

A Study on Multilayer Sub-contracting in Construction Industry of Hong Kong

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Abstract: Multilayer sub-contracting is a significant practice among the world, including Hong Kong. When a principal contractor secured a project from a developer, the specific jobs will usually be breaking down and sub-contractors with the lowest bid [1]. The adoption of multilayer sub-contracting has been a controversy issue which is considered as a two-side blade. While certain studies have been carried out to examine both the contributions, damages and improvements for multi-layer subcontracting, the construction industry and researchers are still waiting for a solid measure to enhance the system. Hence, this research attempts to study the advantages, disadvantages, conducts a comparison between single and multilayer sub-contracting and measures of current Hong Kong construction industry based on literature review, questionnaire and in-depth interviews. To achieve the objectives, Analytic Hierarchy Process (AHP) and total weighted score methods are adopted to examine and rank the criterion. The findings of this study provide a good basis for understanding the major reasons and problems caused by the adoption of multilayer sub-contracting. Besides, the identified safety perspective explores a new perspective regarding to issues of multi-layer subcontracting, which will serve as a solid foundation for further research to enhance safety performance. Finally, the findings of measurements towards improvement of multilayer sub-contracting will also provide a solid solution for construction industry.

Key words: multilayer sub-contracting, advantages and disadvantages, safety, measures, construction industry

1. INTRODUCTION

Subcontracting was described as “an organization which passes the provision of a service or execution of a task previously undertaken in-house to a third party to perform on its behalf” [2]. The history of subcontracting in Hong Kong can date after 1945, the end of the World War II and before the establishment of the government of Peoples Republic of China. At that time, Shanghai of China was one of the most modern cities in the world with advanced building technology. After the WWII, many construction firms from Shanghai came to Hong Kong together with their skills, technology and specialist knowledge [3]. Paul Y. Engineering is one of the examples. The number of “establishments” functioning in Hong Kong construction industry was 19,057 in 2006 whilst the number of persons

directly engaged was 135,337. Each of the establishments only employs 7 employees on average. Of these, 259 establishments are classified as main contractors, and 23,341 persons are directly engaged. Each of the main contractors employs 90 employees on average [4]. The report of the Census and Statistics Department of Hong Kong showed that the total number of “establishments” functioning in Hong Kong construction industry is 11,584 at that time. 430 are classified as main contractors, each of these employed 77 persons on average. The remaining are mainly subcontractors and specialist direct contractors. 9 persons were employed by each firm on average. Integrating the report on 2006 and data of 1987, the industry is growing whilst the size of the contracting firms is decreasing, indicating the ascension of using subcontracting [5].

Efficient, risk transferal, flexible and cost reduction were identified as the major reasons for adopting the subcontracting system in Hong Kong construction industry [6][7]. However, subcontracting is also deemed as a two-sided blade which problems including fragmentation, competitive bidding and non-value-added subcontracting layer arise [8][9]. Hence, a few researches have been conducted to improve the existing subcontracting system since it is considerably essential for the construction activities. Adopting a ‘Partnering’ between main contractor and subcontractor, limit the layers of subcontractors, change the practice of the lowest bid and implement a mandatory registration scheme were major recommendations suggested [10][11][12]. Yet, the effectiveness of these measures may require further observe..

2. RESEARCH METHODOLOGY

AHP is established for dealing with complex decision making, an effective aid to make the best decision. An AHP-design based questionnaire were distributed to the parties working in the construction industry [13]. A point scale was adopted to indicate the level of importance of each criterion as shown as Table 1. Decision hierarchy were developed for defining criterion of the advantage, problem risk factors correlated to safety impact correspondingly as shown in Figures 1 to 3. For those factors, they were extracted from previous research through literature review. Through the weighting by the respondents, calculations were carried out for data analysis process and the criterion would be ranked accordingly to their importance in either AHP method or total weighted score method. By using AHP method, the consistency ratio (CR) shall not exceed 0.1 for ensuring the validity of the results. Apart from conducting questionnaire survey, in-depth interviews were conducted to collect structural views on multi-layer subcontracting based on personal experience since we considered not only the solutions theoretically but also practical ways.

Table 1. Explanation of intensities (Scale) of AHP model [14]

Intensity	Definition	Explanation
1	Equal importance	Two elements contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favor one element over another
5	Strong importance	Experience and judgment strongly favor one element over another
7	Very strong importance	One element is favored very strongly over another, its dominance is demonstrated in practice
9	Extreme importance	The evidence favoring one element over another is of the highest possible order of affirmation

2,4,6,8 can be used to express intermediate values

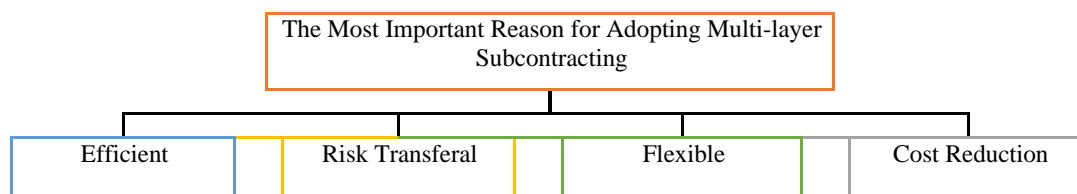


Figure 1. The decision hierarchy for selecting the most important advantage of adopting multi-layer subcontracting system

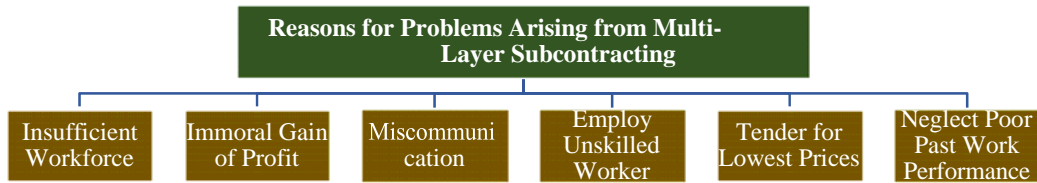


Figure 2. Hierarchy of the reasons for problems arising from multi-layer subcontracting

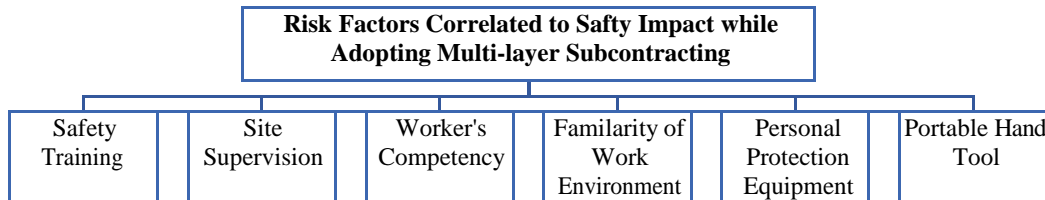


Figure 3. Hierarchy of risk factors correlated to safety impact of adopting multi-layer sub-contracting system

3. FINDINGS AND DISCUSSION

For THE questionnaire survey, 75% (30) responding rate was achieved. Among the respondents, more than a half of them had been working in the construction industry for 11 to 20 years. The respondents had diverse occupations listed varying from civil engineer, project coordinator, project manager, quantity surveyor and such alike. For in-depth interview, 8 out of 15 invitations had accepted. Different parties who had served the construction industry for 5 to 30 years from several institutions including developer, consultant, main contractor and subcontractor had responded to provide further discussions.

3.1 Advantages

A valid result (0.012, which <0.1) was generated through AHP calculation. Table 2 showed a detailed matrix responding to the importance of each advantages through comparison from questionnaire. Referring to Table 3, efficient (35.4%) was revealed as the most important reason for the adoption of multi-layer subcontracting system. In Hong Kong, the uplift demand of construction works becomes the rationale behind this finding, which more interpretations were provided by the respondents of interview. For developers, using multi-layer subcontracting system helps to reduce overhead and simplify the structure. In another mean, the developers are eligible to make optimize use of their resources in appropriate ways to enhance their performance. For subcontractors, the effect of specialization enables them to stay focus on their own trades to shorten the time of site operation. Besides, risk transferal (30.9%) was indicated as the second important criteria for adopting multi-layer subcontracting. A tight difference (4.5%) was recorded between the first and the second criteria, which might consider these two criteria were relatively important to each other. One of the respondents indicated that subletting 80% of works to subcontractors, or even 95% are usual practice in Hong Kong. The higher portion of sublet works, the less risks such as financial risks, project risks to bear.

Moreover, flexible (13.5%) was indicated as the least important criteria. One of the respondents of interview mentioned that subcontracting can help to reduce resources input for construction. Supplemented with the current situation in Hong Kong, the developers, main contractors and subcontractors are cash-rich to further expand their business in different area. Therefore, the low rank of flexible could be interpreted since the construction parties are less aware since they have subsidiary or partnering company to manage inputs.

Table 2. Matrix of the criterion of advantages for adopting multi-layer subcontracting

	Efficient	Risk Transferal	Flexible	Cost Reduction
Efficient	1	1.20	2.82	1.60
Risk Transferal	0.83	1	2.75	1.33
Flexible	0.36	0.36	1	0.86
Cost Reduction	0.62	0.75	1.17	1

Table 3. Consolidated priorities of the criterion

Category	Priority	Rank
Efficient	35.4%	1
Risk Transferal	30.9%	2
Flexible	13.5%	4
Cost Reduction	20.1%	3

Table 4. Matrix of the criterion of problems encounter from multi-layer subcontracting

	Insufficient Workforce	Immoral Gain of Profit	Miscommunication	Employ Unskilled Worker	Tender for Lowest Prices	Neglect Poor Past Work Performance
Insufficient Workforce	1	1.3237	2.6467	1.2673	1.4647	2.2067
Immoral Gain of Profit	0.7555	1	3.5388	2.8213	2.5179	4.3844
Miscommunication	0.3778	0.2826	1	2.6215	1.7473	2.8929
Employ Unskilled Worker	0.7891	0.3544	0.3715	1	1.6473	3.8254
Tender for Lowest Prices	0.6827	0.3972	0.5723	0.6071	1	3.9205
Neglect Poor Past Work Performance	0.4532	0.2281	0.3457	0.2614	0.2551	1
Total	4.0583	3.586	8.475	8.5786	8.6323	18.2299

Table 5. Normalized principle eigenvector

	Normalized Principle Eigenvector	Rank
Insufficient Workforce	22.77%	2
Immoral Gain of Profit	29.06%	1
Miscommunication	15.94%	3
Employ Unskilled Worker	14.24%	4
Tender for Lowest Prices	12.47%	5
Neglect Poor Past Work Performance	5.22%	6

3.2 Disadvantages

Based on the data, the consistency ratio is 8.72% that considered as consistent. According to the result, the most important criteria and the second important criteria of problems encounter from multi-layer subcontracting system are immoral gain of profit (29.06%) and insufficient workforce (22.77%) respectively, two of them counted over 50% that indicate most of the respondents believed it is common in building and construction industry. Half of the interviewee reflected that over subletting the contract to another lower-tier subcontractor to earn the profit damage the subcontracting system, unrealistic price can't finance the task; also, aging problem is also a main reason that arising insufficient workforce. For the least important criteria for multi-layer subcontracting system is neglect poor past work performance (5.22%), one of a interviewee mentioned that construction project is unique, not identical and repetitive, past performance only can be reference to be considered that can't induce in new project under different conditions.

3.3 Safety Issue

To compare the relative importance of six risk factors correlated to safety impact while adopting

multi-layer subcontracting. The risk factors are listed IN Table 6 and findings are summarized in Figures 4 & 5.

Table 6. Risk Factors

Risk Factor	Definition of Risk Factor
Safety Training	Insufficient resource for safety training
Site Supervision	Insufficient qualified site supervision personnel
Workers' Competency	Hiring of non-skilled worker
Familiarity of work environment	Unfamiliar of works environment due to frequent change of work location
Personal Protection Equipment	Insufficient provision of PPE
Portable Hand Tool	Poor quality of portable hand tool as lack of maintenance

Aggregation of judgments for 30 Participant(s)

	1	2	3	4	5	6
1	1	1.27	1.18	1.68	1.47	2.05
2	0.79	1	1.51	2.12	1.66	2.78
3	0.85	0.66	1	2.02	1.62	2.34
4	0.60	0.47	0.49	1	0.62	1.13
5	0.68	0.60	0.62	1.61	1	1.61
6	0.49	0.36	0.43	0.89	0.62	1

Figure 4. Matrix of the criterion of risk factor correlated to safety impact for adopting multi-layer subcontracting system

Consolidated Priorities

Consistency Ratio CR: 0.8%

Category	Priority	Rank
1 SAFETY TRAINING	22.1%	2
2 SITE SUPERVISION	23.7%	1
3 WORKERS COMPETENCY	20.0%	3
4 FAMILIARITY OF WORK ENVIRONMENT	10.6%	5
5 PERSONAL PROTECTION EQUIPMENT	14.5%	4
6 PORTABLE HAND TOOL	9.2%	6

Figure 5. Ranking table of risk factor

For confirming the validity of our survey result, consistency check was done. The consistency ratio of our survey result was 0.008 (< 0.1), i.e. the result is valid. Based on the survey result, site supervision and safety training are the top 2 risk factors contributed to safety impact while adopting multiplayer subcontracting. Besides, these 2 risk factors added up was 45.8%, it almost occupied half of the total. It revealed that lower-tier subcontractor was lack of qualified site supervision personnel and gave insufficient resource on safety training for cost saving reason. On the other hand, the above 6 risk factors could be divided into 3 categories as site management, labor and equipment shown in Table 7. Site management is the most critical factor related to the safety impact while adopting multi-layer subcontracting system.

Table 7. Ranking of category group

Categories	Criterion	Weights	Rank
Site Management	Safety Training, Site Supervision	22.1% + 23.7% = 45.8%	1
Labor	Workers' Competency, Familiarity of Work Environment	20% + 10.6% = 30.6%	2
Equipment	Personal Protection Equipment, Portable Hand Tool	14.5% + 9.2% = 23.7%	3

4. PROPOSED SOLUTION

In this study, four proposed measures were introduced to interviewees. The method includes:

- (a) Adopt a ‘Partnering’ Between Main Contractor and Subcontractor
- (b) Limit the layers of subcontractors
- (c) Change the current Tender practice
- (d) Implement a mandatory registration scheme

The findings from the survey have been summarized in Table 13. The total weight score method is obtained. The rank of relative effectiveness between these measures can be obtained according to their total weighted scores.

Table 8. Scores of the Proposed Solutions

Method	Effectiveness of methods					Total weighted scores
	1	2	3	4	5	
Adopt Partnership	1	9	9	10	1	90
Limit Layers	0	1	4	17	8	122
Change Tender Practices	0	1	8	13	8	118
Implement mandatory registration scheme	0	5	8	15	2	104

(a) Adopt a ‘Partnering’ Between Main Contractor and Subcontractor

The definition of partnering for this research is a simple term to a non-legally relationship between contracting parties in the industry in order to achieve a set of common goals in addition to individual goals. As per the Figure 11, “Adopt a ‘Partnering’ Between Main Contractor and Subcontractor” is considered as the most ineffective methods. Also, all the interviewees did not prefer adopting a “partnering” relationship between MC and subcontractor. It is difficult to set a mutual goal and it is not easy to trust each other. Also, the use of contractual terms in subcontract is always unfair to subcontractor. Therefore, it is hard to build up a fair and trustable relationship.

(b) Limit the layers of subcontractors

It is believed to be the most effective methods as per Figure 11. The appropriate level subcontracting was also indicated in the interview section. It is recommended to prohibit the first-tier subcontractor to sublet more than two layers and included this as a Special Conditions of contract. Reducing the layers can help coordinate contractors more effectively. When problems occurred during the project, it will be easier to identify and quicker to resolve the problem. Moreover, less layers which also means better chance the bottom layer subcontractors will have a more reasonable profit margin.

(c) Change the current Tender practice

It is one of the effective methods from the questionnaire result. The current tender practice should be reviewed to alter the atmosphere from cost-drive to value construction. A type of score system mechanism that evaluates not only the price but also their past performance. The sub-contractors should submit proven performance record including works quality, safety records, wages payment records etc., for reviewing their capacity. In the current practice, the main contractor usually awards the subcontract to the lowest bidder to maximize its profit. All interviewees agreed that the current tender practice of subcontracting system has its disadvantage and there are barriers to change the practice. It is recommended that the developer should step forward to change the situation and provide incentive to both main contractor and subcontractors.

(d) Implement a mandatory registration scheme

In the current stage, it is not necessary to implement a mandatory registration scheme according to the questionnaire result and interview. The government should review their current registered contractor scheme and consider extending the registration scheme to other types of contractors. Also, the scale of registration has to be deeper into the site workers, not only the companies. Also, the main contractor/ upper tier subcontractor in private sector should gradually introduce contractual conditions controlling the employment of Registered Subcontractors.

5. CONCLUSION

Considering the advantages of adopting multi-layer subcontracting, an upward trend of adopting multi-subcontracting system has been observed from the construction activities in Hong Kong, whereas the adoption has changed. From the previous findings, cost reduction was the most important reason for using multilayer subcontracting system. However, efficient replaces as we can observe from this finding. An inter-relationship can also be interpreted among the four advantages related to the use of multilayer sub-contracting. Besides, the research result of problems of subcontracting is similar to previous research findings, the immoral gain of profit rank as the top that indicate the subcontractor still act like a broker to sublet the contract to lower-tier subcontractor to earn the profit is very common. The research result has also clearly said that the situation has not get any change in this two decades. But just a like surprise that insufficient workforce is the 2nd important criteria that point out that the aging problem of building and construction industry become more serious since the past ten years, that's why you can hear about import labour to replace the vacancies. Effectively measures focus on tackling these two criteria can minimize nearly 50% problem arising from multilayer sub-contracting. Site management is the most critical factor related to the safety impact while adopting multilayer sub-contracting work and therefore, it is recommended the industry should put more focus on enhancing management skills in the scope to provide more safety trainings and supervision in order to minimize work injury and diffuse a safety awareness culture from main contractor to the bottom layer. Also, further research about site management in multilayer sub-contracting system is suggested.

To conclude, subcontracting is an influential strategy for the accomplishment of construction contracts. If properly managed by contractors, it will facilitate the execution of works in a cost-effective manner and allocate resources efficiently. However, without appropriate management, uncontrolled subcontracting could have adverse impact on the progress and quality of works. In order to strengthen the effectiveness of the practice, it is suggested that the current tender practice should be reviewed to alter the atmosphere from cost-drive to value construction. Also, prohibit the first-tier subcontractor to sublet more than two layers is recommended that help coordinate subcontractors more effectively.

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