RISK ALLOCATION BETWEEN MAIN CONTRACTORS AND SUBCONTRACTORS IN BUILDING PROJECTS IN SRI LANKA

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ABSTRACT

Risk is identified as a probability of occurrence of an event which may have an adverse impact on the project objectives. Therefore, risk identification and allocation in a well-defined manner is a mandatory prerequisite for a successful project. An optimum risk allocation between main contractor and subcontractor becomes crucial as because in most projects, considerable amount of risk is usually being allocated to subcontractors, and success of a project hugely depends on risk allocation decisions. Hence the aim of this research was to identify and prioritise risks which are common and significant to the relationship between main contractor and subcontractor and to develop a guidance to allocate those risks to the party best placed to manage them. To achieve the aim of this research first, an extensive literature survey was carried out to identify the common risks and to review the concept of risk allocation and its application to the construction industry. A questionnaire survey was carried out to prioritize those short listed risk factors and to find the optimum risk allocation between concerned parties. Through the analysis of collected data using RII, a 'risk register' and a 'risk matrix' were developed. It is recommended that the developed risk register be used as a guidance during the risk identification phase and risk matrix when allocating those risks between concerned parties.

Keywords: *Main Contractor; Risk Allocation; Risk Management; Risk Matrix; Subcontractor.*

1. INTRODUCTION

No construction project is risk-free. "Risk" can be defined as "unpredictable events that might occur in the future whose exact likelihood and outcome is uncertain" (Loosemore *et al.*, 2006, p.8).Construction industry is especially risk prone due to the fact that construction projects are one off projects with many features that make them unique to most industries (Taylor and Mbachu, 2014). According to Latham (1994 cited Lam *et al*., 2007), risk is "manageable, diminishable, transferable or acceptable but not ignorable". Therefore, a proper risk management process is essential to manage risks and successfully fulfil project objectives. Risk management can be viewed as a systematic approach to deal with risks (Edwards and Bowen, 1998). Risks, which are identified and allocated in a well-defined manner is a mandatory prerequisite for a successful project. Herein, risk allocation can be identified as a major function in risk management process, which allows the risks to be divided among the parties best placed to manage them (Hearn, 2004). Hence, in the context of construction projects, risk allocation becomes particularly imperative to project success.

In a construction project, main contractor is employed by the client and is responsible for the overall coordination of a project (Shekar, 2005). Nelson (2007) states that by entering in to a contractual agreement with client, main contractor explicitly assumes the risk of timely and complete performance of works agreed. By "subletting some or all parts of the work", the main contractor can "assign obligations and rights under the contract for building to others who are not parties to the contract, but at the same time retain the overall contractual responsibility as far as the head contract is concerned" (Uher, 2006). While risk allocation is mainly done through contract documents in the case of such subcontracts, this may not always yield results that are fair and is to the satisfaction of both parties (Lam *et al*., 2007). One reason for this is the unavailability and/ or non-usage of standard sub contract documents, which often results in main contractors preparing their own tailor made sub contract documents (Uher, 2006). This can

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often result in passing off the responsibility of most risks to others by the party that prepares the contractual documents (Lam *et al*., 2007).

Using a "risk register" and/or a "risk matrix" are precise ways of optimally allocating risks between parties. In the current construction context, these are used as tools, particularly in PPP/PFI (Public Private Partnership/ Private Finance Initiative) projects, to allocate risks between the client and the main contractor. Herein, "risk register" can be identified as a list of categorized risks and risk factors, while "risk matrix" in addition to above, shows to whom those risk should be allocated (Bing *et al.*, 2005; Ng and Loosemore, 2007). Hearn (2004) states that it may be prudent to develop a risk register or matrix to help identify risks and to keep track of how the risks are allocated and managed.

The risk allocation between the client and the main contractor has been vastly taken into consideration by many researchers. For instance, researchers such as, Grimsey and Lewis (2004); Bing *et al*. (2005); Ng and Loosemore (2007); Susilawati *et al*. (2009) have developed such risk registers/matrices for the purpose of risk allocation between clients and the main contractors. However, the risk allocation between the main contractors and the sub-contractors is often neglected in many researches (Artto *et al*., 2008). In research related to the Sri Lankan construction industry in particular, this area still remains untouched. Hence, the aim of this paper is to develop a risk register and a risk matrix, which can be used as a guidance for identifying and allocating the risks between the main contractor and the subcontractor in building construction projects Sri Lanka.

2. LITERATURE REVIEW

2.1. RISK MANAGEMENT

Both Royal Society (1991 cited Edwards and Bowen, 1998); CIDB (2004) have identified construction risk as a probability of occurrence of an event which may have an adverse impact on the project objectives in terms of time, cost and quality. Typically, risk is expressed in terms of probabilities and consequences (Loosemore *et al*., 2006). Herein, probability alludes to a judgement about the perceived relative likelihood of some event and consequences are measured in monetary terms (CIDB, 2004). Considering the above, risk can be assessed by multiplying the probability of the event by the consequence if it occurred (Hearn, 2004).

Risk = Probability of event x magnitude of loss/gain

According to Nieto-Morote and Ruz-Vila (2011) risks are neither ignorable nor fully eliminable. Therefore, as Baker *et al*. (1997) highlights the choice is between two options; either to accept the risks or to take measures to minimize their consequences. Both of these activities fall under the category of 'risk management', which could be described as the "process of proactively working with stakeholders to minimize the risks and maximize the opportunities associated with project decisions (Loosemore *et al*., 2006, p.29). The aim here is not to avoid risk but to take "calculated risks, make more informed decisions, avoid unpleasant surprises and identify opportunities" (Loosemore *et al*., 2006, p.29).

Baloi and Price (2001) argue that there is a direct relationship between effective risk management and project success. This is because risks are "assessed by their potential effect on the objectives of the project". Loosemore *et al*. (2006) have strengthened the above argument by tracing failed projects with non-achievement of time, cost and quality back to the absence of proper risk management techniques. So it can be concluded that risk management is essential for the survival and success of construction projects. The following section of this paper briefly describes the risk management process.

2.2. RISK MANAGEMENT PROCESS

Risk identification, risk allocation, and risk handling/risk response are the key activities of the risk management process (Baker *et al*., 1997). From these, risk response; which is the process of developing strategic options, and determining actions, to reduce risk to the project's objectives and enhance opportunities (Lam *et al*., 2007); is outside the scope of this paper. The focus of the paper is mainly on the first two activities, risk identification and risk allocation, which are further discussed below.

2.2.1. RISK IDENTIFICATION AND CLASSIFICATION

Nieto-Morote and Ruz-Vila (2011) has defined risk identification as a process of determining which risks may affect the project and documenting their characteristics. According to Flanagan and Norman (1993 cited Perera *et al*., 2009), an identified risk is no longer a risk, but a management problem. Classification of risk also falls under the risk identification category and entails identifying the type, consequence and impact of risk (Perera *et al*., 2009). The risk factors which were identified by the past researches that can be tabulated as given in Table 1.

Table 1: Risk Factors

Risk factor category	Risk factors	Reference					
		1	2	3	4	5	6
Political and Government Policy	Unstable government		✓	✓			
	Strong political opposition/hostility		✓				
Macroeconomic	Inflation rate volatility			✓			
	Interest rate volatility			✓			
	Influential economic events			✓			
Legal	Legislation change	✓					
	Changes in tax regulations	✓					
Natural	Weather					✓	
	Force majeure					✓	
	Geotechnical conditions					✓	
	Environment					✓	
Project Finance	Availability of finance			✓			
Residual Risks	Residual risks		✓				
Design	Delay in project approvals & permits	✓					
	Design deficiency	✓					
Construction	Construction cost overrun				✓		
	Construction time delay				✓		
	Material/labour availability				✓		
	Late design changes				✓		
	Poor quality workmanship				✓		
	Excessive contract variation				✓		
Relationship	Inadequate experience of contractor				✓		
	Inadequate experience of subcontractor				✓		
	Inadequate distribution of responsibilities and risks				✓		
	Inadequate distribution of authority in partnership				✓		
	Differences in working method and know-how between partners				✓		
	Bid shopping						✓
Third party	Staff crises					✓	

Source: Tchankova (2002); Harinarain *et al*. (2008); Edwards and Bowen(1998); Uher (2006); Loosemore *et al*. (2006); Hinze and Trazey (1994)

2.2.2. RISK ALLOCATION

Once the risks are identified, defined and classified, the next stage is to allocate these risks to different parties. Risk allocation involves the division of responsibilities associated with risks among concerned parties regardless of the methods (transferring, sharing, etc.) (Lam *et al*., 2007). Herein, it is important that the risks are allocated so that they rest with the parties that have control over them and are best able to manage them (CIDB, 2004). So, if one party is not in the best position to manage a concerning risk, there might always be another party willing to take that risk as the same risk event may create opportunities for the latter party (Loosemore *et al*., 2006).

2.3. ALLOCATION OF RISKS BETWEEN MAIN CONTRACTORS AND SUBCONTRACTORS

According to ICTAD(2007), main contractor is defined as a tradesman, who has signed a letter of acceptance with the client. Hinze and Tracey (1994) have defined 'subcontractor' as a specialty contractor, hired to perform a specific task of a project. According to Hinze and Tracey (1994), in many building projects, 80% to 90% of the total work is usually performed by subcontractors. Thus, success or failure and profit or loss of a project ultimately depends on the performance of the subcontractors (Nelson, 2007). Hence, optimum risk allocation between main contractor and subcontractor becomes crucial and ever important.

The issue of improper allocation of risks between main contractor and subcontractor and its resulting consequences have been highlighted by a number of researchers. Unavailability of the standard sub contract documents has been identified as a particular issue that can result in risks not being allocated to the party that is best able to effectively and efficiently manage them (Uher, 2006). Hanna *et a*l. (2013) note that the tailor made subcontract documents prepared by most main contractors are highly modified to suit their own requirements while allocating a large portion of risk to the subcontractor. Improper risk allocation between main contractor and subcontractor is further enhanced by client's limited involvement in sub contractual matters (Uher, 2006) and the practice of pre exposing subcontractor's bid price to prospective subcontractors (i.e. bid shopping) in order to come up with a significant lower bid price (Trangkanont and Charoenngam, 2014).

Risk matrix can be identified as a method of showing to which party, each specific risk is allocated together with their category and source if needed (Bing *et al*., 2005; Ng andLoosemore, 2007).Such risk matrices make it easier for parties to keep track of how the risks are allocated and managed between concerned parties (Hearn, 2004).

3. RESEARCH METHODOLOGY

This research aims to develop a 'risk register' by identifying and prioritising the risks between main contractor and subcontractor and a 'risk matrix' that could guide risk allocation decisions. A questionnaire survey was used as the main data collection approach in achieving this aim.

As shown in Table 1, 28 risk factors were identified through the comprehensive literature review and these were used to develop the initial questionnaire. This initial questionnaire was refined using four informal expert interviews (two main contractors and two sub-contractors). These informal interviews were useful to ensure 'sensitivity to participants' language' and 'privilege' [from] their knowledge', especially relating to the Sri Lankan context (Fossey *et al*., 2002). Considering the input of the interviewees, the initial questionnaire was further refined by removing three of the risk factors (i.e. 'unstable government', 'force majeure' and 'staff crises') identified in Table 1. The interviewees noted that these risks are not passed down to the subcontract level and are usually borne by the client or determined at the main contract level. Hence, the three factors were omitted from the final questionnaire as they were deemed not applicable to the relationship between the main contractor and subcontractor in the Sri Lankan construction context. Four new risk factors (i.e. 'political support', 'price increasing of materials', 'working capital' and 'specialized design') were instead included considering the interviewees' suggestions. These factors were not identified through the literature review, but were deemed important by the interviewees as they were prevailing risks when it comes to the Sri Lankan context. Altogether, 29 risk factors were included in the final questionnaire sent out to respondents (refer Table 2).

The developed questionnaire consisted of two main sections. The first section focused on identifying the frequency (or likelihood) of occurrence of each risk factor and their impact to the project objectives. This was necessary to develop a ranked risk register indicating significant risk factors related to the relationship between main contractor and subcontractor. Five point Likert scales were used to ascertain the frequency of occurrence (1-rare to 5-almost certain)and the level of impact (1-negligible to 5-severe) of each identified risk factor. The second section of the questionnaire, focused on allocation of risks between main contractors and subcontractors. Herein, two separate five point Likert scales were used to ascertain the optimum allocation for main contractor and subcontractor of identified risks.

The scope of this research was on main contractors with 'C1' CIDA grading and MEP sub contractors with 'EM1' CIDA grading in the Sri Lankan construction industry. Further, it was limited to building projects under conventional procurement method and to projects exceeding One Million Rupees of subcontract value. Convenience sampling technique was used to select the sample and questionnaires were distributed among 25 quantity surveyors (QS) from main contractors and 25 subcontractors satisfying the above criteria. Out of these, 21 main contractor QSs and 18 subcontractor QSs responded to the questionnaire.

3.1. DATA ANALYSIS

The Relative Importance Index (RII) can transform the findings of 5-point Likert scales in such a way that facilitates ranking of all the factors (Tan *et al*., 2010). Hence, it provided a useful tool to rank the risk factors from the data gained through the first section of the questionnaire. RII also provided a basis for calculating risk allocation percentages for both main contractor and subcontractor. RII was calculated using the following formula in this research:

$$RII = \frac{\sum W}{A \times N} \times 100\% \qquad \text{Eq: 01}$$

Where, W = Weight given to each factor by respondent, A= The highest weight, N = Total number of the respondent

Ranking risk factors: It is important to consider, both probability and consequences when assessing risk. This is because although something may have a very low probability of occurring, extreme consequences can make it a very high risk (CIDB, 2004). Therefore, for the purpose of ranking/prioritizing risk factors (i.e. the focus of the first section of the questionnaire), a rating value was derived considering RII values of both occurrence and impact of risk factors. Ease of referring a single figure value rather than considering both RII values of occurrence and impact at the same time, which could be complex, was also reason to derive a rating value.

The rating value was derived through following steps.

1. Calculated RII (RII_f) for frequency of occurrence (likelihood) of risk factors.
2. Calculated RII (RII_i) for impact for project objectives of risk factors.
3. Calculated rating value by multiplying results from 1 and 2 (RII_f and RII_i).

Risk cut off criteria: Several researchers have developed cut off criteria, which can be used to determine whether a particular risk factor is to be considered as significant or not. According to Sun *et al.* (2008); Kamalanathan (2013) if a risk factor fails to fulfil any of the following requirements, it can be regarded as a not significant risk factor to the concerning context. Those requirements are;

1. With a rating of 0.360 or above
2. With RII of 0.600 or above for the frequency of occurrence (since the rating is 1-5, point 3 considered as the neutral point)
3. With RII of 0.600 or above for the impact on project objectives

Risk allocation: The focus of the second section of the questionnaire was to determine the optimum allocation of risk factors between parties. For this, main contractor QSs and subcontractor QSs were requested to provide their opinions on allocation of risk factors for each party (main contractor and subcontractor) on two different Likert scales. Then RII values of each risk factor for main contractor (RIImc) and subcontractor (RIIsc) were calculated separately, as follows;

- RII values of each risk factor for both main contractor and subcontractor separately, as per the opinion of main contractors' perspective (RIImc - by 21 respondents from main contractor organizations)
- RII values of each risk factor for both main contractor and subcontractor separately, as per the opinion of subcontractors' perspective (RIIsc - by 18 respondents from subcontractor organizations)

According to Uher (2006); Kamalanathan (2013), percentages represented by Likert scale can be considered as follows;

- Point 1 - from0% to 20%
- Point 2 - from 21% to 40%
- Point 3 - from 41% to 59% (neutral point)
- Point 4 - from 60% to 79%
- Point 5 - from 80% to 100%

Considering the above, the following criteria were used in this study to determine the allocation of risks. For each risk factor, if the percentage derived from RII is;

- From 0% to 40% - allocated to the relevant single party
- From 41% to 59% - shared by both parties
- From 60% to 100% - allocated to the relevant single party

4. RESEARCH FINDINGS

4.1. FREQUENCY OF OCCURRENCE OF RISK FACTORS AND THEIR IMPACT TO PROJECT OBJECTIVES

The 29 risk factors used in the questionnaire survey could be categorised into nine categories as shown in Table 4. Calculated RII values considering the frequency of occurrence (RII_f) and the impact for project objectives (RII_i) of each risk factor, rating values, ranks within each risk category and overall ranks are given in Table 2.

Table 2: Ranking Risk Factors

	RISK FACTOR	[A] OCCURRENCE RII (RII_f)	[B] IMPACT RII (RII_I)	[A]x[B] RATING VALUE	RANK	OVERALL RANK
	POLITICAL AND GOVERNMENT POLICY					
01	Political support	0.728	0.683	0.497	1	13
02	Strong political opposition/hostility	0.583	0.606	0.353	2	18
	MACROECONOMIC					
03	Price increasing of materials	0.739	0.822	0.607	1	6
04	Inflation rate volatility	0.739	0.706	0.522	2	11
05	Interest rate volatility	0.561	0.633	0.355	3	17
06	Influential economic events	0.472	0.450	0.212	4	28
	LEGAL					
07	Legislation change	0.728	0.722	0.526	1	10
08	Changes in tax regulations	0.561	0.617	0.346	2	20
	NATURAL					
09	Weather	0.733	0.772	0.566	1	8
10	Geotechnical conditions	0.628	0.650	0.408	2	16
11	Environment	0.494	0.472	0.233	3	27
	PROJECT FINANCE					
12	Working capital	0.856	0.844	0.722	1	1
13	Availability of finance	0.744	0.761	0.566	2	7
	RESIDUAL RISKS					
14	Residual risks	0.494	0.572	0.283	1	24
	DESIGN					
15	Design deficiency	0.817	0.772	0.631	1	4
16	Specialized design	0.617	0.744	0.459	2	15
17	Delay in project approvals and permits	0.533	0.650	0.346	3	19
	CONSTRUCTION					
18	Construction time delay	0.806	0.794	0.640	1	3

19	Construction cost overrun	0.822	0.744	0.612	2	5
20	Late design changes	0.694	0.706	0.490	3	14
21	Excessive contract variation	0.511	0.639	0.327	4	22
22	Poor quality workmanship	0.544	0.589	0.320	5	23
23	Material/labour availability	0.522	0.517	0.270	6	25
	RELATIONSHIP					
24	Inadequate distribution of responsibilities	0.806	0.867	0.699	1	2
25	Inadequate distribution of authority in	0.789	0.700	0.552	2	9
26	Bid shopping	0.689	0.728	0.502	3	12
27	Inadequate experience of Sub-contractor	0.572	0.594	0.340	4	21
28	Differences in working method and know-	0.517	0.517	0.267	5	26
29	Inadequate experience of contractor	0.452	0.447	0.202	6	29

Recognized as non-significant

Out of the 29 risk factors, only 17 were identified as significant risk factors considering the criteria discussed in section 3.0. 'Working capital' was identified as the highest ranked risk factor and 'Inadequate experience of contractor' had the lowest rank.

Under the category of 'political and government policy', 'political support' risk factor has become dominant having relatively higher RII values for both occurrence and impact. But 'strong political opposition/hostility' has become a non-significant risk factor, due to relatively low RII_f, which implies that likelihood of occurrence of this risk factor may be relatively low. It may also be ascertained that latter risk factor is too remote to be included in the relationship between main contractor and subcontractor.

In the 'macroeconomic' category, the risk factors 'price increasing of materials' and 'inflation rate volatility' both have a high impact on project objectives having RII_i values of 0.822 and 0.706 respectively.

Under 'legal' risk factor category, 'legislation change' have become a significant risk factor with dominating RII_f and RII_i values with an overall rank of 10. Though RII_i is high, due to relatively less RII_f, 'changes in tax regulations' have become a non-significant risk factor. This implies that, although the impact on project objectives is high, the respondents consider changes in tax regulations are less likely to happen in the Sri Lankan context.

'Weather' and 'geotechnical conditions' have become dominating risk factors in 'natural' risk factor category, having relatively values higher than 0.600 for both RII_f and RII_i.

Under 'project finance' risk factor category, 'working capital' was identified as the predominant risk factor. This also had an overall rank of 1 considering all the identified risk factors. It had the highest RIIf and second highest RII_i, implying that 'working capital' is a very likely risk factor to take place in the Sri Lankan context and has a very high impact on project objectives if it occurs.

On the other hand, 'residual risks' was identified as a non-significant risk factor having a relatively low RII_i. Under the 'design' risk factor category, 'design deficiency' and 'specialized design' risk factors were identified as the dominant risk factors having relatively high values for both RII_f and RII_i.

Under 'construction' risk factor category, 'construction time delay', 'construction cost overrun' and 'late design changes' were identified as significant risk factors.

Under 'relationship' risk factor category, 'inadequate distribution of responsibilities and risks', 'inadequate distribution of authority in partnership' and 'bid shopping' were identified as significant risk factors. Out of these three, 'inadequate distribution of responsibilities and risks' has become predominant having an overall rank of 2 and highest RII value for impact. On the other hand, 'inadequate experience of contractor' had the lowest rank out of all of the risk factors and emerged as a non-significant risk factor considering the criteria mentioned in section 3.1. As this research was limited to the C1 main contractors, EM1 subcontractors and projects above LKR 1 million subcontract values, this risk factor would be rare in such contexts.

The above findings were used to develop the risk register (refer Table 3).

Table 3: Proposed Risk Register

Risk meta level	Risk factor category	Risk factors	Rank
Macro level risks	**Political and Government Policy**	Political support	13
	Macroeconomic	Price increasing of materials	6
		Inflation rate volatility	11
	Legal	Legislation change	10
	Natural	Weather	8
		Geotechnical conditions	16
Meso level risks	**Project Finance**	Working capital	1
		Availability of finance	7
	Design	Design deficiency	4
		Specialized design	15
		Delay in project approvals and permits	17
	Construction	Construction time delay	3
		Construction cost overrun	5
		Late design changes	14
Micro level risks	**Relationship**	Inadequate distribution of responsibilities and risks	2
		Inadequate distribution of authority in partnership	9
		Bid shopping	12

4.2. OPTIMUM RISK ALLOCATION BETWEEN MAIN CONTRACTOR AND SUBCONTRACTOR

In the second section of the questionnaire, the respondents were requested to indicate how those risk factors, which were identified and shortlisted in the risk register (refer Table 3), should be allocated in order to get those risks managed in the best possible way. For this, main contractor QSs and subcontractor QSs were requested to provide their opinions on allocation of risk factors for each party (i.e. main contractor and subcontractor) on two different Likert scales. Using RII values, allocation percentage for each risk factor were derived as discussed in section 3.1. Table 4 provides the percentage allocation of risks from the perspectives of main contractor and sub-contractor.

Table 4: Allocation of Risks between Main Contractor and Sub-contractor

	Risk Factor	Main Contractor's Perspective		Sub Contractor's Perspective	
		Percentage allocation to main contractor	Percentage allocation to sub-contractor	Percentage allocation to main contractor	Percentage allocation to sub-contractor
	POLITICAL AND GOVERNMENT POLICY				
01	Political support	60%	40%	63%	37%
	MACROECONOMIC				
02	Price increasing of materials	38%	62%	64%	36%
03	Inflation rate volatility	31%	69%	65%	35%
	LEGAL				
04	Legislation change	56%	44%	54%	46%
	NATURAL				
05	**Weather**	56%	44%	58%	42%
06	Geotechnical conditions	41%	59%	55%	45%
	PROJECT FINANCE				
07	Working capital	40%	60%	63%	37%
08	Availability of finance	36%	64%	62%	38%
	DESIGN				
09	Design deficiency	42%	58%	40%	60%

10	Specialized design	35%	65%	30%	70%
11	Delay in project approvals and permits	55%	45%	59%	41%
	CONSTRUCTION				
12	Construction time delay	38%	62%	54%	46%
13	Construction cost overrun	42%	58%	55%	45%
14	Late design changes	60%	40%	70%	30%
	RELATIONSHIP				
15	Inadequate distribution of responsibilities	40%	60%	70%	30%
16	Inadequate distribution of authority in	43%	57%	62%	38%
17	Bid shopping	65%	35%	73%	27%

Consequently, a risk matrix was developed as shown in Table 5, which can be used as guidance when allocating risk between main contractor and subcontractor.

Table 5: Proposed Risk Matrix

Risk factor	**Risk Allocation**			
	Main contractor	Sub-contractor	Shared by both	To be decided after further negotiations
Political support	✓			
Price increasing of materials				✓
Inflation rate volatility				✓
Legislation change			✓	
Weather			✓	
Geotechnical conditions			✓	
Working capital				✓
Availability of finance				✓
Design deficiency		✓		
Specialized design		✓		
Delay in project approvals and permits			✓	
Construction time delay				✓
Construction cost overrun			✓	
Late design changes	✓			
Inadequate distribution of responsibilities				✓
Inadequate distribution of authority in				✓
Bid shopping	✓			
Total	*3*	*2*	*5*	*7*

Out of the 17 risk factors, under agreement of both parties, 3 risk factors were allocated to main contractor, 2 for subcontractor and 5 risk factors were shared by both parties. However, regarding rest of the factors (7), both parties had contradictory views. This was due to either, 1) both parties were transferring those risk factors to the other party or 2) while one party suggest that other party should bear the risk, other party suggest to share the risk instead. However, allocation of those risk factors in question might depend on the nature of the project or let to be further negotiated between parties. Moreover, the three top ranked risk factors of significance were also among those which were not agreed by parties, of allocation.

Practitioners in construction industry can use this risk matrix as guidance for allocating risks between main contractor and subcontractor for building projects in Sri Lanka. This risk matrix would help to get a general idea on what risk factor should be allocated to which party and what risks should be shared among parties, during the risk allocation process. However, limitations of this research discussed under section 3.0 should be taken into consideration, whenever using this risk matrix.

5. CONCLUSIONS AND RECOMMENDATIONS

In the context of construction projects, risk cannot be completely avoided or evaded. Therefore, a proper risk management process is essential to identify and allocate risks in a systematic manner.

This study investigated 29 risk factors, which were identified as affecting the relationship between the main contractor and subcontractor. Out of these, 17 risk factors were found to be significant based on their frequency of occurrence and impact to the project objectives. Risk of "working capital" was the highest ranked risk to the relationship between main contractor and subcontractor, while "inadequate experience of the contractor" was lowest ranked. According to Loosemore *et al*. (2006), although a risk may have a very low probability of occurring, extreme consequences can make it a high risk. Based on this view, some risk factors such as 'interest rate volatility' and strong political opposition and hostility, which were identified as not significant, may have the probability to develop into such risks.

When it comes to the allocation of risks, practitioners must be careful to make both the parties understand that managing risks is a joint responsibility. It is important that ownership of as many risks as possible are determined and allocated to an appropriate party as any risks without ownership may lead to disputes and/or claims later on. Out of the 17 significant risk factors, under agreement of both parties, 3 risk factors were allocated to main contractor, 2 for subcontractor and 5 risk factors were shared by both parties. However, regarding the remaining 7 risk factors, both parties had contradictory views. Finally risk register and risk matrix were developed by using short listed and allocation determining criteria.

It is recommended that the developed risk register be used as a guidance during the risk identification phase and risk matrix when allocating those risks between concerned parties. The research findings revealed that, it is important to consider, both probability and consequences when assessing a risk, because although something may have a very low probability of occurring, extreme consequences can make it a very high risk. Therefore, practitioners must be very careful not to reject risks which have either low probability or low impact by only considering one aspect. Moreover, as it is always important to be proactive rather than being reactive when it comes to risk management, practitioners should be careful enough to consider each and every aspect of the project and related environment to identify and allocate every possible risk before it is too late to manage it later on.

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