sampling was considered to serve the purpose without jeopardizing the research. Fifteen (15) Personnel from 8 subcontractors' organisations currently operating in the Victorian Commercial Building and Construction Industry agreed to take part in the research. These 15 persons interviewed and important points were recorded on the interview sheets during the interviews.

#### **4. Analysis and Discussion**

Subcontractors interviewed came from various trades for example an Electrical Contractor, Hydraulic Contractor, Carpet/Layer contractor, and a Mechanical Contractor. Most of the subcontractors have a university or at least TAFE level education. All of them are employed full time and handle various projects. They have used various ICT tools depending on the demands of each contractor's company they work with. In this way some contractors have gained experience in using more than one ICT tool.

Subcontractors agreed that using ICT is improving their work performance and they see this as a means of improving productivity, if utilized strategically, throughout a supply chain. They appreciated that ICT as a medium or channel of communication is a very useful tool. It saves them a lot of time and provides them with a system that is also a quality assurance system by default. As a repository of information and communication, ICT serves as an efficient tool where one can find old communication through searching the facility. It enhances the speed of correspondence and markedly decreases the reaction time. The speed of data exchange and the reduction of the more traditional communication mechanisms reduce the uncertainty and minimize errors. It has the ability to transmit correspondence to numerous parties at one time, which is a major time saver. Conventional means took a long time either through faxing or manual transfer of documents to reach to multiple parties. Additional out of date versions of drawing were likely to be used in error.

The contractor organisations have adopted various ways to diffuse ICT through their subcontractor base such as providing professional training, arranging help desk and assigning mentors to the subcontractors. After the initial training, contractors set up the formal helpdesk and support mechanisms to facilitate and solve the problems faced by subcontractor on the job. It is the responsibility of the users in the subcontractor organizations to continually learn from their peers and experienced users regarding them as their mentors. The following approaches were taken by the contractors to train their subcontractors:

- Weekly training for the first two months;
- Basic introduction on log on procedure, data retrieval and correspondence and later it was up to the subcontractor to improve its skills;
- Subcontractors were provided with user guides and assumed to learn ICT use on their own;
- In some cases no formal training was provided and no training manual was given. Employees in subcontractor companies learnt from their peers who happened to use ICT tools on previous projects; and
- Some of the subcontractors received formal training and managed to learn it better after using ICT on the job / project.

Subcontractors considered personal characteristics like commitment to learning, basic IT background as important to the diffusion of ICT. A person with motivation to learn and improve his/her productivity via new tools like ICT and his/her basic knowledge IT facilitates his/her adaptation to the ICT. It was hence recommended that before diffusing ICT in the organisation it is important to motivate personnel about the perceived benefits and running basic IT training course. This develops the confidence of the person with the technology and hence increases its use.

A few subcontractors did not consider tangible rewards as an important factor affecting ICT diffusion but some were of the view that because of exposure to this new form of communication they see enhanced job prospects, increased job security, increased knowledge and subsequent company advancement. Intangible rewards however has been felt by all the respondents in the form of ease of performing role and responsibilities, knowledge and peace of mind that information is being transmitted efficiently and accurately in a secure and un-compromised manner, personal satisfaction and self-fulfilment.

Subcontractors also consider sharing knowledge about using ICT to be important. Through this sharing mechanism, personnel are able to seek help from their colleagues and peers who are readily available around them. Culture of the organisation harbouring and encouraging knowledge sharing and helping each other is considered very important regarding the use and diffusion of ICT with in subcontractors' organisation. A negative work group environment reduces the proliferation of ICT, acts as barrier and should be avoided.

Another important aspect of ICT is the facility it provides whereby the subcontractors can communicate to each other quickly as opposed to a traditional way of writing to the main contractors for requesting the information from a certain subcontractor and then waiting for a longer time to receive the information. ICT allows the quick communication among the parties while keeping contractors aware of all these communications and recording for the contractors to exercise the control, if they wish. Subcontractors elicited an important issue mentioning that learning an ICT system of a certain contractor needs a lot of resources in terms of time and money to be put together by the subcontractors. This investment on the part of the subcontractors is meaningful only when subcontractors work with main contractors on long term commitment basis. In case they are not sure of their future with the contractors company, it is very hard to diffuse a certain ICT system with in their organisations. Hence, if contractors are desirous to reap the benefits of ICT they must consider longer-term relationship-building options such as alliancing or partnering with subcontractors on a long-term commitment basis. The long-term commitment acts as a catalyst and serves as a good reason for subcontractors to adopt and diffuse certain contractor ICT system within their organisation. Whereas alliancing has got benefits, a drawback reported by Dainty *et al.*, (2001) was that in an alliance, subcontractors are being labelled as very closely linked with the name of particular alliance and thus contractor. This reduces their attractiveness to other contractors and thereby greatly reduces their potential market opportunities. This dimension of being linked to a particular contractor also was a concern raised by various subcontractors interviewed in this research.

Subcontractors usually concurrently work with various main contractors to draw their economic benefits. Each of the contractors may be using different ICT system and as a result subcontractors might have to concurrently learn, use and diffuse a variety of systems within their organisations. It is emerging as a hassle according to the various subcontractors and most likely acting as a barrier to adopt and diffuse ICT with in their organisations. It is important therefore to call for standardisation of ICT systems at the industry level to improve the overall use of ICT and hence achieving more effective ICT diffusion within subcontractors organisations. Subcontractors also brought to our notice various barriers that may cause non-use of ICT. Technical barriers, for example network breakdown, low speed of Internet connection and out of date hardware. Setting up an ICT infrastructure requires high levels of capital investment by subcontractors; this also serves as a barrier. Hopefully, ICT will advance technically in future and with the advancement of technology hardware, technical issues mentioned above would be resolved in a timely fashion and thus undoubtedly further strengthen the future use of ICT among subcontractors.

## **5. Conclusions and Further Work**

The Australian construction industry is highly fragmented and intensely competitive owing to the increased use of outsourcing and subcontracting by the main contractors. This pilot study indicates that communication and coordination have become the primary issues by the contractors to deal with their

subcontractors. ICT has the capacity to address these issues in a structured and efficient manner. Subcontractors are adopting ICT to communicate with contractors and are finding it very powerful and useful, as the research found out.

The subcontractors' call for standardisation of ICT systems and working with main contractors on long-term basis is timely as the construction industry gears up to greater use of these technologies. Learning and diffusing ICT systems within an organisation have associated cost implications. In the current traditional setting, subcontractors usually concurrently work with various contractors to draw their economic benefits. Contractors using different ICT platforms and infrastructure make the adoption by subcontractors very tedious. Subcontractors are confronted with a difficult task of learning and diffusing a variety of ICT systems within their organizations, often only for the short duration time of the particular project. All their efforts in terms of time and cost are wasted as soon as the contract is completed. There remains no guarantee for the subcontractor to obtain any future new projects with the same contractor. Therefore, long term commitment and partnering with the main contractors and standardisation of ICT systems are important if ICT is to be adopted on broad industry wide scale so that all perceived benefits may be reaped in full. It is in this area that future construction research should be undertaken.

Finally, ICT is serving as a tool for provoking and stimulating collaboration among contractors and subcontractors over which the philosophies of knowledge management and supply chain management have been built. This would pave the way for implementing these philosophies in the supply chains and to exploit them to their best for the industry productivity and profitability.

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