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Implementing supply chain quality management in subcontracting system for construction quality

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Abstract: Achievement of high-quality performance can provide a potential competitive edge in construction industry. Subcontracting has been identified as a source of poor quality and overall poor business performance of projects. The aim of this paper is to shown that modern ideas in Supply Chain Quality Management (SCQM) can positively impact quality problems caused by subcontracting. SCQM integrates quality management into the construction supply chain and is considered an effective method to overcome quality problems in construction subcontracting systems. Based on two case studies, this paper shows that quality improvement can be achieved through adopting SCQM. The relationship between enhancement of quality and SCQM is not examined directly in this paper. However, it provides a perspective that SCQM could address the poor quality performance caused by subcontracting and should be adopted much more widely in construction industry.

Keywords: Quality, Subcontracting System, Construction Industry, Supply Chain Quality Management

1. Introduction

The construction industry has been criticised for its less than satisfactory performance, in terms of quality, productivity and safety (Hoonakker et al., 2010). Nowadays, with an extended definition of construction quality and increasing expectations from clients, therefore, quality improvement is required.

The subcontracting system in the construction industry has been described as the contractual process that main contractor subcontracts parts of projects to other construction firms (Chiang, 2009). The aim of subcontracting is to optimize the resource (Parrod et al., 2007), share the project risks (Yik et al., 2006), and avoid changeable market demands (Ng et al., 2009). However, the

negative impact caused by subcontracting has been overlooked in previous research. Most studies focus on analyzing the poor quality caused by fragmented and complex nature of construction industry, numbers of stakeholders, unilateral quality, etc.(Karim et al., 2006; Hoonakker, et al., 2010).

According to Karim et al. (2006) there may be as much as 90% of the work carried by subcontractors, and consequently subcontractors can seriously impact construction quality. To solve this problem, integrating quality management into construction supply chain has been discussed as an effective approach (Egan, 1998; Kuei & Madu, 2001; Robinson & Amphora, 2005). This integration has been defined by Kuei&Madu2001 and Robinson &Amphora2005 as the term of SCQM. In this paper, SCQM as a quality improvement method will be discussed. The primary focus will be to examine how SCQM could address some of the problems of quality resulting from less than satisfactory subcontracting.

2. Subcontracting System

The nature of construction industry requires larger numbers of specialists working together. Most of time, workers are specialized in a unique aspect of construction processes, and it is quite rare that workers possess multi-skills across the whole project (Yik et al., 2006). Subcontractors that offer various equipment, materials, skilled workers and know-how directly carry out the project, while main contractors are responsible for managing these works to ensure the work could satisfy clients' requirements.

Main contractors adopted subcontracting because it could ease their financial and workload pressures, especially, when several projects operate simultaneously. The subcontracting allows subcontractors to focus on developing their unique skills which leads the work to be accomplished high-effectively (Reeves, 2002), and these repetitive works could impact learning curves in a positive way. Though the construction industry has taking advantage from subcontracting systems, it does not mean this system is free of problems (Reeves, 2002). The aim in next session is to analyse the problem of quality caused by ineffective subcontracting in construction industry.

3. Quality in Subcontracting System

Quality in construction is difficult to define and previous research has not provided a definitive definition of construction quality. The majority of research simplifies construction quality as 'meeting expectations of the customer'

(Palaneeswaran et al., 2006), 'reduced defects' or 'repeat business' (Karim et al., 2006; Chiang, 2009). While Barrett 2000 defined construction quality in a more complete way which is quality not merely requires satisfying the final customer, but needs to meet the requirements from interacting stakeholders as well. These stakeholders include a large number of subcontractors who assist main contractors to complete projects.

However, main contractors tend to adopt the lowest bidder in selecting subcontractors. Furthermore, as is the nature of projects, the majority of the relationships between main contractors and subcontractors are 'one-off' and so establishing a long term financially efficient, quality-focused relationship is not a priority. The research conducted by Tam et al. (2011) illustrated that because of 'the improper work', 'limited profit', the subcontractors can erode quality. Karim et al. (2006) stated that subcontractors needed to take more responsibility for quality.

3.1. Main Contractors And Subcontractors

Yik et al. (2006) illustrated that main contractors considered subcontracting as a procurement method to acquire different specialists, therefore, transaction cost is a dominant factor when main contractors select subcontractors, which contributed the view of 'lowest-bidding'. In general, main contractors are larger hold 'power' positions compared with subcontractors. To protect their own profitability, main contractors tend to believe they must choose subcontractors who offer the lowest prices. This cost-orientated approach may foster self-protection, but not customer satisfaction focusing (Eriksson, et al., 2007). It also forces subcontractors to adopt the same value-orientation to evaluate their following subcontractors and suppliers. In other words, the cost cutting is a potential factor leads poor quality.

In addition, subcontractors who are competing with each other lack of bargaining power (Chiang, 2009). From the motivation of potentially acquiring repeat business from main contractors, the unreasonable low price can be accepted. However, this limits profit which forces subcontractors to sacrifice quality in order to maintaining their own profits. Low margins, high risk and destructive competition add further fuel to the fire.

The poor communication and lack of common understanding between main contractors and subcontractors is another reason. Additionally, as this is often a one-off relationship, contractors and subcontractors are lack of clear understanding of each other. Without any clear and direct control or supervision, subcontractors sometimes cannot complete the work following clients'

requirements. Moreover, due to the unbalanced power position between subcontractors and main contractors, subcontractors are 'bullied' and 'treated with little respect' by their main contractors who have 'arrogant attitudes', 'short-term focus' and 'narrowly win-lose attitudes' (Packham et al., 2003; Xue et al., 2007). Thus, subcontractors do not necessarily have significant motivation to solve problems from the view of main contractors or the clients. According to Yik et al. (2006), subcontractors are not educated or motivated to work precisely and creatively by adherence to requirements of clients/main contractors. They may simply complete works as functions and do not pursue excess clients' expectations or excellence.

3.2. Subcontractors

The self-restriction of subcontractors, in some degree, leads to potential quality issues. Most subcontracting companies are small in size and they do not have enough knowledge and resources to adopt modern quality management. The high mobility in the subcontractor firm leads subcontractors to develop a negative attitude about training. These improper trained workers may increase the possibility of defects during the work. As a consequence, lack of quality management awareness and less qualified workers, subcontractors do not consider quality is an essential factor when they work with main contractors.

The other barrier to quality improvement is the traditional working style among different subcontractors. During the construction processes, different subcontractors only consider their own interests when they collaborate with other subcontractors. They do not consider their following trades as customers (Egan, 1998). Moreover, they ignore the fact that defective work done by them could impact following subcontractor trades (Karim, et al., 2006). With no direct communication and information sharing with other subcontractors (that forms the foundation of modern supply chain thinking) can make them less familiar with other trades' quality codes. It means that any improper actions can become the root cause of poor quality for following subcontractor trades. For example a poorly laid concrete slab can create numerous problems for following electricians and plumbers. Quick 'work-arounds' are the usual solution to these issues but such strategies usually lead to further quality problems for the next trade subcontractor, the main contractor and client and do not encourage the originator of poor quality work to improve.

3.3. Clients and Subcontractors

Indirect communication between clients and subcontractors could be another reason that leads to poor quality. Main contractors are those who are responsible for fulfilling the client's requirements and have formal contracts with clients. On the other hand, it is the subcontractors normally do not have any formal contractual relationship with the client but carry out the work (Tam et al., 2011). Most of time, the subcontractors only take responsibility for the specific work task allocated to them from their main contractors. This again is in stark contrast to modern supply chain thinking where a collective focus on the clients' needs is developed by directly linking and creating an interest in contractors in relation to the affects their work on the client or main contractor. In current construction supply practices, there is little interest from subcontractors, and/or stick and carrot motivation, to providing an excellent outcome for the client. In many cases, due to inefficient communication between subcontractors and clients, subcontractors are not always fully aware of, or interested in, the client's requirements, leading to defective or abortive work (Chiang, 2009).

From the analysis above, to eliminate the negative effects caused by poor collaboration, to encourage the development of subcontractors, to address ineffective communication among different subcontractors, could enable construction quality to improve. Additionally, reducing the number of subcontractors (processes re-engineer) could address the quality problem as well. All of these, point to the concept of supply chain management. SCM has an ability to establish the sense of collaboration among different parties and optimize the process. Therefore, in the fourth section, the purpose of implementing SCQM and the definition of SCQM will be presented.

4. Supply Chain Quality Management

According to Egan (1998), Wong and Fung 1999, Barret2000, Kuei and Madu2001, implementing quality management only in a separate area or one party cannot enhance quality from a client perspective. In other words, in the construction industry, separately control of quality in main contractors and subcontractors could not achieve the goal of improved quality. To enhance quality, the concept of quality needs to be integrated through the whole supply chain, and involve all employees from top to bottom. Supply chain management is a set of principles and practice aimed at managing and coordinating entire supply chains from raw material suppliers to the end customers, and emphasizes the importance of collaboration with every participant across the entire supply chain (Vollman et al., 1997). Construction supply chain management requires establishing mutual interests between the main constructor and the

subcontractor, discarding the short-term considerations, and then delivering maximum value to clients.

Wong and Fung 1999 concluded that SCM would help the main contractor better mange subcontractors and suppliers through working closely and cooperatively. A suggestion by Ehan(1998) that building a unified team with clients, designers, main contractors and subcontractors could better delivered value to the client. The new approach of establishing qualified partnering with main contractor and subcontractors through the supply network can significantly improve quality (Humphreys et al. 2003). Traditional quality programs should now take a view from a supply chain perspective in order to improve quality and satisfy requirements of the marketplace (Robinson & Amphora, 2005). Kuei and Madu2001 concluded that the quality-based paradigm has shifted from the traditional company-centred to involvement into supply chain systems.

Some studies now define this integration between quality management and supply chain management as the concept of SCQM. From the aspect of quality management, construction supply chain could be recognized as delivering quality products and services across every organizations in the supply chain, to clients' expectations. Kuei and Madu2001 defined SCQM used three simple equations. Robinson and Malotra2005 provided a more detailed definition. It is

> *SCQM is the formal coordination and integration of business processes involving all partner organization in the supply channel to measure, analyze and continually improve products , services, and processes in order to create value and achieve satisfaction of intermediate and final customers in the marketplace.*

Thus, adopting SCQM in construction industry seems to have a positive influence on quality improvement. Firstly, SCQM can build the common senses of quality for every participant in the supply chain without being restricted by the boundaries of organizations. Secondly, effective value-add deliveries of the components of construction and services can be achieved by adopting SCQM through process re-engineering and client focus. Moreover, SCQM offers a scope of 'big picture' and is an effective way to overcome the nature of fragmentation and the weak linkages among supply partners in the construction business. Last but not least, SCQM is an approach that could help quality decisions be made wisely by considering whether processes can add value to the end product and not to sacrifice the interest of other participants, especially subcontractors. The aim of following section is to investigate whether there is a

positive link between implementing SCQM and quality enhancement in construction subcontracting systems through case study.

5. Case Study

Two case studies based on the research from Wong and Fung 1999, and Tam et al. (2011) will be discussed as follow.

The first case study is ABC Construction Company. It is one of the successful construction companies in Hong Kong. It adopted ISO and TQM in the early of 21st century for ensuring a high construction quality. Wong and Fung 1999 from a supply chain management and total quality management perspectives analyzed how main contractors managed subcontractors and enhanced the quality of work.

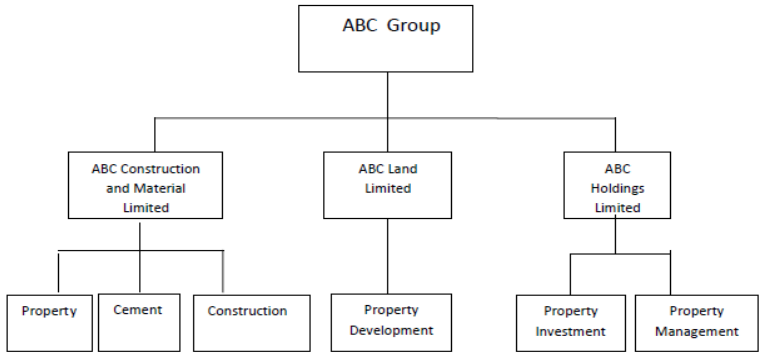

Fig. 1: The ABC's business structure.
Source: Adapted from the website of ABC company.

Inter-organization, the company restructured the organization for better cooperation with subcontractors. Teamwork and open discussion became the core factors in the company. They ensured the company and its own subcontractors could collaborative effectively, and assist the subcontractor to understand the requirement from clients. There are different types of meetings between the company and the subcontractors, which involved the majority of the employees from managers to site staffs. Through these meetings, the message of TQM spreads to every subcontractor from top to bottom, which ensures subcontractors have a better quality performance during the work.

In evaluating the relationship between the subcontracts, ABC Company has its own considerations. Nowadays, partnership has been labeled as the best way to overcome the problem of quality (Errasti et al., 2007). A company did not specifically pursue partnerships with every subcontractor, but chose the 'right'

relationships with its subcontracting partners. From the concept of supply chain, the company carefully analyzed the trade-off when choosing different levels of partnership it needed to establish. There are several levels of relationships. For example, there are long-term subcontractors which have more than 10 years business and personal relationship, while the one-off relationship also could be found. As properly evaluating collaborative level with subcontractors, the company could maintain flexibility and profitability. Moreover, the lowest-bidding is not the only way to select subcontractors in this company. Sometimes they consider 'soft parameters' (Eriksson, 2010), which in some degree avoids the poor quality works by subcontractors due to limited opportunities profits and direct cost pressures.

The other case is a survey conducted by Tam et al. (2011) aimed to examine the relationship between poor quality performance and multi-layer chain subcontracting in Hong Kong. There are six factors that were defined as the reason lead to the issue of quality. The reasons can attribute clients' dissatisfactions are, for instance, 'extra cost', 'communication errors', 'unrealistic contract time' and so on, all of these may be solved by ensuring high quality standards, establishing long-term quality commitments between main contractors and subcontractors (Briscoe & Dainty, 2005), developing channel quality performance measurements and standards (Robinson & Malhotra, 2005), sharing the data of quality inspection, process integration, etc.

When comparing the structure of ABC Company with poorly performing construction companies, a clearly beneficial feature is indicated: ABC plays a role of supplier, developer and contractor within the scope of the Group Company, which establishes better communication channels and shares the common goals among the participants in the supply chain. Therefore, to some degree, ABC integrates quality into its supply chain. What is more, ABC is thus able to nurture a long-term, closed relationship with its subcontractors, which additionally develops effective quality linkages in the downstream of the supply chain.

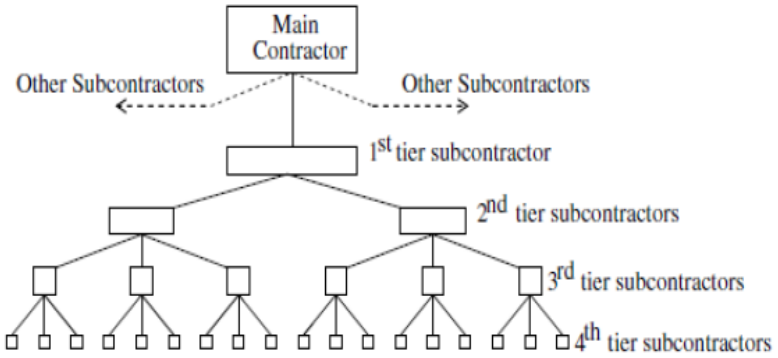

Fig. 2: The structure of multi-layer subcontractor.
Source: Adapted from Yik & Lai 2008.

On the other hand, some construction companies excessively rely on their 'lowest bidding' subcontractors and suppliers. The same situation happens to their subcontractors also, which leads to uncontrolled multi-layer subcontractors, Figure 2. Consequently, serious quality problems develop in many projects. Thus, this weak linkage, lack of trust, information sharing, short-term perspective of various quality goals and measurement systems combined with price orientation within the subcontracting systems can be seen as a major limitation in quality performance in the construction industry， while the concept of SCQM promises to address these situations from linking all participants within the scope of a supply chain and building a common goal. When SCQM becomes widely accepted, the construction process, value chain, and the ability to achieve high quality deliveries can be achieved.

These two cases did not directly examine the way SCQM could address the problem of poor quality. However, they offered a predictive view about integrating quality management into construction supply chain that may improve poor quality performance. Although there are scant objective measures of improvements and evidence presented is largely rhetorical and/or anecdotal. Further, it appears that there are cultural barriers to improving quality by integrating supply chain thinking. Many of the practices that are evident prior to attempts to improve quality by the case study companies have evolved over many years and resulted in entrenched negative quality practices amongst contractors and subcontractors. Overcoming these cultures by implementing modern supply chain cooperative practices will be a major challenge for construction industry worldwide. It will be interesting to attempt to objectively measure this aspect and progress made in the next few years in these companies.

6. Conclusions

This paper has highlighted the relationship between subcontracting and poor quality performance in the construction industry. SCQM as a new concept was presented, which supported by two cases. From the case studies, it appears that the spread the concept of SCQM across construction supply chains, especially, between the main contractors and the subcontractors will offer a positive impact to quality enhancement but there may be problems in doing so.

The cases did not examine the relationship between SCQM and quality improvement in the subcontracting system directly, but, they provide an acceptable prediction that SCQM could be an effective approach to address the issue of quality incurred by subcontractors. SCQM emphasizes the importance of communication, building common quality goals, maintaining the proper relationships and most critically assisting the construction industry building a 'big picture' image. SCQM wisely and smoothly links previous uncontrolled and unpredictable quality performance by different construction organizations formed into a supply chain. SCQM will contribute more satisfactory quality performance and also help high quality projects to be delivered effectively and creatively.

There is a great deal of future research potential to study SCQM in subcontracting system and the authors are developing a hypothesis that whilst this seems to be theoretically possible, there may be serious cultural barriers to meeting its full potential. The authors are concerned that much of the rhetoric provided by companies such as those studied here, may be little more than that and there needs to be serious attempts to measure the real effectiveness of integrated supply chain principles, which take into account long established cultural barriers to cooperation between subcontractors in construction industries. The breakdown of traditional cultural barriers to implementing SCQM between main contractors and subcontractors needs to be examined in the future. In general, the 'problem' is now becoming well documented but solutions and barriers to them and objective measures of their real effectiveness are much less so.

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