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MAPPING THE RISK RESPONSE STRATEGIES ON CLASSIFIED BUILDING CONSTRUCTION-RELATED RISKS

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ABSTRACT

Research works in construction tend to focus on identifying and analyzing risk factors associated with construction projects. The researcher has identified several risk factors associated with building construction projects that are mainly attributed to the contractor. Risk response strategies also developed to include: Avoid, Retain, Reduce and Transfer. However, no research suggests which category of risk to avoid, retain, reduce or transfer. This research aims to map out the risk response strategies for varying risk factors in Building Construction Projects. It can be achievable by identifying the risk factors and response strategies from the literature, assessing each stakeholder's level of importance attached to each risk factor, identifying the most relevant risk factors, and mapping out the risk response strategies to varying risk factors. The study adopted a questionnaire where 68 valid questionnaires were analyzed using frequencies, means and percentages. The result shows that there are 54 risk factors associated with building construction projects, out of which 36 are of high significance. There is a significantly positive relationship between the probability of occurrence and the level of impact of the risk factor i.e. higher probability of occurrence is associated with a higher level of impact. The mapping of risk response strategies on risk factors shows that 37% of the risk factors are to be managed by reducing, 28% by avoiding, 20% by retaining and 19% by transferring. Thus, the best risk response strategies are 'reduce' and 'avoid'. Finally, the study recommends that all stakeholders understand and implement these risk response strategies accordingly.

Keywords: Risk, risk factors, risk response strategies, mapping, building construction

INTRODUCTION

Construction Industry is subjected to more risk and uncertainty than many other industries and does not have a good track record of coping with risks (Salman *et al.*, 2014). Also, is a vast industry that is made up of many types of building and civil engineering jobs. (Jaser, 2005). The construction Industry is a large, dynamic, and complex sector that plays an important role in the economy of a nation. Compared with many other industries, the Construction Industry is subject to more risks due to the unique features of construction activities, such as long periods, complicated processes, abominable environments, financial intensity and dynamic organization structures (Flanagan and Norman, 1993; Smith, 2006). Hence, taking effective risk management techniques to manage risks associated with variable construction activities that has never been more important for the successful delivery of a project (Zou *et al*., 2005). Risks have been identified, classified in different ways, Quantified and modelled in the literature (Zou *et al*., 2005; Banaitiene and Banaitis, 2012; Ibrahim, 2015; Odeyinka, 2016).

According to Greenhalgh (2011), the construction sector is to a large extent investment-led, which means that when a client procures a building, they are buying an 'asset' can has the ability to generate funds into the future. Approximately 50 percent of building work is generated from private clients and 50 percent from central and local government, so the industry's output will inevitably fluctuate by the economic and political cycles. The construction industry is projected to continue to expand over the remainder of the forecast period, recording annual average growth of 3.1% between 2023-2026, supported by the government's investment in infrastructure and housing development projects. The building construction industry covers a wide range of business activities that are brought together by a common interest in the development of land and real estate.

Response strategies have equally been suggested to include Reduction, Retention, Transfer and Avoidance (Likhitruangsilp, 2012; Vivian and Liyin (2012); Sangsomboon and Yan, 2014; Kulkarni and Pimplikar, 2016). However, in the vast risk profiles identified, no work has suggested which class of risk to reduce, which one to retain, which one to transfer and which one to avoid. Achieving this will reduce the stress of managing risks when they occur during the building construction project.

Risk Management

Risk management means different things to different people, but generally, it refers to the management of anything that might jeopardize organizational goals, this includes liability and legal risks, financial risks, workplace safety, fraud, and data security (Shellie, 2020). Risk management also, is the identification, evaluation, and prioritization of risks (define in ISO 31000 as the effect of uncertainty on objectives) followed by coordinated and economical application of resources to minimize, monitor and control the probability or impact of unfortunate events (Hubbard, 2009). Managing risks is a strategic tool for reaping the full benefits of the critical initiatives that are implemented in any organization (Srinivas, 2016). Risk management is a practice that many of us use on regular basis. The complexity and scale of the area we apply risk management determined the complexity of the risk management process. Such as in construction good risk management requires more than purely common sense and instinct. Different risks may be present in each of the different stages of the project and product lifecycle, and there is a wide range of risks that may lead to hazards (Yang *et al.*, 2015). Shim et al. (2012), revealed that, in recent years, with the

rapid development of society, risks are gradually growing because of the increasing structural complexity and project size, and the adoption of new and complex construction methods.

One concept which is widely used within the field of RM is called the risk management process (RMP) and consists of four main steps: identification, assessment, response development and response control. In each of these steps, there are some methods and techniques which facilitate handling the risks. Below is a risk management process as demonstrated by Larson and Gray, (2014).

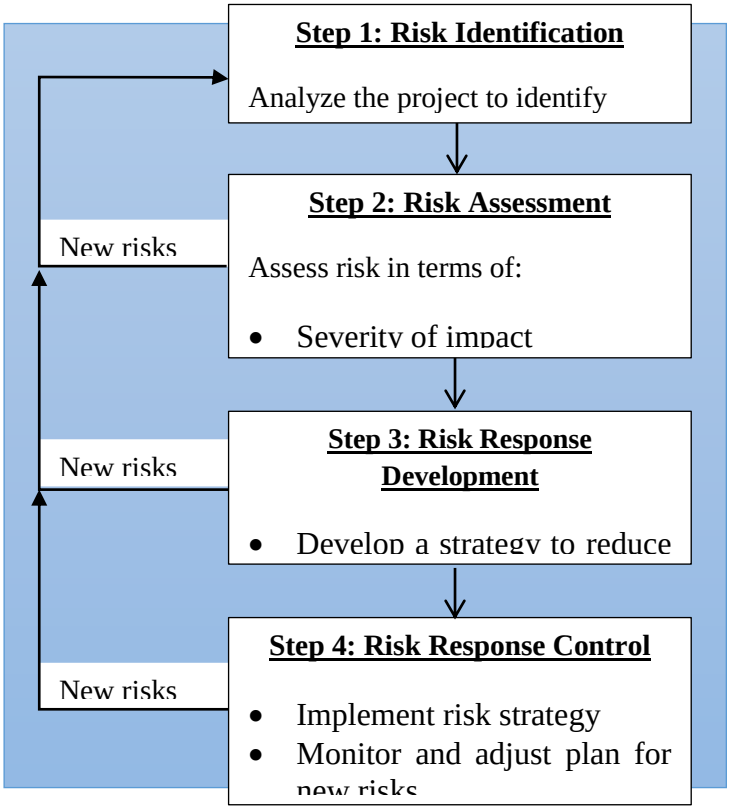

Figure 1*:* The Risk Management Process (Larson and Gray, 2014)

More construction companies are starting to become aware of the risk management process (RMP), but are still not using models and techniques aimed at managing risks. This contradicts the fact that the industry is trying to be more cost and time efficient as well as have more control over projects. Risk is associated with any project regardless of the industry and thus risk management should be of interest to any project manager. Risk management processes are not just about minimizing crippling risks; they are also an opportunity to reduce costs, save time and gain a competitive edge (Shellie, 2020). Risks differ between projects because every project is unique, especially in the construction industry (Gould and Joyce, 2002). However, there are still many practitioners that have not realized the importance of including risk management in the process of delivering the project (Smith, 2006). Even though there is an awareness of risks and their consequences, some organizations do not approach them with established risk management methods.

METHODOLOGY

The primary data for this research was collected via a questionnaire survey, where seventy-eight (78nr), of questionnaires were administered to respondents who are workers in various consulting and contracting organizations/firms/agencies. Sixty-eight (68nr) of these questionnaires which is around (87.18%) were retrieved back while the remaining 12.82% did not respond. According to Elhag and Boussabaine (1999) and Idrus & Newman (2002), a response of 30% is good enough in construction studies. This confirms that the response obtained for this research is acceptable. The majority of the respondents are workers/consultants offering project management services (mostly students who are studying quantity survey), have a minimum qualification of Higher National Diploma (HND), are Registered Members of their Respective Professional Bodies, have a minimum of 10 years of work experience in the field of construction and are in a middle-top management level of their Organisations/agency/firm.

The fifty-four (54) risk factors identified from the literature were presented in the questionnaire and the respondents rated them using a 5-point Likert scale such as; 1 (Very Low), 2 (Low), 3 (Medium), 4 (High) and 5 (Very high). Therefore, the more the mean tends to 5, the more it has attained hence more significance on building projects whereas the more it tends to 1 the less it has attained significance on the building project. The frequency of occurrences was calculated, mean scores and ranking of the responses were also computed to allow for further analysis of the result.

Table 1: Assessment of of the level of importance of various risk factors

S/N	Risk Factors	Occurrence		Impact		Cum.	
		Mean	STD	Mean	STD	Mean	Rank
1	Rush design	4.83	1.021	4.47	1.148	4.65	1st
2	Design changes	4.67	1.164	4.49	1.334	4.58	2nd
3	The financial failure of the contractor	4.44	1.182	4.60	1.041	4.52	3rd
4	Varied labour and equipment productivity	4.40	1.128	4.26	1.209	4.33	4th
5	Awarding the design to unqualified designers	4.32	1.11	4.34	1.078	4.33	5th
6	Actual quantities differ from the contract quantities	4.29	1.111	4.25	1.184	4.27	6th
7	Delayed disputes resolutions	4.27	1.031	4.23	1.01	4.25	7th
8	Inaccurate quantities	4.23	0.945	4.23	1.271	4.23	8th
9	Undefined scope of working	4.21	1.333	4.19	1.071	4.2	9th
10	Inflation	4.21	1.198	3.95	1.22	4.08	10th
11	Exchange rate fluctuation	4.19	1.299	3.97	1.161	4.08	11th
12	Changes in laws or decrees	4.19	1.404	3.85	1.277	4.02	12th
13	Supplies of defective materials	4.25	1.059	3.67	1.282	3.96	13th
14	Unmanaged cash flow	3.42	1.086	4.46	1.06	3.94	14th
15	Not coordinated design (structural, mechanical, electrical, etc.)	3.91	1.329	3.97	1.13	3.94	15th
16	Delayed payments on the contract	4.30	1.096	3.34	1.129	3.82	16th
17	Difficulty to access the site (very far, settlements)	2.70	1.096	4.72	1.22	3.71	17th
18	Legal disputes during the construction phase among the parties of the contract	2.90	1.288	4.40	1.071	3.65	18th
19	Ambiguous planning due to project complexity	3.20	1.285	4.10	1.069	3.65	19th
20	Information unavailability (including uncertainty)	2.51	1.269	4.55	1.248	3.53	20th
21	Difficulty to get permits	2.38	1.192	4.66	1.185	3.52	21st
22	New governmental acts or legislation	3.78	1.352	3.22	1.155	3.5	22nd
23	Inappropriate tender method or contract document form.	2.98	1.158	3.96	1.071	3.47	23rd
24	Selection of inappropriate service provider	2.34	1.072	4.46	1.096	3.4	24th
25	Damage to materials and equipment during transportation	3.56	1.11	3.22	0.993	3.39	25th
26	Undocumented change orders	3.42	1.227	3.16	1.173	3.29	26th
27	Changes in management ways	2.99	1.245	3.49	1.237	3.24	27th
28	Unstable security circumstances (Invasions)	3.26	1.252	3.22	1.072	3.24	28th
29	Adverse weather conditions	3.45	1.166	2.91	1.139	3.18	29th
30	Lack of consistency between bill of quantities, drawings and specifications	3.63	1.082	2.67	1.069	3.15	30th
31	High competition in bids	2.97	1.021	3.27	1.268	3.12	31st
32	Tender evaluation risk	3.11	1.164	3.13	1.068	3.12	32nd
33	Flood	2.05	1.182	4.19	1.121	3.12	33rd
34	access to spare parts for equipment	3.41	1.128	2.77	1.08	3.09	34th
35	Liability for acts of others	2.97	1.11	3.17	0.76	3.07	35th
36	Ecologically damaged sites	2.85	1.111	3.15	1.146	3	36th
37	Unavailable labor, materials and equipment	2.56	1.031	3.36	1.1	2.96	37th
38	Closure	2.17	0.945	3.71	1.044	2.94	38th
39	Resource management	2.67	1.333	3.17	1.152	2.92	39th
40	Defective design	3.11	1.198	2.73	1.188	2.92	40th
41	Rush bidding	2.56	1.299	3.14	1.033	2.85	41st
42	Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications	2.15	1.404	3.45	0.99	2.8	42nd

43	Poor communication between involved parties	3.34	1.059	2.24	1.231	2.79	43rd
44	Monopolizing of materials due to closure and other unexpected political conditions	2.73	1.086	2.71	1.252	2.72	44th
45	The ambiguity of work legislation	2.12	1.329	3.28	1.081	2.7	45th
46	Religious and cultural conflicts	2.57	1.096	2.73	1.119	2.65	46th
47	Revolution	1.88	1.096	3.22	0.091	2.55	47th
48	Coping with local laws	2.19	1.288	2.77	1.005	2.48	48th
49	Poor communications between the home and field offices	2.90	1.285	1.76	1.02	2.33	49th
50	Occurrence of accidents because of poor safety procedures	1.79	1.269	2.87	1.081	2.33	50th
51	Inaccurate project program	2.11	1.192	2.37	1.041	2.24	51st
52	No specialized arbitrators to help settle fast	2.30	1.352	2.14	0.915	2.22	52nd
53	Lower work quality in presence of time constraints	2.78	1.158	1.52	1.021	2.17	53rd
54	Specify the wrong requirements	2.18	1.072	2.16	0.913	2.15	54th

Table 1 above revealed all the 54 risk factors related to building construction projects. It is showing their level of significance as depicted by all the stakeholders of a building construction project. They are further analyzed in the tables below.

Table 2: Risks categorization based on significance (Highest significance)

S/N	Risk Factors	Mean	Level of Significance
1	Rush design	4.65	HIGHEST SIGNIFICANCE
2	Design changes	4.58	
3	Financial failure of the contractor	4.52	
4	Varied labor and equipment productivity	4.33	
5	Awarding the design to unqualified designers	4.33	
6	Actual quantities differ from the contract quantities	4.27	
7	Delayed disputes resolutions	4.25	
8	Inaccurate quantities	4.23	
9	Undefined scope of working	4.20	
10	Inflation	4.08	
11	Exchange rate fluctuation	4.08	
12	Changes in laws or decrees	4.02	

Table 3: Risk categorization based on significance (High significance)

S/N	Risk Factors	Mean	Level of Significance
1	Supplies of defective materials	3.96	HIGH SIGNIFICANCE
2	Unmanaged cash flow	3.94	
3	Not coordinated design (structural, mechanical, electrical, etc.)	3.94	
4	Delayed payments on the contract	3.82	
5	Difficulty to access the site (very far, settlements)	3.71	
6	Legal disputes during the construction phase among the parties of the contract	3.65	
7	Ambiguous planning due to project complexity	3.65	
8	Information unavailability (including uncertainty)	3.53	
9	Difficulty to get permits	3.52	
10	New governmental acts or legislation	3.50	
11	Inappropriate tender method or contract document form.	3.47	
12	Selection of inappropriate service provider	3.40	
13	Damage to materials and equipment during transportation	3.39	
14	Undocumented change orders	3.29	
15	Changes in management ways	3.24	
16	Unstable security circumstances (Invasions)	3.24	
17	Adverse weather conditions	3.18	
18	Lack of consistency between bill of quantities, drawings and specifications	3.15	
19	High competition in bids	3.12	
20	Tender evaluation risk	3.12	
21	Flood	3.12	
22	access to spare parts for equipment	3.09	
23	Liability for acts of others	3.07	
24	Ecologically damaged sites	3.00	

Table 4: Risk categorization based on significance (Low)

S/N	Risk Factors	Mean	Level of Significance
1	Unavailable labor, materials and equipment	2.96	LOW SIGNIFICANCE
2	Closure	2.94	
3	Resource management	2.92	
4	Defective design	2.92	
5	Rush bidding	2.85	
6	Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications	2.80	
7	Poor communication between involved parties	2.79	
8	Monopolizing of materials due to closure and other unexpected political conditions	2.72	
9	Ambiguity of work legislations	2.70	
10	Religious and cultural conflicts	2.65	
11	Revolution	2.55	

12	Coping with local laws	2.48
13	Poor communications between the home and field offices	2.33
14	Occurrence of accidents because of poor safety procedures	2.33
15	Inaccurate project program	2.24
16	No specialized arbitrators to help settle fast	2.22
17	Lower work quality in presence of time constraints	2.17
18	Specify the wrong requirements	2.15

Table 5: Correlation test between the Probability of occurrence and level of impact of risk factors

Risk Factors		**Probability of Occurrence**	**Level of Impact**
Probability of Occurrence	Pearson Correlation	1	0.411
	Sig. (***2-tailed***)		0.002
	N	54	54
Level of Impact	Pearson Correlation	0.411	1
	Sig. (***2-tailed***)	0.002	
	N	54	54

**. Correlation is *significant* at the 0.01 level (*2-tailed*).

The table above shows the relationship between the probability of occurrence of risk factors and their level of impact. The probability of occurrence and level of impact has a statistically significant linear relationship ($p > 0.001$). The direction of the relationship is positive that is the probability of occurrence and level of impact are positively related meaning that the two variables tend to increase together (i.e. higher probability of occurrence is associated with a higher level of impact). The magnitude or strength of the relationship is approximately moderate ($r =$ **0.411**).

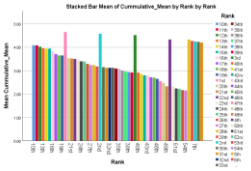

Figure 1: Showing the Cumulative mean for Risk factors and the ranking

Mapping out the Risk Response Strategies

This section covers the mapping of the risk response strategies to the risk factors that are related to building construction. 54 risk factors were identified and 4 response strategies were also identified from the literature.

Table 6: Risk factors that are best managed by avoiding

S/N	Risk Factors	Avoid	Reduce	Transfer	Retain
1	Rush design	**40.3**	30.3	5.9	23.5
2	Financial failure of the contractor	**37.2**	35.3	29.4	0
3	Awarding the design to unqualified designers	**35.3**	29.4	11.8	23.5
4	Delayed disputes resolutions	**35.3**	0	29.4	35.3
5	Inaccurate quantities	**53.1**	25.0	12.5	9.4
6	Exchange rate fluctuation	**44.8**	17.2	20.7	17.2
7	Supplies of defective materials	**64.7**	11.8	17.6	5.9
8	Delayed payments on contract	**35.3**	0	29.4	35.3
9	Inappropriate tender method or contract document form.	**35.5**	22.58	19.355	22.6
10	Selection of inappropriate service provider	**64.5**	25.81	3.2258	6.45
11	Lack of consistency between bill of quantities, drawings and specifications	**34.5**	34.48	27.586	3.45
12	access to spare parts for equipment	**44.8**	17.24	20.69	17.2

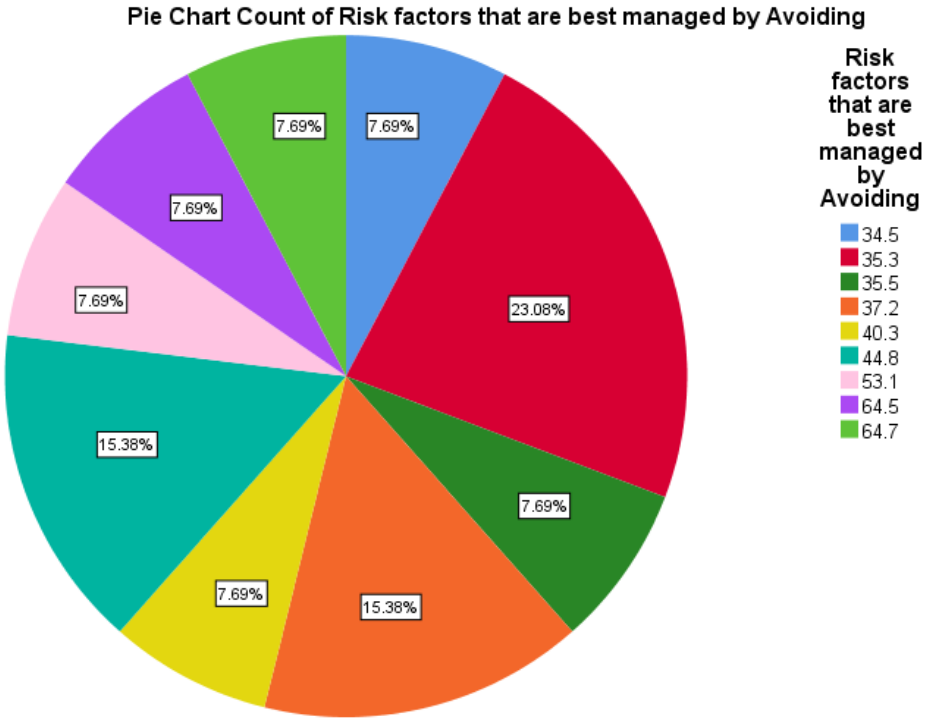

Figure 2: *Risk factors that are best managed by avoiding*

Table 7: Risk factors that are best managed by reducing

S/N	Risk Factors	Avoid	Reduce	Transfer	Retain
1	Design changes	17.6	**47.1**	5.9	29.4
2	Varied labor and equipment productivity	41.2	**52.9**	0	5.9
3	Actual quantities differ from the contract quantities	23.5	**35.3**	23.5	17.6
4	Undefined scope of working	25.8	**32.3**	22.6	19.4
5	Unmanaged cash flow	29.4	**58.8**	5.9	5.9
6	Not coordinated design (structural, mechanical, electrical, etc.)	11.8	**58.8**	23.5	5.9
7	Difficulty to access the site (very far, settlements)	17.6	**29.4**	23.5	29.4
8	Ambiguous planning due to project complexity	17.6	**47.1**	5.9	29.4

9	Information unavailability (including uncertainty)	23.5	**35.3**	23.5	17.6
10	Difficulty to get permits	23.3	**43.33**	20	13.33
11	Damage to materials and equipment during transportation	30	**50**	13.333	6.667
12	High competition in bids	22.6	**41.94**	19.355	16.13
13	Ecologically damaged sites	17.6	**47.1**	5.9	29.4

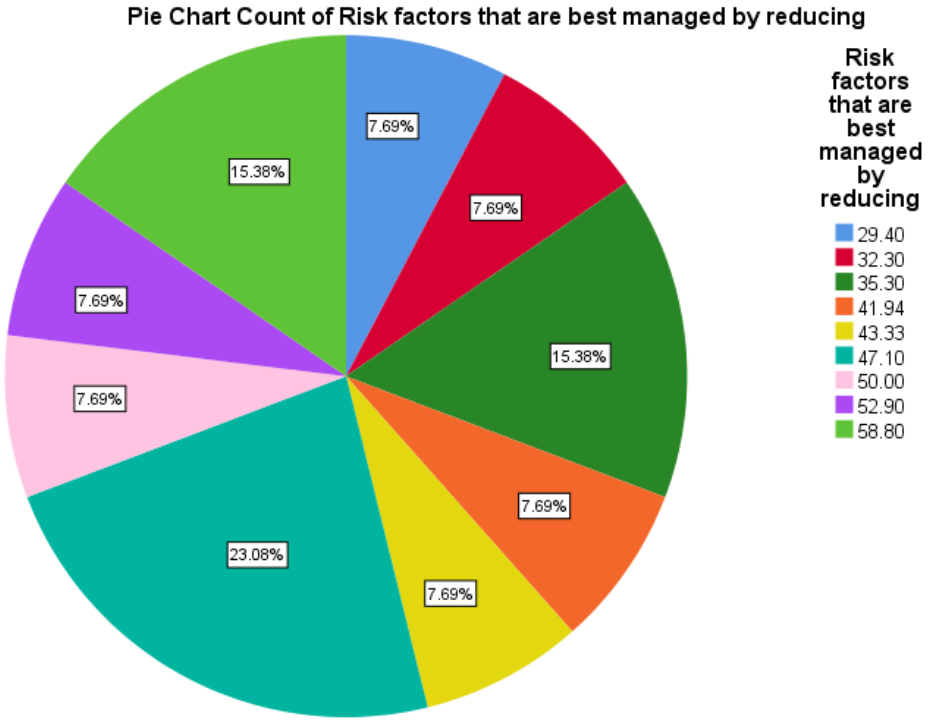

Figure 3: *Risk factors that are best managed by reducing*

Table 8: Risk factors that are best managed by transferring

S/N	Risk Factors	Avoid	Reduce	Transfer	Retain
1	Changes in laws or decrees	16.7	26.7	**36.70**	20.0
2	Legal disputes during the construction phase among the parties of the contract	11.8	29.4	**35.30**	23.5
3	New governmental acts or legislation	21.2	18.18	**54.55**	6.06
4	Unstable security circumstances (Invasions)	5.9	41.2	**52.90**	0
5	Tender evaluation risk	10	20	**40.00**	30
6	Flood	20.7	27.59	**41.38**	10.3
7	Liability for acts of others	10.3	37.93	**41.38**	10.3

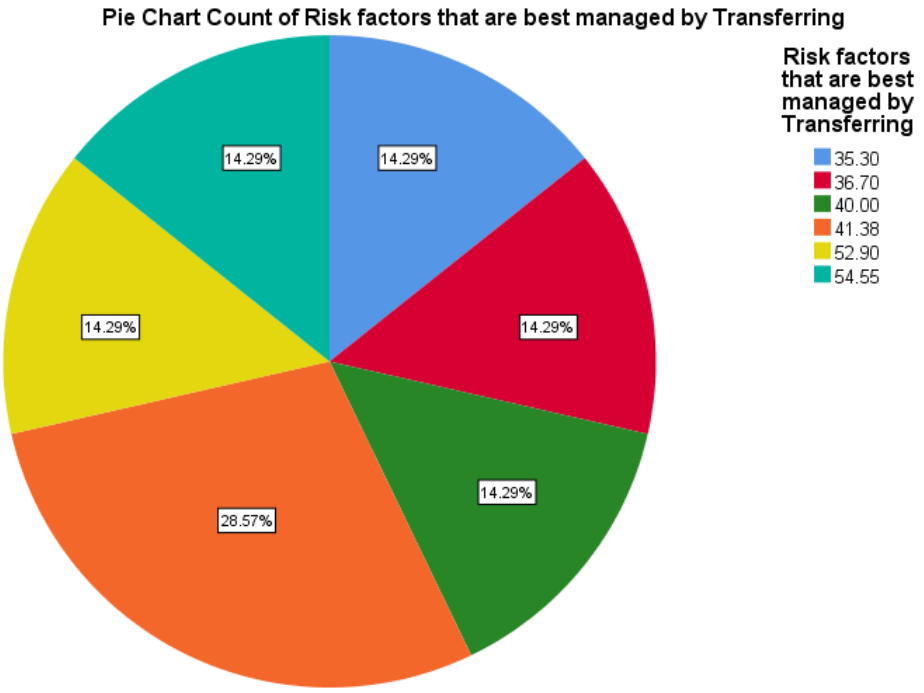

Figure 4: Risk factors that are best managed by transferring

Table 9: Risk factors that are best managed by retaining

S/N	Risk Factors	Avoid	Reduce	Transfer	Retain
1	Inflation	9.7	12.9	22.6	**54.80**
2	Undocumented change orders	41.2	5.9	5.9	**47.10**
3	Changes in management ways	35.3	5.9	11.8	**47.10**
4	Adverse weather conditions	25.8	22.58	12.903	**38.71**

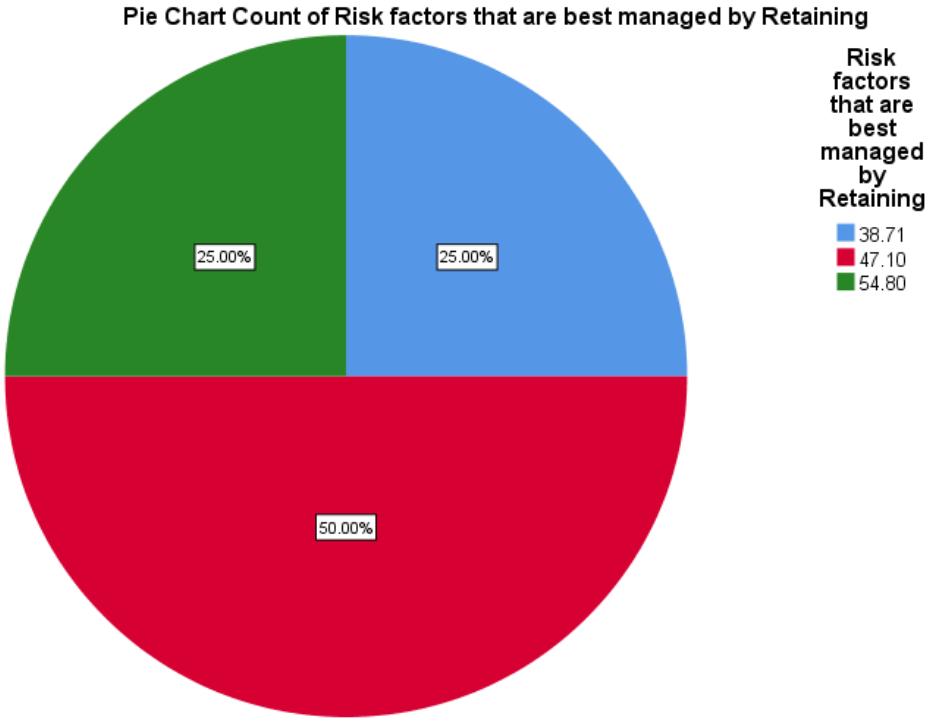

Figure 5: Risk factors that are best managed by retaining

Table 10: Risk factors that are best managed by all groups; avoiding, reducing, transferring & retaining

S/N	Avoid	Reduce	Transfer	Retain
1	40.30	47.10	36.70	54.80
2	37.20	52.90	35.30	47.10
3	35.30	35.30	54.55	47.10
4	35.30	32.30	52.90	38.71
5	53.10	58.80	40.00	-
6	44.80	58.80	41.38	-
7	64.70	29.40	41.38	-
8	35.30	47.10	-	-
9	35.50	35.30	-	-
10	64.50	43.33	-	-
11	34.50	50.00	-	-
12	44.80	41.94	-	-
	-	47.10	-	-
TOTAL	**525.30**	**579.37**	**302.21**	**187.71**

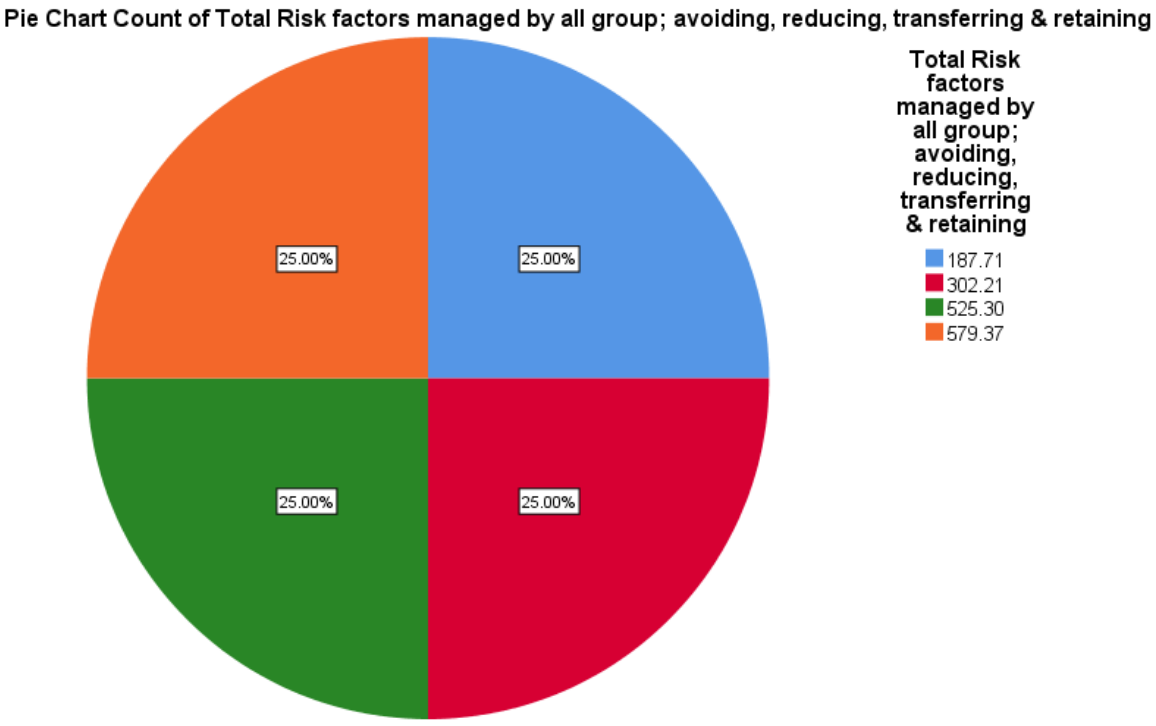

Figure 6: Risk factors that are best managed by all groups; avoiding, reducing, transferring & retaining

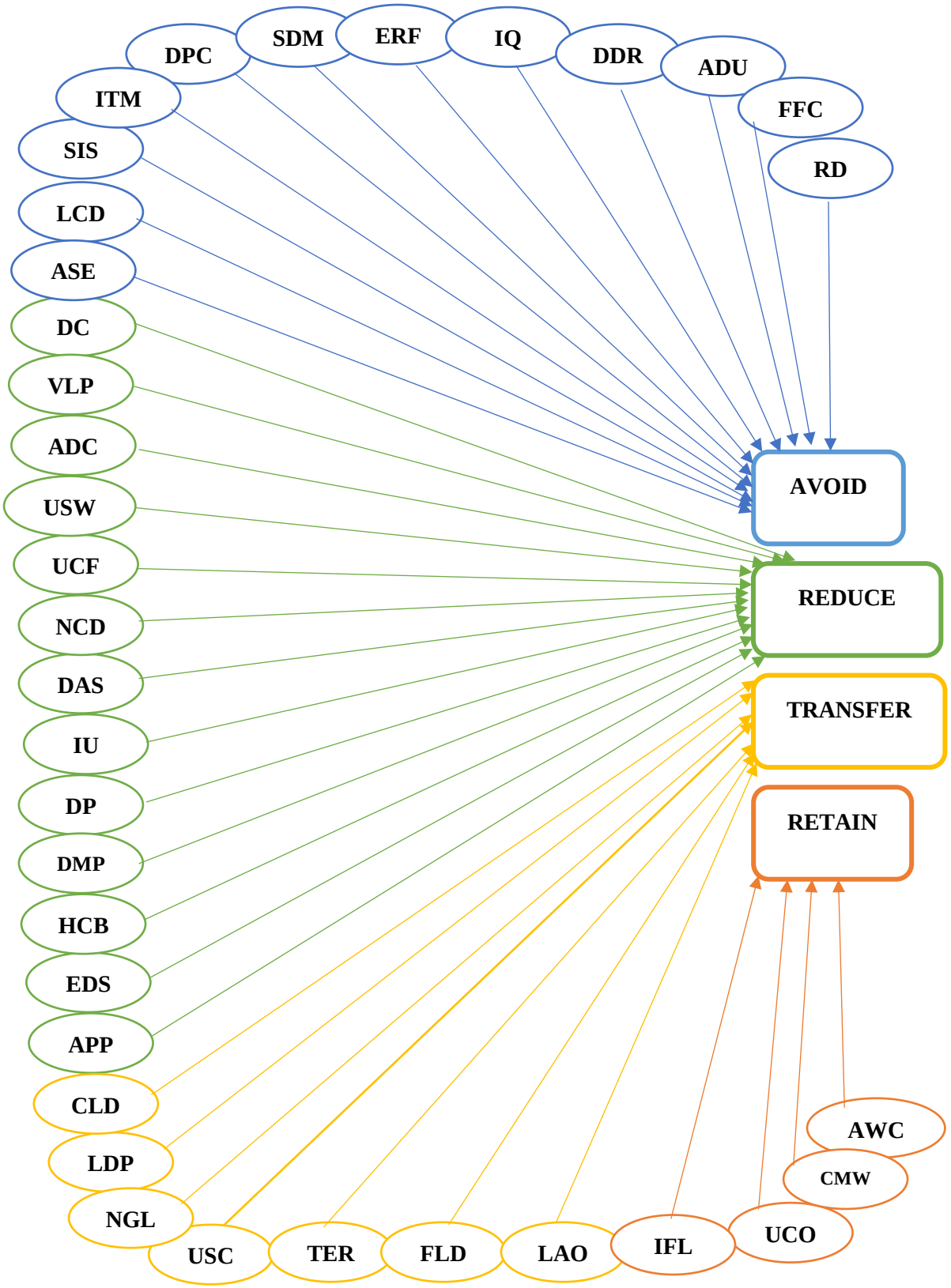

Figure 7**:** Mapping of Response Strategies on Risk Factors

DISCUSSION

From the finding, fifty-four (54) risk factors relating to technical, financial, legal, management, organizational, design, constructions, logistics, tendering, etc. were identified. Four (4) risk response strategies were equally identified from the literature to be reduction, avoidance, retention, and transfer.

As seen in the analysis and result presentation, most of the respondents are Quantity Surveyors, Engineers, Builders, Environmentalists, Planners and Statisticians working in consulting and contracting organizations or agencies. The

responses were mostly from the middle management has years of experience between 11 – 20 years.

Furthermore, the result on the level of importance of the risk factors revealed that quite a number of the risk factors are having a very high level of significance and influence on project objectives. 36 of the risk factors are having a high level of significance and influence on project objectives, while the other risk factors are having low level of significance and influence on project objectives. This indicates that more than 65% of the risk factors identified are having high to a very high level of significance and influence on the project objectives.

More so, there is a significantly positive relationship between the probability of occurrence and level of impact of the risk factors, meaning the higher probability of occurrence is associated with a higher level of impact. Therefore, no chance can be taken on managing these risks and appropriate response strategies should be developed to tackle risks risk factors with high significance.

The result of mapping risk response strategies shows that 12(33%) of the risk factors are to be managed by avoiding, 13(37%) of the risk factors are to be managed by reducing, 7(20%) of the risk factors are to be managed by transferring and the remaining 4(11%) are to be managed by retaining.

SUMMARY AND CONCLUSION

In summary, this research has identified and assessed risk factors affecting building construction and a risk management map was developed. The following are the findings of this research on the bases of responses from the respondents:

i. 54 risk factors impacting the building construction and 4 risk response strategies were identified from the literature and 36 of the risk factors were found to be of high significance
ii. The three most significant of them are rush design, design change and financial failure of the contractor, while the three least significant of them are: no specialized arbitrators to help settle fast, lower work quality in presence of time constraints and specify the wrong requirements.
iii. There is a significantly positive relationship between the probability of occurrence and the level of impact of the risk factors, therefore no chance can be taken on managing these risk and appropriate response strategies should be developed to tackle these risks.
iv. A risk management map was developed on the risk response strategies on the risk factors with a high level of importance.

The best risk response strategy was found to be reducing the risk which is having the highest of occurrence, followed by avoiding the risk, transferring the risk and finally retaining the risk.

In given of the above findings, this research work concludes that most of the risk factors affecting building construction are of high level of significance i.e. they are having high probability of occurrence and level of impact, also there is a positive relationship between the probability of occurrence and level of impact of the risk factors which means no chance can be taken on managing these risks. Finally, the mapping of the risk response strategies on risk factors indicates that the best risk management strategies are reducing and avoiding the risks. Further studies should be conducted on the techniques to be used in managing (reducing, avoiding, transferring and retaining) the risks associated with building construction.

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