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Criteria for Selecting Nominated Subcontractors in Commersial Building Construction

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ABSTRACT

Construction industry employs Nominated Subcontractors (NSCs) who may not possess the required expertise. Hence various issues tend to arise affecting the success of the project. On the other hand selection of subcontractor plays a pivotal role to project's success. Therefore, the issues caused by these NSCs and the actions required to prevent them were identified from the literature, validated through interviews and ranked through a questionnaire survey. 'Delays caused by subcontractor' is ranked as the most critical issue which arises due to improper selection of NSCs. The most important action that will prevent this issue is to make the NSC's program of Works to fall in line with Main Contractor's program of Works. Subsequently the next most critical issue aroused due to the improper selection was recognized as subcontractor's incompetency and the most suitable action to prevent this issue is to check subcontractor's experience, proficiency and capacity to deliver quality work on time. Finally, selection criteria were proposed to prevent the issues arising from selection of NSCs. The most significant criteria to avoid the issue, 'delays caused by subcontractor' was recognized as 'progress'. Afterwards the overall suitability of the criteria financial capacity; experience; resources; work quality; progress; design quality; site safety; general obligations were investigated. The calculated overall suitability scores of the criteria and the overall suitability bands revealed that the criteria were considered as 'suitable' to prevent the issue 'subcontractor insolvency' and for the other issues, the criteria were identified to be 'somewhat suitable'.

***Keywords**: nominated subcontractor, selection, documentation, payment*

INTRODUCTION

A large proportion of work in building projects is entirely handled by the subcontractors (Abbasianjahromi et al., 2013). According to Matthews et al. (1996), subcontracting has become common in the modern construction industry as many Main Contractors (MCs) prefer to undertake only management and co-ordination activities. Subcontracting is done by a party specialised in a particular type of construction work (Bennett and Ferry, 1990). For specialized works, clients prefer specialist subcontractors expecting them to fulfil their requirements as much as possible. Since subcontractors are seen as 'specialists', the client expects a higher quality output from them (Mbachu, 2008). Kwok and Hampson (1997) claim that subcontractors handle eighty to ninety per cent of the value of work of construction projects. However, they may not fully possess the expertise expected by their clients (Humphreys et al., 2003) because of the ease and very little capital investment with which they enter the industry (Matthews et al., 1996). Thus, selection of Nominated Subcontractors (NSCs) is crucial for success of any project. According to Rahman et al. (2013) and Arditi and Chotibhongs (2005), many construction projects suffer from delays and the probability of these delays is increased by the variables and uncertainties of the construction industry. Thus, the selection of NSCs has to be done carefully as

otherwise the successful completion of a project in terms of its time, cost and quality can get affected (Chong, 1994).

Problem Statement

Not much research, both locally and overseas, has been done on subcontracting. The research findings of one country on its construction industry cannot be applied to the construction industries of other countries as the construction industry is an industry that can differ from one country to the other. In Sri Lanka, the highest involvement of subcontractors is in building construction (77.8%) and among the buildings it is the commercial buildings that have their highest involvement (Department of Census and Statistics, 2013). However, the issues that can arise from the improper selection of NSCs for the construction of commercial buildings in Sri Lanka have not been ascertained so far. Furthermore, nominated subcontracting has a huge impact on the construction industry because of the large number of subcontracting firms involved in the industry (Yik et al., 2006). Hence, the management of NSCs working in the construction of commercial buildings in developing countries has to be improved by identifying the issues that can arise due to their improper selection and by identifying the preventive actions. Therefore, the aim of this research was to improve the selection of NSCs involved in the construction of commercial buildings in developing countries, especially in Sri Lanka. In order to derive at the aim, the following objectives were achieved.

- Identify and rank the issues related to nominated subcontracting
- Identify and rank the actions necessary to prevent the identified issues

Propose selection criteria for preventing issues arising from improper selection of NSCs.

LITERATURE SYNTHESIS

Subcontracting and Selection of Nominated Subcontractors

Arditi and Ranon (as cited in Chamara et al., 2015) identify a subcontractor as an individual or a business that signs a contract to perform a special part or all of the obligations of another's contract. Subcontractors can be classified as domestic subcontractors and NSCs. Yik et al. (2006) state that domestic subcontracting is initiated by a MC by subletting parts of his contractual work while in the case of a NSC, it is the client who selects the NSC and sets aside for him certain works of the contract. Murdoch and Hughes (2000) disclose that NSCs enter into subcontracts with the MC.

Different subcontractors have different skills and they work for projects of different organizations (Murdoch and Hughes, 2000). Nowadays, all building projects involve a large number of subcontractors (Dow et al., 2009). The selection of the right subcontractor will contribute to the successful completion of a project (Dow et al., 2009; Artto et al., 2008). Thus, it is essential to focus on the selection of the right NSCs to ensure successful completion of a project. Many researchers identify subcontractors as the key contributors to the success of a construction project. For instance, according to Parfitt and Sanvido (1993), subcontractor's experience, the qualifications of his staff, reputation, and his current workload in similar facilities are the important criteria to be considered in building projects.

Chua et al. (1999) have developed a hierarchical model for construction project success and have identified the capability of the key personnel, competency of the team, turnover rate, support received from the top management, track record, and the level of service as the criteria for subcontractor's performance. After recognizing the importance of subcontracting in achieving project success, researchers have begun to address subcontracting issues according to various perspectives such as site productivity, quality of subcontractor's supply chain, relationship with main contractors as well as subcontractor performance (Hsieh 1998, Ko et al., 2007). However, very little research has been carried out on the criteria to be used in selecting NSCs, especially in developing countries

RESEARCH METHODOLOGY

An extensive literature survey was carried out on subcontracting and the literature studied had information on subcontractors of other countries. Therefore, the findings of the literature survey had to be validated through four interviews which provided additional information during the process. The details of the interviewees are provided in Table 1. The data collected were analysed using code based content analysis software package NVIVO.

Table 1: Details of the interviewees

	Interviewee A (IA)	**Interviewee B (IB)**	**Interviewee C (IC)**	**Interviewee D (ID)**
Profession	Chartered Quantity Surveyor	Chartered Quantity Surveyor	Chartered Quantity Surveyor	Chartered Quantity Surveyor
Type of Organization	Consultancy	Consultancy	Contractor	Contractor
Designation	Director	Director	Director	Chief Quantity Surveyor
Experience	24 years	23 years	23 years	26 years

A questionnaire survey was done to rank the identified issues and their preventive actions and ascertain the most critical issue and the most suitable preventive action among them and also to identify the suitability of criteria to prevent these identified issues. Mean Rating (MR) was used to evaluate the criticality of the issue, the importance of the preventive action and the suitability of the criteria to prevent the issues.

$$\boldsymbol{MR = \sum_{i=1}^{5} (Fi\ x\ \%R)}$$

where MR= Mean Rating for an attribute; Fi= Frequency of responses for an attribute (ranging from 1-5) and %R= Percentage response to the rating point of an attribute. The criteria were ranked using Relative Important Index (RII). Criterion Suitability Score (CSS) and Overall Suitability Score (OSS) were used to evaluate the suitability of criteria for preventing the issues and thereby ensuring the proper selection of the NSCs.

$$\boldsymbol{CSSi = RIIi\ x\ MRi}$$

$$\boldsymbol{OSS = \sum_{i=1}^{n} CSSi}$$

The OSS requires the adoption of a suitable range to obtain the end result. Table 2 illustrates the ranges used for the OSS in this research. The minimum OSS was 8 and the highest was 40. The range of 32 had to be divided by 5 (6.40). A similar method had been used by Ahamad et al. (2013), Alaghbari et al. (2007), Chang and Ive (2002) and Ekanayake and Perera (2016) in their research. These overall suitability bands derived from the calculations given in Table 2 could be used to ascertain the suitability of the selection criteria.

Table 2: Overall suitability bands

OSS Value	**Calculation**	**Overall Suitability Bands**
<14.40	8 + 6.40	Not Suitable
14.41 - 20.80	14.40 + 6.40	Little Suitable
20.81 - 27.20	20.80 + 6.40	Somewhat Suitable
27.21 - 33.60	27.20 + 6.40	Suitable
33.61 - 40.00	33.60 + 6.40	Very Suitable

RESEARCH ANALYSIS AND FINDINGS

Criticalness of Issues related to Improper Selection of Nominated Subcontractors and the Importance of the Preventive Actions

The respondents of the questionnaire survey had to rank the issues and their respective preventive actions to ascertain the criticalness of the issues and the importance of the actions that will prevent these issues. In Table 3, these issues and their preventive actions are ranked according to their criticalness and importance respectively.

Table 3: Criticalness of the issues related to improper selection of nominated subcontractors and the importance of preventive actions

Issue	MR	Rank	Actions Required	MR	Rank
Delays caused by the subcontractor	4.64	**1**	**Making the NSC's program of Works to fall in line with the MC's program of Works**	4.31	**1**
			Incorporating clauses related to liquidated damages in the tender documents	4.20	**2**
			Ensuring that NSC has a proper program	3.98	**3**
			Conducting a background study to check the NSC's work history	3.89	**4**
Subcontractor's incompetency	4.49	**2**	Checking subcontractor's experience, proficiency and capacity to deliver quality work on time	4.18	**1**
			Ensuring that the technical expertise of the staff of the NSC are substantiated by their qualifications and verifying the number of skilled and semi-skilled permanent labourers employed by the NSC	3.82	**2**
			Requesting a performance bond from NSC.	3.78	**3**
			Properly supervising the NSC's work	3.62	**4**
			Making NSC registration mandatory	3.44	**5**
			Selecting subcontractors using the QA system of contractors	3.42	**6**
Defects in NSC's work	4.45	**3**	Implementing a quality management system	4.05	**1**
			Making quality certification and occupational licensing compulsory	4.00	**2**
			Ensuring that NSC's employees have the required skills	3.78	**3**
			Adopting zero defect initiative/policy	3.76	**4**
			Checking quarterly reports on ISO standards	3.47	**5**
Inefficiency of employees	4.38	**4**	Ensuring that NSC's employees are properly trained	4.22	**1**
			Avoiding overloading of the NSC with other projects	3.93	**2**
			Incorporating clauses related to liquidated damages in the tender documents	3.87	**3**
			Paying proper attention to NSC's work	3.84	**4**
			Providing project specific training	3.71	**5**
			Paying for the quantity of work done	3.58	**6**
			Maintaining proper co-ordination with relevant parties	3.51	**7**
Subcontractor insolvency	4.20	**5**	Checking the NSC's financial capacity from audited accounts	4.31	**1**
			Checking the NSC's credentials such as job references, past performance and projects in hand	4.25	**2**
			Obtaining an advance payment security	4.16	**3**
			Obtaining a performance bond	4.15	**4**
			Checking the NSC's credibility before awarding the subcontract	4.02	**5**
			Avoiding direct contract	3.33	**6**
			Making contractual provisions to deal with bankrupt subcontractors	3.22	**7**
			Establishing a project bank account	2.56	**8**
Poor MC-NSC relationship	3.98	**6**	Developing better communications between parties	4.18	**1**
			Contract management and contract administration	4.04	**2**

Issue	MR	Rank	Actions Required	MR	Rank
			Feedback	3.96	**3**
			Conducting a background study before selecting the NSC to check his working relations with the MC	3.56	**4**
			Reducing the number of layers/ tiers of subcontracting to effectively manage the communication gap	3.55	**5**
			Early selection of the subcontractor	3.29	**6**
			Partnering	3.24	**7**
			Appointing a facilitator for management	3.04	**8**
			Letting MC and NSC to collectively decide on the staff	2.91	**9**
Inability of MC to control NSC	3.89	**7**	**Having separate project management systems**	3.53	**1**
			Avoiding direct payments	3.47	**2**
			Sticking to formalities	3.33	**3**
			Observing main contractor-subcontractor relationship	3.09	**4**
Reluctance to spend money on health and safety	3.87	**8**	Allowing sufficient provisions for safety when pricing	4.27	**1**
			Inculcating a safety culture at sites	4.16	**2**
			Getting the MC to provide safety equipment, site doctor etc.	3.65	**3**
High wastage of materials	3.78	**9**	Using construction materials efficiently	4.35	**1**
			Identifying various waste management solutions	4.00	**2**
			Developing efficient and convenient waste disposal methods	3.87	**3**
			Providing proper training to workers on waste minimising	3.85	**4**
			Avoiding errors in the calculation of materials	3.75	**5**
			Introducing reusing or recycling processes	3.55	**6**
			Selecting the NSC early to enable him to get more involved in the design	3.45	**7**
Poor awareness on health and safety	3.73	**10**	**Providing awareness on the health and safety of the environment**	4.31	**1**
			Appointing supervisory personnel	3.84	**2**
			Making the NSC to learn safe working through common sense, mistakes of others and by observing others	3.69	**3**
			Off-the job training	3.65	**4**

Source: (Rodrigo and Perera, 2016)

Ten issues were identified from the literature and the interviews as resulting from the improper selection of a NSC. The respondents had ranked delays caused by the subcontractor as the most critical issue with the highest mean rating of 4.64. This was ranked as “very critical” by 70.91% of the respondents. The second most critical issue is subcontractor’s incompetency which has the second highest mean rating of 4.49.

Making the NSC’s program of Works to fall in line with the MC’s program of Works (mean rating of 4.31) is identified as the most important action that can prevent the delays caused by the subcontractor and 54.55% of the respondents had ranked this as ‘very important’. The ‘Incorporation of clauses related to liquidated damages in the tender documents’ is ranked as the second most important action.

Checking subcontractor’s experience, proficiency and capacity to deliver quality work on time (with a mean rating of 4.18) is identified as the best action that would prevent subcontractor’s incompetency. The second most important action for this issue is to ensure that the technical expertise of the NSC staff are substantiated by their qualifications and by verifying the number of skilled and semi-skilled permanent labourers employed by the NSC.

Selection Criteria suitable to prevent Issues Related to Improper Selection of NSCs

The criteria to be considered during the selection of NSCs were first identified from the literature and validated through the interviews. The main criteria identified were financial capacity, experience, resources, work quality, progress, design quality, site safety and general obligations. Initially, the criteria were ranked by the respondents of the questionnaire survey to ascertain their importance when selecting a NSC and the collected data were analysed using RII. RII values calculated are given in Table 4 and were later used to calculate CSS and OSS. The respondents were thereafter requested to identify the importance of each criterion in preventing related issues. The data collected were analysed using the Mean Rating (MR) to identify the most important criterion. The MR values that were calculated are presented in Table 4. CSS and OSS values were then calculated using the equations given under research methodology, to find out the overall suitability of the selection criteria to prevent each issue related to improper selection of NSCs. The suitability of selection criteria was ascertained by comparing the OSS values calculated with the overall suitability bands shown in Table 2.

Table 4: Criteria and their suitability to prevent issues related to improper selection of NSCs

Rank	Issue	Criteria	MR	RII	CSS	OSS	Suitability Bands
1	Delays caused by the subcontractor	Progress	4.29	0.905	3.885	25.162	Somewhat Suitable
		Resources	4.22	0.895	3.773		
		General obligations	3.78	0.756	2.860		
		Financial capacity	3.65	0.855	3.123		
		Experience	3.58	0.902	3.230		
		Quality of work	3.56	0.913	3.253		
		Design quality	3.36	0.825	2.777		
		Site safety	2.76	0.818	2.261		
2	Subcontractor's incompetency	Quality of work	4.40	0.913	4.016	27.175	Somewhat Suitable
		Experience	4.35	0.902	3.919		
		Resources	4.31	0.895	3.855		
		Progress	3.98	0.905	3.605		
		Design quality	3.80	0.825	3.137		
		Financial capacity	3.62	0.855	3.092		
		General obligations	3.56	0.756	2.695		
		Site safety	3.49	0.818	2.856		
3	Defects in subcontractor's work	Quality of work	4.07	0.913	3.717	24.736	Somewhat Suitable
		Experience	4.02	0.902	3.624		
		Resources	3.87	0.895	3.464		
		Design quality	3.64	0.825	3.002		
		General obligations	3.42	0.756	2.585		
		Financial capacity	3.38	0.855	2.890		
		Progress	3.35	0.905	3.029		
		Site safety	2.96	0.818	2.425		
4	Low efficiency of employees	Experience	3.91	0.902	3.525	22.317	Somewhat Suitable
		Progress	3.64	0.905	3.293		
		Quality of work	3.31	0.913	3.020		
		Resources	3.24	0.895	2.895		
		Financial capacity	3.18	0.855	2.719		
		Design quality	2.93	0.825	2.416		
		General obligations	2.87	0.756	2.173		
		Site safety	2.78	0.818	2.276		
5	Subcontractor insolvency	Financial capacity	4.31	0.855	3.682	27.551	Suitable
		Experience	4.20	0.902	3.788		
		Quality of work	4.18	0.913	3.817		
		Resources	4.16	0.895	3.725		
		Progress	4.04	0.905	3.655		
		General obligations	3.75	0.756	2.833		
		Design quality	3.69	0.825	3.047		
		Site safety	3.67	0.818	3.005		
6		Quality of work	4.16	0.913	3.800	25.036	Somewhat Suitable

Rank	Issue	Criteria	MR	RII	CSS	OSS	Suitability Bands
	Poor MC-NSC relationship	General obligations	4.02	0.756	3.039		
		Progress	3.98	0.905	3.605		
		Experience	3.71	0.902	3.345		
		Design quality	3.64	0.825	3.002		
		Financial capacity	3.25	0.855	2.781		
		Site safety	3.22	0.818	2.633		
		Resources	3.16	0.895	2.830		
7	Inability of MC to control NSC	General obligations	3.84	0.756	2.902	22.963	Somewhat Suitable
		Experience	3.75	0.902	3.378		
		Resources	3.49	0.895	3.123		
		Progress	3.42	0.905	3.095		
		Quality of work	3.38	0.913	3.087		
		Design quality	3.31	0.825	2.732		
		Site safety	2.95	0.818	2.410		
		Financial capacity	2.62	0.855	2.237		
8	Reluctance to spend money on health and safety	Site safety	3.89	0.818	3.183	22.145	Somewhat Suitable
		Financial capacity	3.80	0.855	3.247		
		Experience	3.64	0.902	3.279		
		Quality of work	3.15	0.913	2.871		
		General obligations	3.05	0.756	2.310		
		Resources	2.89	0.895	2.586		
		Progress	2.82	0.905	2.552		
		Design quality	2.56	0.825	2.116		
9	High wastage of materials	Experience	4.44	0.902	4.001	22.931	Somewhat Suitable
		Quality of work	4.11	0.913	3.750		
		Design Quality	3.60	0.825	2.972		
		General obligations	3.13	0.756	2.365		
		Progress	3.05	0.905	2.766		
		Resources	3.00	0.895	2.684		
		Site safety	2.67	0.818	2.187		
		Financial capacity	2.58	0.855	2.206		
10	Poor awareness on health and safety	Site safety	4.33	0.818	3.540	20.897	Somewhat Suitable
		Experience	3.67	0.902	3.312		
		Financial capacity	3.02	0.855	2.579		
		Quality of work	2.80	0.913	2.556		
		General obligations	2.69	0.756	2.035		
		Resources	2.69	0.895	2.407		
		Design quality	2.60	0.825	2.146		
		Progress	2.56	0.905	2.321		

The overall suitability of the selection criteria to prevent each issue related to improper selection of NSCs is based on the calculated OSS values presented in Table 4. The highest overall suitability score (27.551) is for subcontractor insolvency followed by subcontractor's incompetency (27.175). The third highest overall suitability score is for delays caused by the subcontractor (25.162) while the next highest overall suitability score is for imperfection in main contractor-subcontractor relationship (25.036). According to pre-defined suitability bands (please refer Table 2), the overall suitability score of 27.551 of the issue 'subcontractor insolvency' falls between the overall suitability band 27.20 and 33.60. Hence, the selection criteria can be considered as 'suitable' to prevent the issue 'subcontractor insolvency'. However as for the other nine issues, the selection criteria are only 'somewhat suitable'. None of the issues has 'not suitable' or 'little suitable' for the selection criteria. Hence, the selection criteria are suitable to prevent the issues that arise from the improper selection of NSCs. If the identified selection criteria are followed, these issues could be easily prevented.

CONCLUSION

There is a considerable degree of nominated subcontracting involved in construction projects and the management of NSCs has thus become important to ensure satisfactory project performance. However, nominated subcontractors in Sri Lanka follow informal practices resulting in various issues. Therefore, the issues related to improper selection and actions to prevent them were investigated. There were 10 issues related to improper selection. The actions were also identified to prevent these issues. Thereafter, the significance of these issues and their preventive actions were explored. The most critical issue related to improper selection of NSCs is the delays caused by the subcontractor and the most important preventive action is to make the NSC's program of Works to fall in line with the MC's program of Works. Subsequently, the selection criteria, namely financial capacity, experience, resources, work quality, progress, design quality, site safety and general obligations were recognized as 'suitable' to prevent subcontractor insolvency related to improper selection of the NSCs. The selection criteria were identified as 'somewhat suitable' to prevent the other nine issues. Hence, the selection criteria can be considered as suitable to prevent the issues related to improper selection of NSCs.

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The manuscript should be within the range of 5000 – 7500 words in Times New Roman font, 12 point type. Authors are requested to state how many words their paper contains. The manuscripts should be typed and single spaced on one side of A4 paper only, with 4 cm margins on the sides, the top and the bottom. All text should be set aligned justified throughout. The pages should be numbered in order.

Title Page

The first page of the manuscripts must contain the full title, name of author(s), designation(s) of affiliation(s), highest academic qualification and the present address(es) with the telephone/fax/e-mail contact information listed.

Abstract and Keywords

The abstract must not exceed 250 words and should summarise the paper including the main conclusions. There shall be not more than 5 keywords.

Text

The order when typing manuscripts: Title, author(s), highest academic qualification, Affiliations, Abstract, Keywords, Main Text (Aim, Problem Statement/Issues, Methodology and Analysis), Conclusion and Recommendations, References, Acknowledgment and Appendix (if any). Simple language, short sentences and a good use of headings are encouraged. Headings should be numbered and the use of more than three levels of heading should be avoided. Headings and paragraphs should be separated by two carriage returns. Text following a heading should not be indented.

Illustration

Photographs, diagrams and charts should be referred to as "Figure(s)" and numbered in the order in which they are referred to in the text. Maps and diagrams should be submitted in a form ready for reproduction, all in legible digital format. Please note that illustrations in the journal shall be printed in black-and-white or grey-scale.

Units

All measurements and data should be given in metric units or, if other units are used, then the metric equivalent should be given in parentheses.

Reference

The APA 6th reference system is used. The reference is referred to in the text by the following manner:

Journal

Alesheikh, A. A., Ghorbanali, A., & Nouri, N. (2007). Coastline change detection using remote sensing. *International Journal of Environmental Science & Technology*, *4*(1), 61-66.

Baig, M. H. A., Zhang, L., Shuai, T., & Tong, Q. (2014). Derivation of a tasselled cap transformation based on Landsat 8 at-satellite reflectance. *Remote Sensing Letters*, *5*(5), 423-431.

Book

Malcolm Taylor (2000) *Avoiding Claims in Building Design: Risk Management in Practice*, Blackwell Science Ltd, London

Conference Proceeding

Hamzeh, F.R. (2011). The Lean Journey: Implementing the Last Planner System in Construction, Proceedings of the 19th Annual Conference of the International Group for Lean Construction, IGLC 19, 13-15 July, Lima, Peru, pp. 379- 390

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