International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 06 | June 2019 www.irjet.net p-ISSN: 2395-0072

Impacts of Significant Risk Factors on Forecasted Construction Cash Flows of Building Projects

Kimata N. Malekela[1]

[1]*School of Architecture, Construction Economics and Management, Ardhi University, Dare es Salaam, Tanzania*

Abstract – *There have been significant variations (impacts) on forecasted construction cash flows (FCCFs) which exceed the contingency sum provided during execution of construction projects. These variations may be caused by risk factors inherent in construction projects. This research is therefore aimed to analyze the impacts of significant risk factors in causing the variations on FCCFs of building projects in Dar es Salaam, Tanzania. These impacts were analyzed in terms of relative contributions/importance of risk factors in causing variations on FCCFs of building projects. The study was conducted through documentary reviews which covered various contract documents from 40 completed building projects in Dar es Salaam (from 2009 to 2014). Also, interviews with project members and informal self-auditing to contract documents were done during documentary reviews in order to get additional information which were not directly found in contract documents. The data were mainly analyzed using Statistical package for social sciences (SPSS) version 20 and Microsoft Excel. The study found that significant risk factor with highest overall NRI (0.249) in causing variations (impacts) on overall FCCFs of building projects is unclarity of clients' requirements, and the second highest overall NRI (0.187) is errors in project documents (Bills of Quantities). It is therefore recommended that established relative contributions /importance of significant risk factors in causing variations (impacts) on FCCFs of building projects should be used as ones of input parameters in modelling the variations on FCCFs. Also, risk avoidance measures are recommended to be used for controlling the risk factors with highest overall NRI in causing impacts on FCCFs in building projects such as unclarity of clients' requirements, and errors in project documents (Bills of Quantities).*

***Key Words*: Construction cash flows, Impacts, Risk Factors, Variations, Relative Contribution, Building projects, Tanzania**

1. INTRODUCTION

There have been significant variations on forecasted construction cash flows (FCCFs) which exceed the contingency sum provided during execution of construction projects (Malekela, 2018) [16]. These variations may be caused by risk factors inherent in construction projects (Malekela et al., 2017a) [17]. The risk factors on FCCFs may therefore disturb the plan of client and bring failure of the projects if their impacts are not analyzed and controlled well in project planning (Khayani, 2011) [13]. For instance in Tanzanian construction industry, overall cost performance is poor whereby most of construction projects are completed with many variations compared to their initial budget (Eliufoo, 2017 [8]; Ngonwe, 2013 [22]; Malekela, 2008 [15]; and Hokororo, 2006 [11]). This implies that FCCFs tend to change significantly (i.e. experiencing large variations between forecasted and actual construction cash flows) due to the impacts of risk factors on FCCFs in construction projects.

Problem of poor cost performance is evidenced to be common in construction projects in Tanzania (Eliufoo, 2017 [8]; Rwakarehe and Mfinanga, 2014 [28]; Ntiyakunze, 2011[23]; and Hokororo, 2006 [11]). For instance, a pilot study (COST, 2011) [6] surveyed 25 completed public construction projects in Tanzania and reported an average cost overrun of 29%. Generally, many construction projects in World experience cost overruns which exceed initial contract sums (Shanmugapriya and Subramanian, 2013 [29]; Memon, et al., 2011 [20]; Khayani, 2011 [13]; Nega, 2008 [20];). Cost overrun is a significant problem in both developed and developing countries (Nega, 2008) [20]. But it is severe in developing countries where project costs exceed up to 100% of the anticipated cost (Memon, et al., 2011) [20].

According to Ogunsanmi et al., (2011) [26], risks are the factors that can cause a project to fail in meeting its goals during implementation of the project. This definition provided by Ogunsanmi et al., (2011) [26] is also used in this study. Actually, anything that prohibits project stakeholders to reach a certain project goal is referred as risk. In addition, Malekela (2018) [16] pointed that sometimes the risk factors may cause more variations which change construction scope and impact on construction cost and time. By implication, it impacts construction cash flows too. Significant risk factors causing variations on FCCFs of building projects in Tanzania are errors in project documents (Bills of Quantities), poor communication among project participants, consultants' lack of experience and technical skills, unethical practices to consultants, poor/incomplete design, incomplete information at tender stage, unclarity of clients' requirements and clients' lack of financial resources.

Normally, risk has two characteristics which are frequency and impact. Frequency is about how often someone engages with the risk. While impact may be measured in terms of the financial impact of the risk (Gruneberg et al., 2007) [10], schedule and quality impact of the risk (Wiguna and Scott, 2006) [10]. But this study is delimited to the impact characteristic only.

Therefore, the objective of this study is to analyze the impacts of significant risk factors in causing the variations on FCCFs of building projects in Dar es Salaam, Tanzania. These

impacts were analyzed in terms of relative contributions/ importance of risk factors in causing variations on FCCFs of building projects.

Based on the objective of this paper, this study is delimited to positive construction cash flows derived from staged cash flows in building projects. The significant risk factors were extracted from the study of Malekela (2018) [16] as shown in Table 1. It should be noted that wherever the word variations used in this study mean the impacts of risks on FCCFs. Also, the word building project means the building project that is procured under fixed price contract. In addition, variations and impacts were used interchangeably in this study. Lastly, relative contribution and relative importance terms were also used interchangeably.

Table 1: Significant Risk Factors Causing Variations on FCCFs

Significant Risk factors causing variations on FCCFs
a. Errors in project documents (Bills of Quantities)
b. Poor communication among project participants
c. Consultants' lack of experience and technical skills
d. Unethical practices to consultants
e. Unclarity of client's requirements
f. Clients' lack of financial resources
g. Poor/Incomplete design
h. Incomplete Information at tender stage

Adopted from Malekela, 2018 [16]

2. LITERATURE REVIEW

Normally, construction cash flow is the important aspect in managing the construction projects. It concerns with the incoming or outgoing of money to or from a company over a given period (usually monthly) or upon completion of a certain work activity (RICS, 2012) [27]. But it needs to be updated throughout the construction phase by controlling risk factors impacting the cash flows (Malekela, 2018) [16].

In addition, cash flow can be optimised through analysing the impacts of different variables (such as risk factors in this case) during executing construction projects (Cui et al., 2010) [7]. Basically, analysing the impacts of risks enables the risk response planning actions to be set for minimising the project threats (Malekela, 2018) [16].

For negative cash flow is the monies paid out of a business while positive cash flow is the money flowing into a business. The difference between the positive and negative cash flows is the net cash flow (Malekela et al., 2017b) [18]. This study is based on positive construction cash flows of building projects which is the movement of money from client to contractor during execution. According to Melik (2010) [19], client is interested much on positive construction cash flow.

The cash flow is mostly included as time-phased budget or stage phased budget during execution of construction projects (RICS, 2012) [27]. Normally, monies received by contractor can be in the form of staged cash flows or monthly cash flows which make positive construction cash flows. These monies include payments to works performed, release of retention, settlements of final account, and settlements of profit lost due to termination of contract (Malekela et al., 2017b) [18]. As previously stated, this study is focused on the positive cash flows derived from payments based upon completion of various activity parts of building projects (i.e. staged payments). In addition, according to Malekela et a., (2017a) [17]., forecasted construction cash flows (FCCFs) are the estimated amounts of money to be received by contractor from client after completing various work activities of the building project. While actual construction cash flows are the actual amounts of money paid to contractor for the various completed work stages of the project after being valued and certified.

Therefore, variation is the difference between actual and forecasted construction cash flows in the execution of the construction project. The variations are also referred as the impacts of risk factors involved in implementation of construction projects (Malekela et al., 2017b) [18]. In that sense, risk factor means the factor that can cause variations on FCCFs in this study. In addition, Zou et al., (2007) [31] pointed out that most of the risk factors affect time and quality aspects of the construction projects as well.

Furthermore, one of the goals of risk analysis is to analyze numerically all the risk issues in implementation of project (Kerzner, 2009) [12]. The potentials impacts of risk factors can be analyzed numerically in terms of relative contributions of those risks in affecting project objectives (Malekela, 2018) [16]. In this study, the impacts of significant risk factors in causing variations on FCCFs were also analyzed in terms of relative contributions/indices.

3. METHODOLOGY

The data used were obtained through documentary review of various project contract documents from recently completed building projects reviews for addressing the objective of the research. Also, in conducting documentary review, the researcher conducted interviews with various project members and did "informal self-auditing" to various documents (where necessary) in order to get additional information on the significant sources of the identified variations through documentary reviews.

3.1 Data Collection

Documentary review can take many forms, but in building projects include the following documents namely contract documents, minutes of site meetings, site records, letters, memoranda, cash flow projections, work programs, progress reports, payment certificates and associated valuations, proposals, and other communications (Ntiyakunze, 2011) [23]. Historical data from various documents are normally used to capture directly the characteristics of the project

performance in establishing the parameters concerned with execution of construction projects (Li et al., 2006) [14].

Documentary review of various project contract documents aimed to collect data on extents of variations (impacts) caused by each significant risk factor on FCCFs of building projects (i.e. differences between actual construction cash flow and forecasted construction cash flows caused by each significant risk factor). These data were collected for the purpose of establishing the relative contributions of the significant risk factors in causing variations (impacts) on FCCFs.

This documentary review method covered various project documents from recently completed building projects in Dar es Salaam (from 2009 to 2014) in collecting data for this study. These project documents includes Bills of Quantities, cash flow projections, work programme, original drawings, revisions made, payments applications, payments certificates and associated valuations, original design drawings, contractor's claims, site instructions, correspondences, original site layout, contract provisions, variations, and changes made to the design. As previously stated, researcher conducted interview with various project members and did "informal self-auditing" to various documents during documentary reviews in order to get additional information where necessary. The protocol for documentary review was generally established so as to provide guidelines for collecting the data for each significant risk factor as shown in Figure 1. It should be noted that the sources of evidence used in documentary review are shown in Table 2 including their respective data collected using project documents.

3.2 Sample Size

Documentary review was done on various project documents from recently completed building projects in Dar es Salaam (from 2009 to 2014) as stated earlier. These recent building projects were selected through purposive sampling. The choice of purposive sampling technique was centred on the fact that the study is directed towards documentary review of various project documents which involved in-depth study of the significant risk factors causing variations on FCCFs based on various work stages of building projects. The selection of recently completed building projects was mainly based on accessibility to the various project documents in terms of permission from the firm/company owner to use those documents for the purpose of this study. But those selected completed building projects were having the following criteria:

i. The scope of all buildings selected were at least two storey-buildings by having thirteen main activities (substructure, frame, stairs, wall partitions, roofing, doors, windows, wall finishes, floor finishes, ceiling finishes, fittings and fixtures, external works, services installations);

ii. Selected building projects were recently completed building projects from 2009 to 2014 which they are located in Dar es Salaam City (Ilala, Kinondoni and Temeke Municipalities);

iii. Selected building projects were traditionally procur The value of contract for buildings selected ranging from TZS 150 Million to TZS 3 Billion; and

iv. Contract durations of the selected building projects were ranging from 6 months (26 weeks) to 24 months (104 weeks).

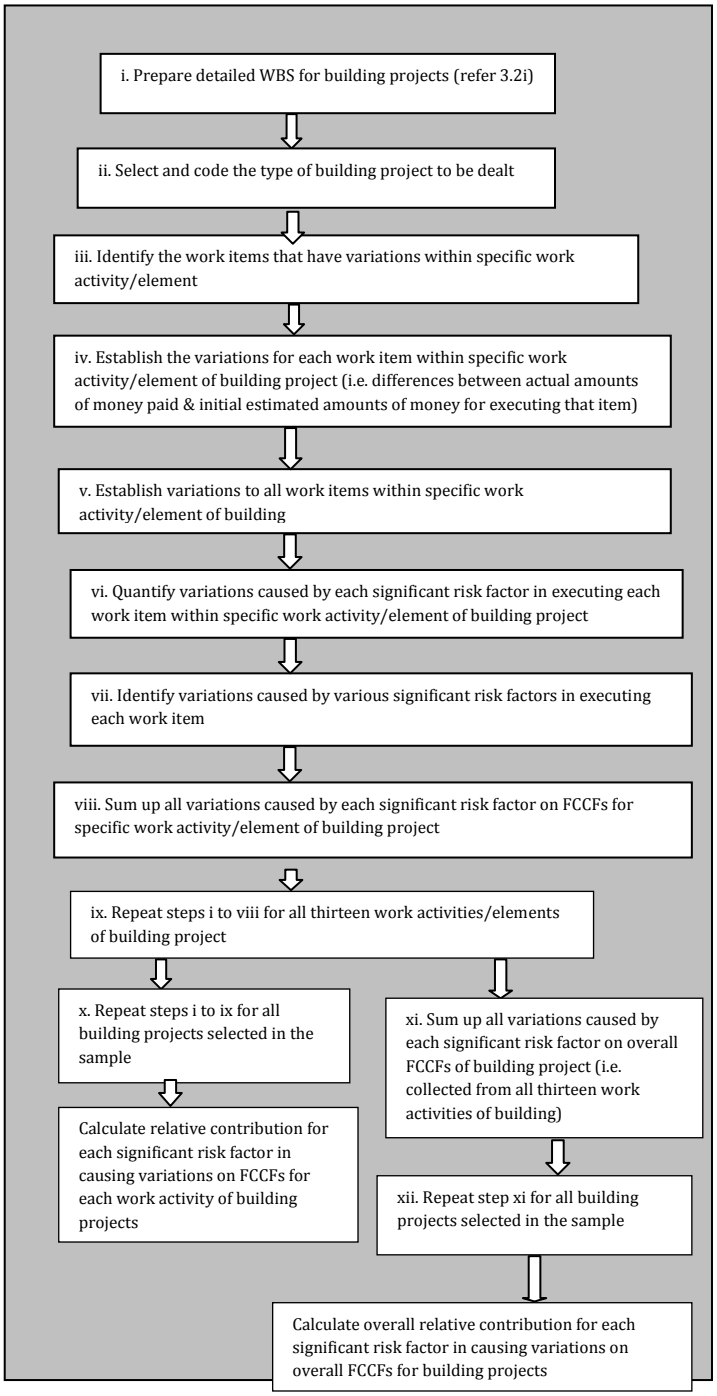

Figure 1: Protocol for Documentary Review

Table 2: Data collected and their Respective Sources of Evidence

S/N	Data collected	Sources of evidence
(i)	Extents of variations (impacts) caused by each significant risk factor on FCCFs for each work activity/element of building project; and building project as whole.	Cash flow projections, Bills of Quantities, interim valuations for payment, site instructions, correspondences, contractor's claims, payment certificates issued, work programme, original design drawings, drawing revisions made, original site layout, and contract specifications.
(ii)	Total variations(impacts) occurred on FCCFs for various work activities in building project; and building project as whole	Bills of Quantities, cash flow projections, interim valuations for payment, contractor's claims, and payment certificates issued.
(v)	Extra information related to the variations (impacts) occurred on FCCFs	Interviews to project participants and "informal self-auditing" to various contract documents (where necessary)

The sample size was 40 recently completed building projects in Dar es Salaam. The sample size was considered sufficient to establish the impacts caused by each significant risk factor on FCCFs of building projects. The criteria used in identifying the sample size were based on empirical evidences from related studies that used purposive sampling to collect historical data on cash flow studies. For instance Odeyinka and Lowe (2000) [24] used 19 completed building projects; 40 recently completed building projects were used in the study of Odeyinka et al. (2002) [25]; Al-Joburi et al. (2012) [2] used 40 on-going projects; and a sample of 20 completed projects was used in the study of Banki and Esmaeili (2009) [4].

From above evidences, maximum sample size used was 40. Therefore, sample size of this study (40) was based on those past empirical evidences. Furthermore, Mohamed (2010) pointed out that a sample of 30 subjects permit use of large sample statistics in empirical researches. In that manner, the sample size was considered to be sufficient.

4. RESULTS AND DISCUSSION

Statistical package for social sciences (SPSS) version 20 and Microsoft Excel were used for statistical analyses of relative contributions of significant risk factors in causing variations (impacts) on FCCFs. The historic data from various project documents were used for analyses of variations caused by significant risk factors in this study which led into establishment of relative contributions. These historic data were extracted from recently completed building projects files obtained from the project consultants' offices or contractors' offices. The study extracted information on extents of variations (impacts) caused by each significant risk factor on FCCFs of building projects (i.e. differences between actual construction cash flow and forecasted construction cash flows caused by each significant risk factor).

The data extracted from the project files were expressed in percentages for easing the analyses because various recently completed building projects used were having various projects' values. Hence, percentages put the common measurements in presenting the data and then, percentages were converted to relative contributions as per Table 3. This study used weighting of 10 scores as shown in Table 3 for establishing relative contributions of significant risk factors in causing variations on FCCFs for specific work activity in building projects as modified from Eybpoosh's work (2010) [9]. Then, the formula in Equation 1 (adopted from Malekela, 2008) [15] and established weighting ratios were used to calculate the relative contributions of significant risk factors in causing variations (impacts) on FCCFs for specific work activity in building projects. Microsoft Office Excel was then used to calculate those overall relative contributions. Finally, these relative contributions were normalised using Equation 2 to make sense in the analyses of impacts of risk factors on FCCFs.

Similarly to relative contributions of risk factors for specific work activity, the formulae (Equations 1 and 2) and established weighting ratios were also used to calculate the overall relative contributions of significant risk factors in causing variations (impacts) on overall FCCFs of building projects. This part involves mainly two sections namely relative contributions of significant risk factors in causing variations (impacts) to various work activities in building projects; and overall relative contributions of significant risk factors in causing variations in building projects.

Table 3: Weighting Risk Scales Used for Establishing Relative Contributions of Significant Risk Factors

Range of variation percentage	Weighting risk scales
0% < Variations(impacts) found ≤ 10%	1
10% < Variations(impacts) found ≤ 20%	2
20% < Variations (impacts) found ≤ 30%	3
30% < Variations(impacts) found ≤ 40%	4
40% < Variations(impacts) found ≤ 50%	5
50% < Variations(impacts) found ≤ 60%	6
60% < Variations(impacts) found ≤ 70%	7
70% < Variations(impacts) found ≤ 80%	8
80% < Variations (impacts) found ≤ 90%	9
90% < (impacts) Variations found	10

Modified from Eybpoosh (2010) [9].

$$Relative\ contribution\ (importance) = \sum_{k=1}^{10}(R_{pjk} \times \frac{nR_{jk}}{N})\frac{MW}{TAR} \quad (1)$$

Where:

j = significant risk factor (to be dealt);

R_{pjk} = weighting risk scale (ranging from 1-10): Table 1;

nR_{jk} = number of items (i.e. buildings for this case) belongs to weighting ratio k;

N = total number of items (i.e. forty buildings for this case) in the sample;

MW = maximum weighting ratio (i.e. 10 for this case): Table 1; and

TAR = total for average ratios for all risk factors

$$\text{Normalised relative contribution (importance)} = \frac{\text{Relative importance (index)}}{\text{Sum of all relative contributions (importance)}} \times 1.000 \quad (2)$$

4.1 Relative Contributions of Significant Risk Factors in Causing Variations (Impacts) to Various Work Activities in Building Projects

The relative contributions were established from various work activities of building projects as shown in Table 4, 5, 6, 7 and 8. For the purpose of presenting the data in this Section, the results for all manageable work activities were presented in five Tables (Table 4, 5, 6, 7 and 8). Furthermore, the discussion in this Section was based on relative contributions of each individual significant risk factor in causing variations (impacts) on FCCFs to various work activities of building projects.

4.1.1 Errors in project documents (Bills of Quantities)

The relative contribution of errors in project documents (Bills of Quantities) is the highest relative contribution in causing variations on FCCFs in three work activities of building projects namely substructure, frame and roofing (Table 4 and 5) compared to all relative contributions for other significant risk factors. The normalised relative importance (NRI) of errors in project documents (Bills of Quantities) to those parts are 0.243, 0.276 and 0.333 in causing variations on FCCFs on those three work activities respectively. Also, Table 4, 5, 6, 7 and 8 indicate that the relative contributions of errors in project documents (Bills of Quantities) in causing variations on FCCFs to other work activities (except fittings and fixtures) of building projects are among top three higher relative contributions of various significant risk factors in causing variations on FCCFs to those work activities.

It is a fact that higher variations on FCCFs to significant work parts in building projects such as substructure and frames are contributed by errors in project documents (Bills of Quantities) because there is accumulation of errors in substructure and frames elements due to many items which are found in these work activities. Work items such as concrete, steel reinforcements and formwork in those work activities are normally expensive and have large quantities. Basically, the projected construction cash flows depend much on project documents such as Bills of Quantities in projection or forecasting the construction cash flows. This implies that if there are big errors in project documents, FCCFs in substructure and frame works are also going to experience high variations between actual and planned construction cash flows.

4.1.2 Poor communication among project participants

The relative contributions of poor communication among project participants in causing variations on FCCFs in frame, windows and floor finishes (with normalised relative importance (NRI) of 0.103, 0.057 and 0.063 respectively as indicated in Table 4 and 5) are among top five highest relative contributions of various significant risk factors in causing variations on FCCFs to those work parts of building projects. Also, relative contributions of poor communication among project participants in causing variations on FCCFs to the rest work parts of buildings range from 0.011 to 0.055 (normalised relative importance) as indicated in Table 4, 5, 6, 7 and 8.

The results show that the impacts of poor communication among project participants on FCCFs to most parts or activities in building projects are low compared to impacts of other significant risk factors. The reason of this situation is that poor communication among project participants can cause other risk factors to occur and cause severe impacts to cash flows for various work activities. Therefore, this risk factor affects indirectly other significant risk factors in terms of cost and time as project objectives and then cash flows as well.

4.1.3 Consultants' lack of experience and technical skills

Consultants' lack of experience and technical skills has highest relative contribution in causing variations on FCCFs in staircase works. Its normalised relative contribution is 0.373 (Table 4). Furthermore, the relative contributions of consultants' lack of experience and technical skills in causing variations on FCCFs in frames, walls and partitions, wall finishes, floor finishes and services installations are among top three highest relative contributions of various significant risk factors on FCCFs to those work activities of building projects (Table 4, 5, 6 and 8). The normalised relative importance (NRI) of consultants' lack of experience and technical skills are 0.247, 0.130, 0.113, 0.141 and 0.167 in causing variations on FCCFs to those work activities respectively of building projects. It is a fact that consultants' lack of experience and technical skills impacts most work parts of building projects.

4.1.4 Unethical practices to consultants

The study found that unethical practices to consultants has low relative contributions in causing variations on FCCFs in all work parts of building projects. The NRI of unethical practices to consultants range from 0.019 to 0.081 (Table 4, 5, 6, 7 and 8). But its highest relative contribution in causing variations on FCCFs (ranked fourth with normalised relative importance 0.070) occurred on ceiling finishing in building projects.

The results for relative contributions of unethical practices to consultants in causing variations (impacts) on FCCFs to occur in all work parts in building projects were expected because the building industry in Tanzania experiences users' dissatisfaction, cost and time overruns (Ngonwe, 2013). Sometimes dissatisfaction, cost and time overruns may be associated with unethical practices to consultants. Also, most of these effects are related to variations on FCCFs during implementation of building projects depending on financial value of the building projects.

4.1.5 Unclarity of clients' requirements

The study found that unclarity of clients' requirements has highest relative contributions in causing variations on FCCFs in walls and partitions, doors, windows, wall finishing, floor finishing, ceiling finishes, external works and services installations of building projects (Table 4, 5, 6, 7 and 8). Its NRI in causing variations on FCCFs to these eight work parts are 0.486, 0.345, 0.543, 0.412, 0.418, 0.479, 0.280 and 0.224 respectively. Also, Table 4, 5 and 7 indicates that NRI of unclarity of clients' requirements on FCCFs in substructure, frames, roofing, fittings and fixtures are among top three highest normalize relative importance to those work parts. Their NRI are 0.196, 0.162, 0.124 and 0.235 in causing variations on FCCFs on those four work parts respectively. These results implies that unclarity of clients' requirements is the extremely serious risk factor that causes the changes in original design during execution of construction projects as pointed out by Andi (2006) [3]; and Aibinu and Jagboro (2002) [1].

4.1.6 Clients' lack of financial resources

The study found no relative contributions of clients' lack of financial resources in causing variations (impacts) on FCCFs in doors, windows, and fittings and fixtures (Table 5, 6 and 7). But there are low relative contributions of clients' lack of financial resources in causing variations on FCCFs to the rest work activities in building projects. These relative contributions are 0.013, 0.011 and 0.010 for substructure, roofing and external works respectively (Table 4, 5 and 6).

The above results for relative contributions of clients' lack of financial resources are contrary with literature from Al-Joburi et al. (2012) [2] which insists that clients' lack of financial resources always lead to significant increases in cost and time and may even lead to the financial collapse of the construction project. This implies that clients' lack of financial resources can affect the cash flows as well in the implementation of building projects due to some experiences in delayed payments and suspensions.

In reality, the impacts of clients' lack of financial resources on FCCFs to various work parts of building projects are high. But some contractors do not claim interest on delayed payments, additional preliminaries and overheads to the company on the issue of suspension due to sympathy of contractors to private clients and maintaining business relationship with private clients. This was revealed during conducting documentary review which was supplemented with interviews.

4.1.7 Poor/incomplete design

The relative contributions of poor/incomplete design in causing variations on FCCFs in stairs, roofing, doors, fittings and fixtures, and services installations are among top three highest relative contributions in those work activities (Table 4, 5 and 7). The NRI of poor/incomplete design in causing variations on FCCFs in these work parts are 0.148, 0.226, 0.249, 0.156 and 0.214 respectively.

It is a fact that high impacts of poor/incomplete design can occur to most work parts due to existence of incomplete designs that can cause a severe impact on cost increase in building projects. Therefore, the preparation of cash flow might be subjected to variations during actual payments of works executed at the site because these activities are susceptible to changes in implementing the building projects. Basically, according to Odeyinka and Lowe (2000) [20], these changes due to poor/incomplete design are always expected to have serious impact on the cash flow forecasts.

4.1.8 Incomplete information at tender stage

The relative contributions of incomplete information at tender stage in causing variations on FCCFs in substructure, windows, fittings and fixtures, and external works are among top three highest relative contributions to those work parts (Table 4, 6 and 7). The NRI of incomplete information at tender stage in causing variations on FCCFs to those work activities are 0.208, 0.106, 0.300 and 0.278 respectively. Also, the study found no impacts influenced by incomplete information at tender stage on FCCFs in walls and partitions and ceiling finishing in building projects (Table 5 and 7).

The study found that highest relative contributions in substructure, windows, fittings and fixtures, and external works are caused by incomplete information at tender stage. It is a fact that sometimes contractor may be offered the tender with little information to those parts due to the nature and urgency of project. Celenegil (2010) [5] pointed out that it is possible to encounter some risks when a construction process is started with semi-finished information about the project. This risk factor may cause design modifications which lead to additional costs to the projects and increment to cash flows as well.

Table 4: Relative Contributions for Significant Risk Factors in Causing Variations on FCCFs to Substructure, Frame and Stairs of Building Projects

Risk factors	Substructure					Frame					Stairs				
	N	Relative importance	NRI	Cumulative NRI	Rank	N	Relative importance	NRI	Cumulative NRI	Rank	N	Relative importance	NRI	Cumulative NRI	Rank
EPDB	40	2.428	.243	.243	1	35	2.758	.276	.276	1	34	1.894	.189	.189	2
PCAPP	40	0.552	.055	.298	6	35	1.031	.103	.379	4	34	0.223	.022	.212	8
CLETS	40	1.258	.126	.424	4	35	2.474	.247	.626	2	34	3.732	.373	.585	1
UPC	40	0.353	.035	.459	7	35	0.438	.044	.670	8	34	0.808	.081	.666	5
UCR	40	1.965	.196	.656	3	35	1.624	.162	.832	3	34	0.557	.056	.721	6
CLFR	40	0.133	.013	.669	8	35	0.593	.059	.892	5	34	0.278	.028	.749	7
P/ID	40	1.236	.124	.792	5	35	0.567	.057	.948	6	34	1.476	.148	.897	3
IITS	40	2.075	.208	1.000	2	35	0.515	.052	1.000	7	34	1.030	.103	1.000	4
Total		**10.000**	**1.000**				**10.000**	**1.000**				**10.000**	**1.000**		

Table 5: Relative Contributions for Significant Risk Factors in Causing Variations on FCCFs to Walls and Partitions, Roofing and Doors of Buildings

Risk factors	Walls and partitions					Roofing					Doors				
	N	Relative importance	NRI	Cumulative NRI	Rank	N	Relative importance	NRI	Cumulative NRI	Rank	N	Relative importance	NRI	Cumulative NRI	Rank
EPDB	39	1.840	.184	.184	2	34	3.333	.333	.333	1	34	1.491	.149	.149	3
PCAPP	39	0.354	.035	.219	7	34	0.108	.011	.344	8	34	0.387	.039	.188	7
CLETS	39	1.297	.130	.349	3	34	1.183	.118	.462	4	34	0.690	.069	.257	5
UPC	39	0.448	.045	.394	5	34	0.699	.070	.532	6	34	0.387	.039	.296	7
UCR	39	4.858	.486	.880	1	34	1.237	.124	.656	3	34	3.453	.345	.641	1
CLFR	39	0.401	.040	.920	6	34	0.108	.011	.667	8	34	0.000	.000	.641	8
P/ID	39	0.802	.080	1.000	4	34	2.258	.226	.892	2	34	2.486	.249	.890	2
IITS	39	0.000	.000	1.000	8	34	1.075	.108	1.000	5	34	1.105	.110	1.000	4
Total		**10.000**	**1.000**				**10.000**	**1.000**				**10.000**	**1.000**		

Table 6: Relative Contributions for Significant Risk Factors in Causing Variations on FCCFs to Windows, Wall and Floor Finishes of Building Projects

Risk factors	Windows					Wall finishes					Floor finishes				
	N	Relative importance	NRI	Cumulative NRI	Rank	N	Relative importance	NRI	Cumulative NRI	Rank	N	Relative importance	NRI	Cumulative NRI	Rank
EPDB	33	1.954	.195	.195	2	38	1.812	.181	.181	2	36	1.612	.161	.161	2
PCAPP	33	0.575	.057	.253	5	38	0.470	.047	.228	7	36	0.629	.063	.224	5
CLETS	33	0.144	.014	.267	7	38	1.129	.113	.341	3	36	1.411	.141	.365	3
UPC	33	0.259	.026	.293	6	38	0.424	.042	.384	8	36	0.479	.048	.413	6
UCR	33	5.431	.543	.836	1	38	4.117	.412	.795	1	36	4.181	.418	.831	1
CLFR	33	0.000	.000	.836	8	38	0.753	.075	.871	4	36	0.302	.030	.861	8
P/ID	33	0.575	.057	.894	5	38	0.705	.071	.941	5	36	1.058	.106	.967	4
IITS	33	1.063	.106	1.000	3	38	0.588	.059	1.000	6	36	0.327	.033	1.000	7
Total		**10.000**	**1.000**				**10.000**	**1.000**				**10.000**	**1.000**		

Table 7: Relative Contributions for Significant Risk Factors in Causing Variations on FCCFs to Ceiling Finishes, Fittings and Fixtures and External Works of Building Projects

Risk factors	Ceiling finishes					Fittings and fixtures					External works				
	N	Relative importance	NRI	Cumulative NRI	Rank	N	Relative importance	NRI	Cumulative NRI	Rank	N	Relative importance	NRI	Cumulative NRI	Rank
EPDB	33	2.732	.273	.273	2	34	1.190	.119	.119	5	37	1.925	.193	.193	3
PCAPP	33	0.310	.031	.304	6	34	0.198	.020	.139	7	37	0.375	.038	.230	7
CLETS	33	0.705	.070	.375	4	34	1.218	.122	.261	4	37	0.550	.055	.285	5
UPC	33	0.705	.070	.445	4	34	0.482	.048	.309	6	37	0.525	.053	.338	6
UCR	33	4.789	.479	.924	1	34	2.351	.235	.544	2	37	2.800	.280	.618	1
CLFR	33	0.282	.028	.952	7	34	0.000	.000	.544	8	37	0.100	.010	.628	8
P/ID	33	0.479	.048	1.000	5	34	1.558	.156	.700	3	37	0.950	.095	.723	4
IITS	33	0.000	.000	1.000	8	34	3.003	.300	1.000	1	37	2.775	.278	1.000	2
Total		**10.000**	**1.000**				**10.000**	**1.000**				**10.000**	**1.000**		

Table 8: Relative Contributions for Significant Risk Factors in Causing Variations on FCCFs to Services Installations of Building Projects

Risk factors	Ceiling finishes				
	N	Relative importance	NRI	Cumulative NRI	Rank
EPDB	39	1.667	.167	.167	3.5
PCAPP	39	0.286	.029	.195	7
CLETS	39	1.667	.167	.362	3.5
UPC	39	0.190	.019	.381	8
UCR	39	2.238	.224	.605	1
CLFR	39	0.571	.057	.662	6
P/ID	39	2.143	.214	.876	2
IITS	39	1.238	.124	1.000	5
Total		**10.000**	**1.000**		

4.2 Overall Relative Contributions of Significant Risk Factors in Causing Variations in Building Projects

Unclarity of clients' requirements was found to be the most significant risk factor in causing variations (impacts) on overall FCCFs of building projects as shown in Table 9, and its normalised relative contribution/ importance (NRI) is 0.249. The second significant risk factor is errors in project documents (Bills of Quantities) with normalised relative importance (NRI) of 0.187, while clients' lack of financial resources is the least significant risk factor (with normalised relative importance 0.050).

Normally, unclarity of clients' requirements is a serious risk factor that causes changes in original design during implementation of construction projects as pointed out by Andi (2006). This risk factor always causes cost changes on planned budgets. Also, variations caused by errors in Bills of Quantities in buildings are dominant because they are accumulated from various expensive work activities of buildings due to errors contributed by multi-causes in preparation of project documents such as inadequate time for preparation of those documents and negligence.

Table 9: Overall Relative Contributions for Significant Risk Factors in Causing Variations (Impacts) on Overall FCCFs of Building Projects

S/N	Risk factors	N	Overall Relative importance	Overall NRI	Overall Cumulative NRI	Ranks
1	EPDB	40	1.865	.187	.187	2
2	PCAPP	40	0.728	.073	.259	7
3	CLETS	40	1.314	.131	.391	3
4	UPC	40	0.764	.076	.467	6
5	UCR	40	2.487	.249	.716	1
6	CLFR	40	0.497	.050	.766	8
7	P/ID	40	1.297	.130	.895	4
8	IITS	40	1.048	.105	1.000	5
Total			**10.000**	**1.000**		

5. CONCLUSIONS

This paper has been concentrated on analysing the impacts of significant risk factors in causing the variations on on forecasted construction cash flows of building projects. They were analyzed in terms of relative contributions/ importance of risk factors in causing variations on FCCFs of building projects. Actually, the relative contributions of significant risk factors give the real picture for the impacts of significant risk factors on FCCFs.

Based on the analysis, the study found that significant risk factor with highest overall NRI (0.249) in causing variations (impacts) on overall FCCFs in building projects is unclarity of clients' requirements, and second highest overall NRI (0.187) is errors in project documents (Bills of Quantities). Other significant risk factors causing variations (impacts) on FCCFs (with their respective overall NRI) are consultants' lack of experience and technical skills (0.131), poor/incomplete design (0.130), incomplete information at tender stage (0.105), unethical practices to consultants (0.076), poor communication among project participants (0.073) and clients' lack of financial resources (0.050).

Furthermore, relative contributions of unclarity of clients' requirements in causing variations (impacts) on FCCFs to all work activities (except stairs) of building projects are among top three highest relative contributions of various significant risk factors in causing variations to those work activities. Also, it was found that no impacts influenced by incomplete information at tender stage on FCCFs in walls and partitions and ceiling finishing in building projects.

6. RECOMMENDATIONS

The study recommends that established relative contributions/importance of significant risk factors in causing variations on FCCFs of building projects should be used as ones of the variables in modelling the variations on FCCFs. These established relative contributions may be used as input parameters for minimising the variations on FCCFs through modelling.

Also, stakeholders in building industry should involve the proactive risk response planning actions that can minimize the variations (impacts) caused by significant risk factors on FCCFs of building projects. Risk avoidance measures are recommended to be used for controlling the risk factors with highest overall NRI in causing variations (impacts) on overall FCCFs of building projects such as unclarity of clients' requirements, and errors in project documents (Bills of Quantities).

Table 10: List of Abbreviations of the Risk Factors Used in Analysis

STATEMENT	ABBREVIATION
Errors in project documents (Bills of Quantities)	EPDB
Poor communication among project participants	PCAPP
Consultants' lack of experience and technical skills	CLETS
Unethical practices to consultants	UPC
Unclarity of clients' requirements	UCR
Clients' lack of financial resources	CLFR
Poor/Incomplete design	P/ID
Incomplete Information at tender stage	IITS

Table 11: List of Abbreviations of the General Terms

STATEMENT	ABBREVIATION
Forecasted Construction Cash Flows	FCCFs
Normalized Relative Importance	NRI

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