

Subcontracting System-A Platform Fostering Technology Transfer in the Hong Kong Building Projects

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ABSTRACT

It is a common practice for main contractors of Hong Kong building projects to sublet most of their works to subcontractors. This approach has been in operation for a long period of time as a strategy to deal with long-term environmental uncertainties and to buffer the technical core of main contractors against short-term contingencies. Technology transfer can foster the growth of indigenous technological capacity of the local industry. This paper presents the questionnaire survey to investigate whether the local multilayered subcontracting system can function effectively as a platform for technology transfer.

Keywords

Subcontracting, Knowledge Sharing, Strategy, Barrier

1.0 INTRODUCTION

1.1 Subcontracting

Due to fluctuation of workload, there is a high level of subcontracting in the Hong Kong building projects. Labour-only subcontractors and fee subcontractors contributed 24 per cent and 42 per cent of the gross value of construction work performed in 2008 according to Hong Kong government statistics. Main contractors normally divide the project into work packages by trade and sublet them to the first layer trade subcontractors. The first layer trade subcontractors further divide their work packages into smaller packages and sublet them to the second layer subcontractors. The subletting process may sometimes go down several more layers and can be characterised as multilayered subcontracting. A survey (Cheng and Law, 2005) to review the degree of subcontracting in the local building projects shows that 74 per cent, 15.6 per cent and 4.2 per cent of the respondents were usual second layer, third and fourth layer subcontractors respectively.

The role of main contractor has gradually transformed from a constructor to a manager of subcontractors due to the rapid development in terms of complexity and size of Hong Kong building projects in the last decades. Frisby (1990) defined the management of the subcontractors as one of the key functions of the main contractor. To become a competent main contractor for the modern high-rise building projects, a firm's technical capacity must be continuously advanced by capturing the latest technology introduced by the subcontractors in particular the overseas specialist firms.

1.2 Technology Transfer

Knowledge management is the process of acquiring, creating, sharing, utilizing and storing intellectual assets and other stimuli from the internal and external environments that facilitates an organisation to perform successfully (Huber, 1991). Technology (Ofori, 1994) may be defined as the application of the existing body of knowledge (science) to the production of goods and services. Technology transfer has been defined in many different approaches. For instance, Simkoko (1989) defined it as the planned conveyance and acquisition of technological knowledge and technique during the implementation of international construction projects; and Dichter (1988) defined it as the process whereby knowledge in some form is transferred from a person or organization who possess it (the transferor) to another person or organization who arranges to receive it (the transferee). People play a vital role in cross-projects knowledge transfer that can be taken place through the interactions among the participants in a project.

2.0 AIM OF STUDY

Technology transfer is vital to the growth of indigenous technological capacity of the local construction industry and promotes economic growth in the long term. Subcontracting system is an excellent platform for knowledge sharing. The aim of this paper is to investigate whether the

platform can function effectively in the Hong Kong building projects. This study reviewed the encouraging factor and discouraging factor to the effectuation of the platform. Encouraging factor refers to the appropriate knowledge management strategies adopted by building contractors to facilitate technology transfer. Discouraging factor refers to the essential barriers in establishing the knowledge sharing culture.

This study only covered building projects because main contractors of the civil engineering projects would not sublet too much of the work to their subcontractors as the nature of work is not too labour intensive.

3.0 RESEARCH METHODOLOGY

This study adopted an integrated research approach including a questionnaire survey to collect quantitative data and in-depth interviews to experienced industry practitioners to explore the possible causes for the findings.

3.1 Strategy

The cross-projects knowledge transfer process involves two routes: transfer between main contractor and subcontractors in a project and transfer within the construction company from one project to another as demonstrated in Figure 1.

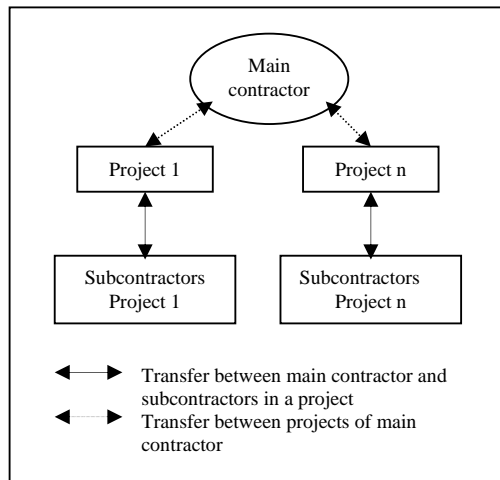


Figure 1: Technology transfer routes

Kamara et al. (2002) suggested that the management of knowledge in construction firms, covering the two routes, should include the following elements:

- A strong reliance on the knowledge accumulated by individuals.
- The use of long-standing agreements or framework with subcontractors to maintain continuity and the reuse and transfer of knowledge.
- The capture of lessons learnt and best practice in operational procedures, design guidelines, etc., which serve as a repository of process and technical knowledge. Post-Project Reviews are usually the means for capturing lessons learned from projects.
- The involvement (transfer) of people in different activities as the primary means by which knowledge is transferred and/or acquired.
- The use of formal and informal feedback between providers and users of knowledge as a means of transfer learning/best practice, as well as to validate knowledge.
- A strong reliance on informal networks and collaboration, and 'know-who' to locate the repository of knowledge.
- Within firms with hierarchical organizational structures, a strong reliance on department/divisional heads to disseminate knowledge shared at their level, to people within their sections.
- The use of appropriate IT tools to support information sharing and communication.

Thirteen common knowledge-sharing practices that facilitate technology transfer between main contractors and subcontractors in the building projects in accordance with the strategies recommended by Kamara et al. (2002) were shortlisted for the questionnaire survey as shown in Table 1. In the questionnaire, respondents working in the main contracting firms were requested to advise whether their firms had regularly organized the knowledge-sharing practices to capture the new technology from subcontractors and disseminates within the company.

Table 1: Common knowledge-sharing practices

Item	Practices	Percent (%)
P1	Long-standing agreements or framework with subcontractors to maintain continuity in the reuse and transfer of knowledge	62.75
P2	Intranet and e-library that support information sharing and communication between main contractor and subcontractors in project	54.95
P3	Regular cross-projects site visit programme to enable the transfer of lessons learned in a project to others	52.94
P4	Coaching or mentoring system that enable senior experienced employees to provide face-to-face training to junior staff	45.10

P5	Regular departmental meeting that disseminates knowledge to people within the department.	43.14		knowledge which differed from their colleagues that can sustain job security or even promotion prospects within the workplace	
P6	Job rotation by which knowledge is transferred and/or acquired.	31.37	H4	Both main contractors and subcontractors unwilling to disclose confidential design information and the special project features that may reduce their competitiveness	6.33
P7	Inform knowledge exchange seminars between main contractor and subcontractors as a means of transfer learning and best practice, establish informal networks and collaboration, and 'know-who' to locate the repository of knowledge.	29.41	H5	Fragmented (too many trades) nature of the construction industry unable to develop long term sharing culture	5.82
P8	Project award programme or partnership arrangement between main contractor and subcontractors to reward innovation in project planning and preparation	25.49	H6	Long communication path between main contractor and sub-subcontractors that actually carrying out the site work under the local multilayered subcontracting system hindered the feedback of information	5.41
P9	Formal feedback such as regular meetings, reports between main contractor and subcontractors as a means of transfer learning and best practice, as well as to validate knowledge	17.65	H7	Dynamic project organization unable to establish mutual trust within the project environment for knowledge sharing	5.02
P10	Guide book updated regularly that introduce new knowledge to staff	15.69	H8	Most of subcontractors are small firms and they have no long-term commitment to the development of the industry	4.71
P11	Standardized project summary report for each subcontractor for capturing lessons learnt and best practice in operational procedures, design guidelines	13.73	H9	Due to unreasonably tight construction programme, site management staff reluctant to adopt new technology unless its impact to the working progress can be fully recognized	3.76
P12	Post-project reviews with subcontractors for capturing lessons learned from projects.	9.80	H10	Difficult to measure the benefits to the project from an innovation due to uniqueness of each building project and consequently justifying the award to the scheme become arguable	3.18

3.2 Barriers

Dainty et al. (2005) concluded the following three principal barriers to the creation of a knowledge-sharing culture by studying a large construction company based in Hong Kong.

- An supportive culture,
- Poor communication structures, and
- Time constraints.

Ten essential hurdles to the knowledge sharing were developed based on the three principles. In the questionnaire, respondents were requested to rate from 1 (totally agree) to 9 (totally disagree) to represent their views on whether the hurdles had already significantly hoarding the knowledge transfer between main contractors and subcontractors in the Hong Kong building projects.

Table 2: Hurdles to knowledge sharing

Item	Hurdle	Mean score
H1	Insufficient subcontractors' involvement in the preconstruction planning stage	7.80
H2	Heavy day-to-day pressure of working within the project environment likely to prevent the open knowledge sharing	7.33
H3	Hoarding knowledge may help to maintain a degree of specialty	7.02

4.0 DATA ANALYSIS

The questionnaires were posted and distributed through private relationship to industrial practitioners, 51 valid replies were received. Respondents had in average over six years of working experience in construction industry. Experienced industrial practitioners were invited to explain the survey results and some of their insights are summarised below.

4.1 Practices

Table 1 above summarizes the per cent of respondents' firms that regularly organized the common knowledge-sharing practices in a descending order of priority. Only three out of 12 practices have scores over 50%, which are regarded as knowledge-sharing practices frequently adopted in the local building contracting firms.

Long-standing agreement between main contractors and subcontractors has the highest score because it is essential for knowledge transfer

as well as a business strategy to obtain a competitive price for the subcontract.

Information technology has already been commonly utilized in the high-rise building projects in the recent years. Fifty-five per cent of the respondents' firms have installed the intranet system or e-library to support information sharing between main contractor and subcontractors in their projects.

Regular cross-projects site visit programme has the third highest score because it not only can encourage the sharing of experience, but is also a common and important component of the quality assurance plans of local construction companies.

The scores for *formal coaching/mentoring scheme and regular departmental knowledge-sharing meeting programme* are slightly below 50 as they are common practices in the well-established firms, but not the medium and small size firms.

Job rotation, knowledge exchange seminar and project award scheme were seldom organized by construction companies as only about 20% to 30% of the respondents' firms adopted these practices.

Formal feedback channels, regularly updated guide book, project summary reports have the similar low scores. Time is the most important indicator that main contractors used to assess the performance of their subcontractors in the Hong Kong building projects according to the result of a survey by Ng and Price (2005). As a result, in order to ensure the timely completion of the projects, both main contractors and subcontractors are prone not to dilute their resources to prepare the documents that have no immediate urgency such as the knowledge-sharing report.

Post-project review with subcontractors is rarely organized as a means to capture the lessons from the projects simply because most of the project participants would not honestly express their views for the causes of the site problems as they may be afraid that the information would be used to justify the claims in the preparation of the final accounts for the subcontracts.

Among the knowledge-sharing practices selected for this study, 7 practices are used to enhance the knowledge transfer route between main contractor and subcontractors in a project while the other 5 practices are for the cross-projects transfer route within main contractor as demonstrated in Figure 1 and Table 3. The mean score for the main contractor internal transfer route is only slightly higher than that of main contractor/subcontractors transfer route. This reflects that construction companies in general adopted a balanced knowledge management strategy.

Table 3: Practices in the knowledge-transfer route

Knowledge transfer route	Practices	Mean score (%)
Between main contractor and subcontractors in a project	P1, P2, P7, P8, P9, P11, P12	30.53
Within main contractor	P3, P4, P5, P6, P10	37.65

Figure 2 shows the number of knowledge-sharing practices adopted by each respondent's firm. It is a normal distributed graph. The average number of practices adopted in one firm is only 4, which indicates that local building contractors are not keen on promoting the technology transfer.

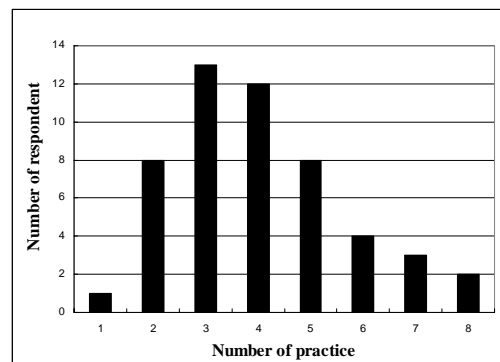


Figure 2: Number of knowledge-sharing practices adopted by respondents' firms

4.2 Hurdles

Table 2 summarizes the mean score rated by the respondents to represent their views on whether the hurdles had already significantly blocked the knowledge transfer between main contractors and subcontractors in the Hong Kong building projects. Under the 9-points scoring system of this survey, hurdle with mean score higher than 5 is regarded as having significant impact hoarding the knowledge transfer. The survey results show that 7 out of 10 hurdles are significant hurdles. This reflects that knowledge cannot be effectively transferred in the local building projects currently.

Insufficient subcontractors' involvement at the preconstruction planning stage is the most significant hurdle. Johansen and Wilson (2006) defined the term first planning as the initial construction planning which takes place during the preconstruction stage of a project. Preconstruction planning efficiency has been identified as of crucial importance in the successful delivery of any project (Dvir *et al.*, 2003; Gidado, 2004). As the tender period and contract duration of most of the Hong

Kong building projects are unreasonably short due to high land price, main contractors would not have sufficient time to have detail discussions with their subcontractors before submitting the tender and commencing the site work. Most of the local building projects are understaffed due to low tender price resulted from very keen competition in the industry. Site management staff cannot devote extra time to capture, digest and share new technology other than handling the project production work. Thus it is not surprised that *heavy day-to-day working pressure* has the second highest mean score.

Under the poor local market conditions in the recent years, it is understandable that a staff prefer to maintain a degree of specialty knowledge to sustain job security and promotion as well as a firm reluctant to disclose confidential design information to maintain their competitiveness. This culture has already significantly obstructed the flow of knowledge. As a result, these two hurdles are at the third and fourth position of the table.

The fifth to the ninth important hurdles including *the fragmented nature of construction industry, long communication path and small size subcontractors resulted from local multilayered subcontracting system, dynamic site organization and very tight construction programme* are all related to the special nature of the local building construction industry.

It is not easy to measure the benefits of a new technology to the project as each project has its unique nature. As a result, only about 25 per cent of the respondent's firm of this survey have implemented the reward scheme for successful innovations. This hurdle thus has the lowest mean score.

5.0 CONCLUSION

Subcontracting system can be an excellent platform for knowledge sharing in the Hong Kong building construction industry. A questionnaire survey was conducted to investigate whether the platform could function effectively. The study covered the reviews on the knowledge management strategy adopted by the building contractors and the importance of the barriers hoarding the technology transfer.

Twelve common knowledge-sharing practices were developed corresponding to each of the knowledge management strategy suggested by Kamara et al. (2002). The survey results show that only 3 practices are regularly adopted by local building contractors including *long-standing agreements with subcontractors, intranet and e-library, and regular cross-projects site visit programme*. Local

main contractors are found inactive in promoting technology transfer as in average each firm organizes only 4 knowledge-sharing practices. Ten essential hurdles were developed based on the three principles on barriers to knowledge transfer concluded by Dainty et al. (2005). Seven of them are found to have significantly impact to knowledge transfer. Most of them such as *insufficient subcontractors' involvement at the project planning stage due to unreasonable short tender period, conservative attitude in disclosing essential information and dynamic project organization etc.*, cannot be resolved in short term unless there is a major restructure to the local construction industry.

On the whole, the knowledge transfer in the local building industry is not effectively due to insufficient supports from construction companies and the inherited hurdles in connection with the multilayered subcontracting system.

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