

Developing Strategies for Risks Associated with the Adoption of Green Buildings Practice in Public Tertiary Institutions Projects

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ABSTRACT

Green buildings are type of buildings that require less use of natural resources and increase the reusability of such materials and products for the same or similar purpose. It reduced waste, and the process applied sustainable development concepts to the building life cycle. Most of the constructions at public tertiary institutions mainly focused on traditional method, while green buildings construction was observed to be left behind, despite its important in achieving SDG. Structured questionnaire was used and administered to targeted respondents, where quantitative data was collected. List of 24 risks affecting adoption of green building were identified. The data collected was analyzed using popularity of options, mean, percentage and ranking to describe respondents' attitude toward risks affecting adoption of Green Buildings. The findings indicate both avoidance and mitigation have average percentage of 87.30% preferred usage, out of 100%. Both response strategies emerged as dominant risk management tactics to minimize the effect of top 10 risks, for proper uptake of GB practice in public tertiary institutions. Supporting green buildings development in public institutions by relevant stakeholders would increase chances of achieving sustainable constructions.

Keywords: green buildings practice, risks assessment, GB sustainability, environmental

INTRODUCTION

Construction industry was regarded as sector that has great impacts in the environment, society and economy; this is because it has significant impact on sustainability when compare to other industries (Okoye et al., 2022). According to Reddy (2016), construction sector account for about 50% of global energy usage and also account for 50% of global solid waste generation, furthermore, it account for about 50% of global carbon emitted into the atmosphere, and then 25-50% of global natural resources consumption and 40% of global extracted raw materials

consumption. Wu et al., (2019) highlighted that countries spent huge amount on Construction sector annually and development of most people is depended by the construction sector, this creates the built environment and this was regarded as one of the main contributors to the climate crisis and the destroying natural habitats (Okoye et al., 2022).

Green building developments have significant impact in our environmental, conservation, climate change mitigation, public health, economic benefits and social responsibility. GB helps to improved energy efficiency, water conservation, improved indoor air quality and reduces waste in the environment. UNDESA (2019) revealed that 60% to 70% of the world's population lives in cities, this occupied about 3% of the planet's also about 75% of energy are consuming and high carbon emissions, it was also predicted by UN that by 2050, almost 70% of humanity will live in urban settlements and about 90% of people in developing countries will likely move to urban settlements, as results of high requirements of new houses, schools, hospitals and related constructions. The importance/benefits related with the adoption of green buildings are revealed in the various literatures (Zhang et al., 2019). Looking at its benefits, green buildings have been considered worldwide as the largest investment opportunity for the next decade both by financiers and investors, governments, developers, and owners across the world (Okoye et al., 2022). Willar et al., (2021) stated green building is a process that sought to maintain harmony between the natural and built environments by applying sustainable development concepts to the building life cycle.

One of the key aspects of sustainable measurement is focusing on the present and future benefits of sustainability in the construction sector (Clark & Sunderland, 2018). However, studies have shown the adoption of sustainable construction practices is not an easy task in developing countries considering the process involved (Willar et al., 2021). It was observed that most of developing countries were mainly depend on traditional construction process while green building development was left behind (Kibert, 2016).

Furthermore, Public tertiary institutions were established to provide sound education to the general public for economy development of the nations, therefore, it requires facilities most especially construction projects and enable environment for teaching and learning process (Ijigah et al., 2023). Public tertiary institutions were regarded as one major stakeholder of construction projects development, but it was observed that most of the construction projects executed are traditional or conventional buildings. However, the use of green building practice in public tertiary institutions was observed to be left behind, despite its important in achieving SDG. This is greatly limiting the capacity of public institutions to achieve its sustainable construction.

Though literatures highlighted some risks associated with green building developments, but it was observed that previous studies were restricted mostly on identification and assessment of risks/challenges only, while literature have it that identification and assessment only will be worthless unless effective response strategies are developed and implemented (Hillson, 1999).

Therefore, it is in line with this background that, this study was conducted to develop and

identify most effective response strategies for risks affecting adoption of GB practice in public tertiary institutions.

The construction industry is recognized for its significant impact on the growth and progress of a country, and the sector is also considered as one being responsible for environmental pollution and global climate change (Ahmad et al., 2019). It was revealed that construction sector contributed significant environmental pollutants and other greenhouse gas emissions that impact on human health (Cui et al., (2018). Literatures have shown that, the construction sector consuming more than 40% of stone and sand, 25% of natural wood, and 16% of water globally. This has negative impact on natural resources (Robichaud & Anantatmula, 2022). A study also stated that construction buildings account for about 70% of timber used worldwide (Thilakaratne & Lew, 2019). Li et al., (2016) highlighted that, more than 30% of worldwide energy was consumed by construction buildings.

The traditional building construction contributed to environmental pollution by providing a huge amount of waste during their life cycle (Berardi, 2017). Literature highlighted that, GBs are focus more on social and environmental aspects compare to traditional buildings which is more concentrate on natural resources (Ahmad et al., 2019).

However, the importance of GB-related works have been drawn the attention of academic researchers, and their studies have promoted the development of sustainability across the world, and it contributed to protect the society.

Furthermore, Okoye et al., (2022) identified and assessed 23 critical risk factors affecting the implementation of sustainable construction practices in Nigeria and found that the effect was moderate and the study revealed that there is no significance difference in the risk level of the risk factors associated with implementation of sustainable construction practices based. Erdenekhuu et al., (2022) also identified assessed critical risks and the study shows that air, water, and land pollution, water consumption, and solid waste are the most critical. Hwang et al. (2017) identified 42 risks and study found that overlooked high initial cost, unclear requirements of owners, complex procedures to obtain approvals, and lack of availability of green materials and employment constraint, equipment found as top 5 critical risks in green building construction projects. Another study of Zou and Couani (2012) recommended that engaging experienced professionals of green building in managing green construction risks will enhance its adoption.

However, in the context of Nigeria, there is no clear evidence of study directed towards developing response strategies to risks/challenges affecting the adopting of green buildings construction practices in the literature. Many studies have been conducted and most of them are focusing on the risk identification and assessment (Bahamid et al., 2019). Literatures have shown that identification assessment only will be worthless unless effective risk response strategies are developed and implemented (Hillson, 1999).

RISK RESPONSE STRATEGIES:

Risk response strategies could be described as process of developing strategic options to be used and determining actions to be taking, in order to enhance opportunities and reduce threats to the project objectives (*PMBOK Guide, 2013*). Risk response strategies, adopted for this study, are broadly classified into four categories namely: *avoid, transfer, mitigate* and *accept*.

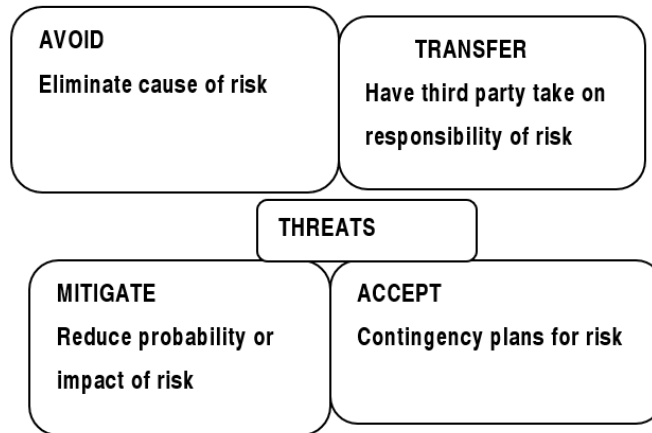


Fig. 1: Strategies for negative consequence of risks. (Tipili & Yakubu, 2014)

RISK MANAGEMENT PROCESS

The main processes of risk management are:

- Risk management experience: defined as an adequate understanding of the rationale and formal processes of project decision-making under risk and uncertainty. This process can be measured through the availability of risk analyst such as health and safety specialist (Jannadi and Almishari, 2003),
- Risk identification and ranking: such as risk checklists,
- Risk analysis techniques: statistical techniques such as Monte Carlo simulation, which is not commonly practiced in the construction industry (Dina & Dil Bahadun, 2022),

The risk management procedure (the risk assessment phase) can be viewed in three stages: risk identification, risk analysis and risk response (Smith, 2008).

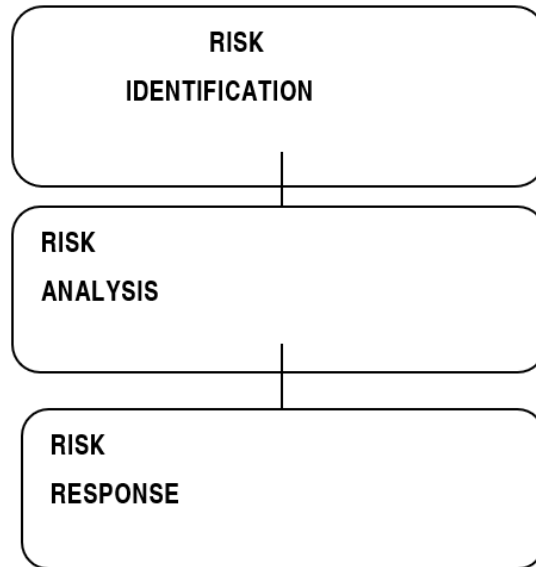


Fig. 2: Risk management procedure (Smith, 2008).

Risk identification

The identification of risk is a process for uncovering any risk which could potentially affect a process, initially the construction team should identify risks, and the risks should be identified to the maximum extent that is practicable (Ojo & Odediran, 2015).

Risk Analysis

The analysis of risk is the process of assessing and analyzing the identified risks and the analysis could be done through quantitative or qualitative approach (Smith, 2008).

Risk Response Strategies

After identification and analysis of the risks identified, next is risk response strategies. Risk response strategies could be described as process of developing strategic options to be used and determining actions to be taking, in order to enhance opportunities and reduce threats to the project objectives (PMBOK Guide, 2013). Once risks are identified and assessed, a proper response strategy has to be formulated and be made accountable for implementation. Response strategies to be used for this study are categorized into four, which includes: AVOID, TRANSFER, MITIGATE and ACCEPT

Risks to green buildings

An extensive review of various literatures was conducted and 24 potential risks to green building project adoption are identified.

METHODS

Structured questionnaire was used and the choice of this method is to collect quantitative data and this is planned and designed to collect very specific information from construction professionals, where list of 24 risks affecting adoption of green building were identified, so as to assess and allocate prefer response strategies to risks.

Sample size

The sample size was obtained using a (Yamane, 1986) formula to determine sample size.

$$n = \frac{N}{1+N(e)^2}$$

Where n = Sample size, N = Total population, 1 is Constant and $e = (0.05)^2 = 0.0025$ error margin will be considered. Having a confidence level of 95% $n = 360$. Therefore, the sample size (n) for the survey is found to be 360. This implies that 360 questionnaires would be administered to the targeted respondents.

Targeted respondents

The targeted respondents for this study are construction professionals involved in construction projects executed at public tertiary institutions.

DATA ANALYSIS

Descriptive statistics such as mean, percentage and ranking describe respondents' attitude toward risks affecting adoption of green buildings. Furthermore, in order to determine the percentage level of effect, the formula below was used:

$$\text{Risk Effect (\%)} = \frac{(I_m \times O_m)}{25 \times 100}$$

Where: I_m = Mean of impact; O_m = Mean of occurrence; 25 = 5-point scale of impact x 5-point scale of occurrence, 1 – 45% = Low effect, 46 – 65% = Moderate effect, and above 65% = High effect.

However, in allocating the response strategies for top risks (popularity of options method was adopted, using allocation preferences). The preferred strategies allocated will be presented as percentages of total counts of respondents' responses. The criteria used for allocation was called **popularity of options** where above 50% is in favour of allocating. For interpretation purposes, response strategies allocate to risks identified where responses frequencies is above 75% are considered as "sole allocation," meaning that, is the only strategy to be considered among all other response strategies, whereas response frequencies between 50% and 75% are regarded as "primary allocation," meaning that, the response strategy selected, is considered as first before other response strategies. On the other hand, if none of frequencies for any risk response is up to 50%, the risk response is regarded as being "dependent on individual project circumstances." This method had been previously used by Ibrahim et al. (2006).

FINDINGS

Section A: Results

Table 1: Assessing level of effect of risks affecting adoption of green buildings, using 5-point Likert scale.

	Impact occurrence			
	Mean	Mean	(%) Risk effect	Rank
Risks				
Lack of practical experience of GBs	4.41	3.92	63	8th
Unavailability of green building materials and equipment	4.05	3.90	69	3rd
Uncertainty in the quality of green building materials	3.66	3.63	53	12th
Inadequate technical experts of sustainable	3.85	3.50	54	11th
Lack of public awareness and knowledge	4.08	4.07	66	5th
Inadequate qualified professionals	3.02	3.01	36	17th
Incorrect sustainable design information	3.28	3.06	37	16th
Financial capability of clients	2.86	2.52	29	21st
Inexperience project team to provide services of sustainable construction	4.02	4.00	64	7th
Uncertainty in energy saving and renewable energy	3.30	3.23	43	13th
Poor scope definition of GB	3.30	3.16	42	14th
Lack of proper allocation of roles in sustainable construction	3.0	2.98	38	15th

	Impact occurrence			
	Mean	Mean	(%) Risk effect	Rank
Failure to meet sustainable construction certification requirements	3.00	2.02	24	22nd
Lack of planning of sustainability measures by stakeholders	4.19	3.97	67	4th
Change of sustainable building certification policies	3.02	3.06	37	16th
Unachievable project requirements	3.70	2.03	30	20th
High sustainable construction premiums	2.87	2.90	33	18th
Cost of investment in skills development and shortage of skills	4.08	4.01	65	6th
High initial sustainable cost	4.00	3.94	63	8th
Lack of market demand	4.59	4.09	75	1st
Lack of government support	4.31	4.04	70	2nd
Unclear contract conditions for claims, litigations and dispute resolution	2.72	2.68	29	21st
Lack of innovative technology	4.00	3.90	62	10th
Lack of good materials for GBs construction	2.77	2.77	31	19th
Overall Average Effect =			52	

Table 1 shows the results of the level of risks effect affecting the adoption of green building practice. The study established that all the risks identified had negative impact on the adoption of green buildings, with percentage effects range from (24%) the least effect and (75%) the highest effect. The overall average effect is 52%.

The study identified 24 risks affecting the adoption of GBP. Therefore, table 2 below shows top 10 out of 24 risks identified, with percentage effect range between 62% and 75%.

Table 2: Top 10 out of 24 risks identified

	Impact occurrence			
	Mean	Mean	(%) Risk effect	Rank
Risks				
Lack of market demand	4.59	4.09	75	1st
Lack of government support	4.31	4.04	70	2nd
Lack practical experience GBs	3.92	4.41	69	3rd
Lack of planning of sustainability measures by stakeholders	3.97	4.19	67	4th

	Impact occurrence			
	Mean	Mean	(%) Risk effect	Rank
Lack of public awareness and knowledge of GBs	4.08	4.07	66	5th
Cost of investment in skills development and shortage of skills	4.01	4.08	65	6th
Inexperience project team to provide services of sustainable construction	4.00	4.02	64	7th
High initial sustainable construction costs	3.90	4.05	63	8th
Unavailability of green building materials and equipment	4.00	3.94	63	8th
Lack of innovation technology	3.90	3.85	62	10th

RESULTS

Table 2: shows the overall 10 risks with moderate/high effect on the adoption of green building practice where “Lack of market demand.” was found to be risk with the highest effect on the adoption of GBP, it ranked 1st with percentage effect of 75%, follow by “Lack of practical experience.” ranked 2nd with effect percentage of 70%. Other risks with high effect on adoption of GBP are “Lack of practical experience of GBs.” ranked 3rd with effect of 69% and “Lack of planning of sustainability measures by stakeholders.” ranked 4th with risk effect of 67% and while “Lack of public awareness and knowledge of GBs.” ranked 5th with effect of 66%, whereas “Cost of investment in skills development and shortage of skills.” and “Inexperience project team to provide services of sustainable construction.” ranked 6th & 7th with effect of 65% & 64% respectively, while “High initial sustainable construction costs.” and “Unavailability of green building materials and equipment.” both ranked 8th with 63% effect. However, the last one was “Lack of innovation technology.” ranked 10th with risk effect of 62% respectively. As shown in Table 1: The results of the research indicates that the 10 risks with moderate/high effect are the most significance threaten the adoption of Green Building Practice in public institutions, with average percentage of effect 66%.

DATA PRESENTATION AND DISCUSSIONS

Table 3: Preferred response strategies for risks affecting adoption of GBP using popularity of options method

	Risk response allocation (%)				Preferred response
	Avoid	Transfer	Mitigate	Accept	
Risks					

	Risk response allocation (%)				
	Avoid	Transfer	Mitigate	Accept	Preferred response
Lack of practical experience of GBs	80	0	20	0	Avoid
Unavailability of green building materials and equipment	74.5	0	25.5	0	Avoid
Uncertainty in the quality of green building materials	40	0	60	0	Mitigate
Inadequate technical experts of sustainable construction	35	0	65	0	Mitigate
Lack of public awareness and knowledge	12	10	78	0	Mitigate
Inadequate qualified professionals	25	45	30	0	Transfer
Incorrect sustainable design information	55	0	45	0	Avoid
Financial capability of clients	8	47	45	0	Transfer
Inexperience project team to provide services of sustainable construction	70	0	30	0	Avoid
Uncertainty in energy saving and renewable energy	12	48	40	0	Transfer
Poor scope definition of GB	30	0	70	0	Mitigate
Lack of proper allocation of roles in sustainable construction	60	0	40	0	Avoid
Failure to meet sustainable construction certification requirements	62	0	38	0	Avoid
Lack of planning of sustainability measures by stakeholders	15	0	85	0	Mitigate
Change of sustainable building certification policies	5	0	45	50	Accept
Unachievable project requirements	45	0	55	0	Mitigate
High sustainable construction premiums	20	0	70	10	Mitigate
Cost of investment in skills development and shortage of skills	89	0	11	0	Avoid
High initial sustainable construction costs	29.5	0	70.5	0	Mitigate
Lack of market demand	23	5	72	0	Mitigate
Lack of government support	6	5	89	0	Mitigate
Unclear contract conditions for claims, litigations and dispute resolution	40	30	30	0	Avoid

	Risk response allocation (%)				
	Avoid	Transfer	Mitigate	Accept	Preferred response
Lack of innovative technology	77	0	20	3	Avoid
Lack of good materials for GBs construction	17	40	38	5	Transfer

DISCUSSIONS

Avoid strategy that was Response to 9 risks out of 24 risks identified. From table 3, the survey results shows that the respondents generally prefer to allocate avoid response option to Nine (9) risks that had scored above 50%. Of these, out of nine (9) risks, "Avoid." response strategy was solely applied to three (3) risks having frequencies above 75%. These include "Lack of practical experience of GBs," "Cost investment in skills development and shortage of skills." and "Lack of innovative technology." Furthermore, "Avoid." response strategy was also primarily allocated to the remaining six (6) risks, having scored between 50% and 75%. These include "Unavailability of GB materials and equipment," "Incorrect sustainable design information," "Lack of proper allocation roles in sustainable construction," "Failure to meet sustainable construction certification requirements," "Inexperience project team to provide services of sustainable construction," and "Unclear contract conditions for claims, litigations and dispute resolutions."

Mitigate strategy that was Response to 10 risks out of 24 risks identified. The results also shows that respondents preferred to allocate mitigate response strategy to Ten (10) risks having scored above 50%. Therefore, out of 10 risks, mitigate response strategy was solely allocate Three (3) risks that had scored above 75%. These include: "Lack of public awareness and knowledge," "lack of planning of sustainability measures by stakeholders" and "lack of government support." In addition, mitigate response strategy was also primarily allocated to the remaining Seven (7) risks having scored between 50% and 75%. These include: "uncertainty in the quality of GB materials," "inadequate technical expert of sustainable construction," "poor scope definition of GB," "unachievable project requirements," "high sustainable construction premium," "high initial sustainable construction costs," "lack of market demand."

Transfer strategy that was Response to 4 out of 24 risks identified. The respondents prefer to allocate transfer response strategy to Four (4) risks having frequencies between 40% and 48%. Therefore, this dependent on individual project circumstances, since the frequencies is less than 50%. Transfer response strategy was allocated to "Inadequate qualified professionals," "Uncertainty in energy saving and renewable energy," "Financial capability of clients." and "Lack of good materials for GBs construction."

Accept strategy that was Response to 1 out of 24 risks identified. The respondents prefer to allocate accept response strategy to One (1) risks having frequencies between 50% and 75%. There-

fore, Accept response strategy was primarily allocated to “Change of sustainable building certification policies.”

However, the study established that majority of the respondents preferred avoid and mitigate strategies as the most prominent/significant response strategies to be used, so as to minimize the negative effects of the risks identified for this study. Therefore, in dealing with the risks affecting the adoption of green buildings for construction projects in tertiary institutions, the respondents preferred avoid and mitigate response strategies, both response options were having overall mean percentage (%) above 50%, while transfer response options was having overall mean percentage (%) of less than 50%. Though major international studies reiterate about all four responses strategies allocated in project risk management at different levels, in this study the main response strategies as perceived by respondents are Avoid and Mitigate. The findings of the present research offer a lot of insights on the practices being followed in the implementation of risk response strategies.

As stated by Hiremath and Mallik (2014) avoid and mitigate strategies revolves around effective communication and collaboration between the parties involved at early stage of work, the existence of team spirit and a caring environment did not necessarily imply a robust reporting structure. In other words, a process-oriented approach to risk management reaps better benefits than loosely bound processes, which are not well-defined. Assessment and management of risks periodically and communicating it to the concerned stakeholders can help resolve major uncertainties and lead to project success.

Using a phase-wise approach towards risks assessment and management can occur with effective interaction and cooperation between project managers and other stakeholders involved in the process. Methods to explore and develop free flow of communication among the professionals involved can help managing risks more effectively (Bhoola et al., 2014). At different phases of the project, top management, project steering committee, and internal & external stakeholders should be aware of the deliverables. The steering committee plays a critical role together with the sponsor in approving the project scope, deliverables and financials. Their responsibilities with respect to project management are to provide support to the project team to ensure a smooth project delivery process and implementation.

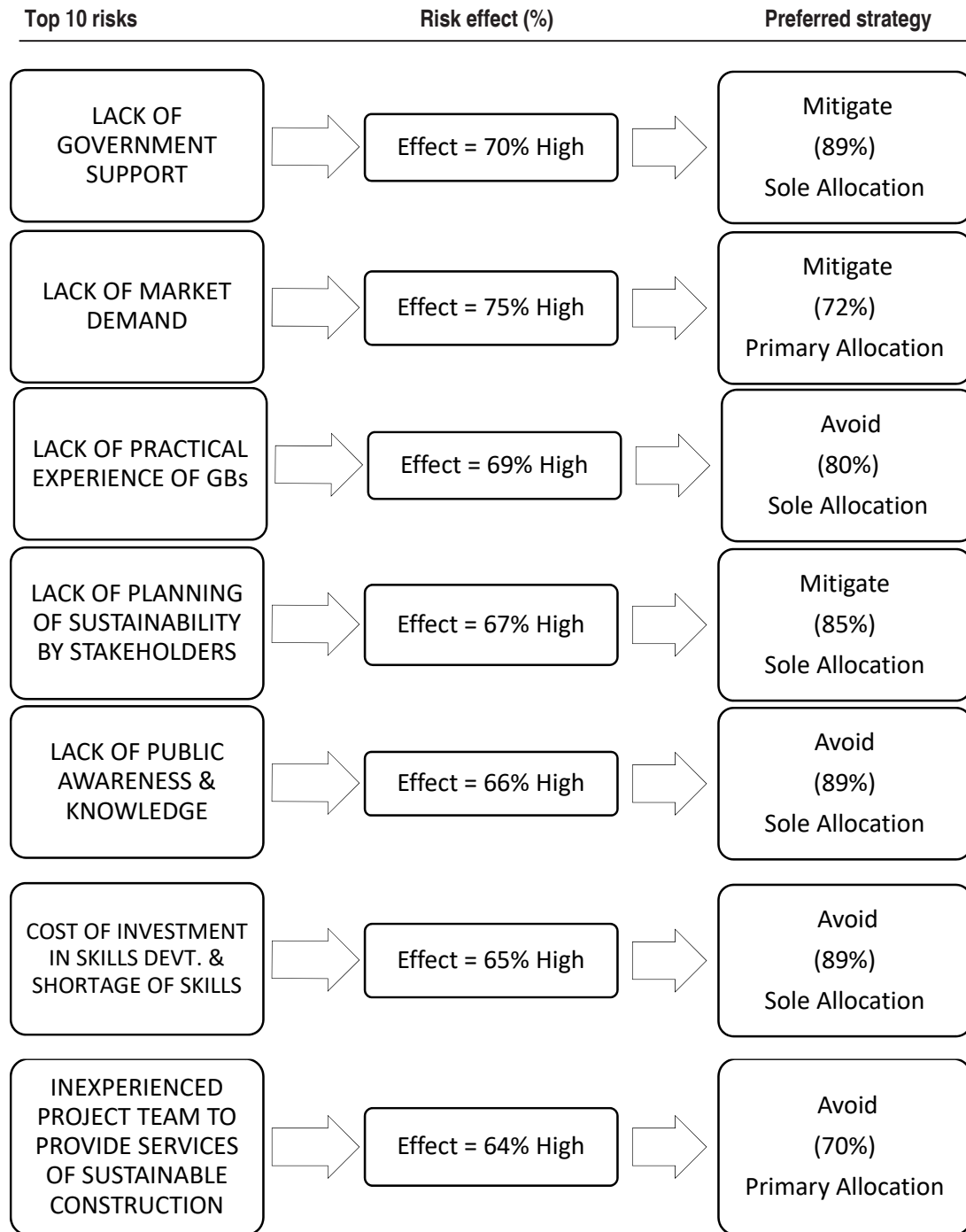
The specific response strategies under the overall *avoid*, *transfer*, *mitigate* and *accept* mentioned above play a fundamental role to impact the quadruple targets of scope & quality, schedule and cost. Processes, which are mostly tailor-made to meet the objectives and requirements of the projects, are targeted to meet the deadlines, maintain quality, avoid rework and conflict and improve productivity, in a realistic manner. Communicating risks in projects requires special skills, project managers often share information about project risks ineffectually or not at all, and hence projects suffer unnecessary set back. Communicating risks at a scheduled time regularly scheduled team meetings, in scheduled progress reports and upper- management reviews, and in special meetings will increase the likelihood of controlling projects from any kind of risks that might affect the suc-

cess. In a nutshell, the findings suggest that the management of risks is an integral part of project management and it needs to be weaved with all the process groups of initiating, planning, executing, monitoring and controlling. Risks can be effectively controlled through proper communication using different modes, for example, formal or informal, spoken or written, manual or electronic, amongst various stakeholders, as applicable to each milestone to achieve the targets of scope & quality, schedule and cost (PMBOK, 2013).

The findings of the present research offer a lot of insights on the practices being followed in the implementation of risk response strategies. These results also correlate with the previous findings of Bhoola et al., (2014) a study conducted on software project management, and assessed Avoid, Transfer, Mitigate and Accept response strategies.

Table 4: Developing risk response strategies for top 10 risks

	Risk effect (%)	Preferred strategies	Type of response (%)
Top 10 risks			
Lack of market demand	75	Mitigate	Primary allocation (72)
Lack of government support	70	Mitigate	Sole allocation (89)
Lack of practical experience	69	Avoid	Sole allocation (80)
Lack of planning of sustainability measures by stakeholders	67	Mitigate	Sole allocation (85)
Lack of public awareness and knowledge	66	Mitigate	Sole allocation (78)
Cost of investment in skills development and shortage of skills	65	Avoid	Sole allocation (89)
Inexperienced project team to provide services of sustainable construction	64	Avoid	Primary allocation (70)
High initial sustainable construction costs	63	Mitigate	Primary allocation (70.5)
Unavailability of green building materials and equipment	63	Avoid	Primary allocation (74.5)
Lack of innovative technology	62	Avoid	Sole allocation (77)



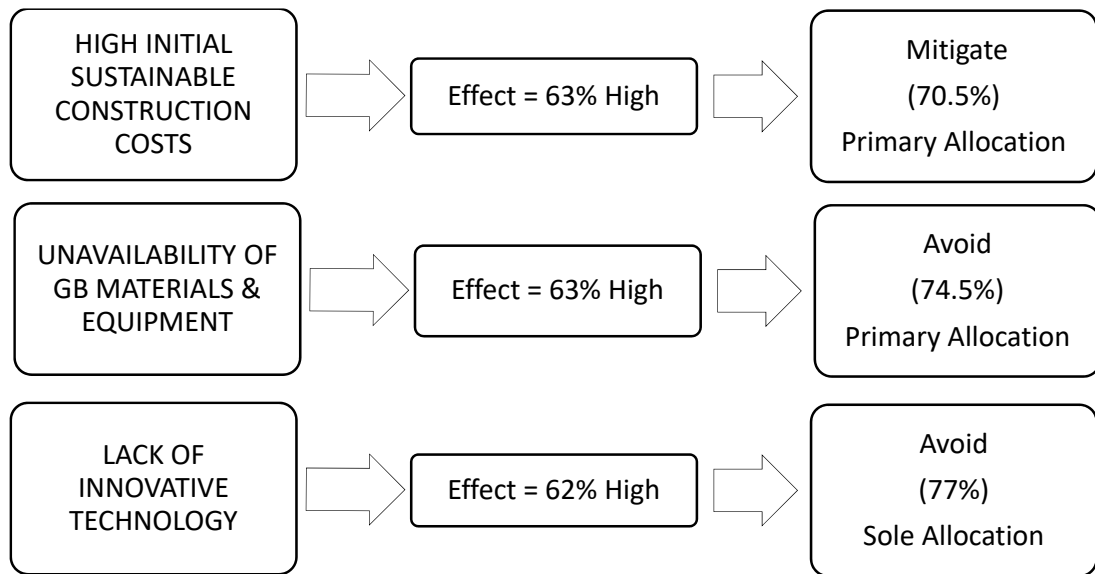


Fig. 3: Outline process chart for developing risk-response strategies

CONCLUSION

This study has described the results of a questionnaire survey that assessed the perception of construction professionals involved in public institutions construction projects, on effects of identified risks and their response strategies allocation preferences. The survey instrument used twenty (24) risks identified from relevant literatures about risks associated with the adoption of Green Buildings. The results of the study shows 10 top risks with percentage effect range between 62% and 75%. These are—"Lack of market demand," "lack of government support," "lack of practical experience of GBs," "lack of planning of sustainability measures by stakeholders," "lack of public awareness & knowledge," then "cost of investment in skills development & shortage of skills," "inexperience project team to provide services of sustainable construction," "high initial sustainable construction costs," "unavailability of GBs materials & equipment," and "lack of innovative technology."

The results also show majority of the respondents preferred to used Mitigate and Avoid response strategies to top 10 risks affecting the adoption of GB. Therefore, literature indicated that *mitigate* and *avoid* response strategies mostly revolve around effective collaboration and communication across all parties involved in the project delivery, there must be effective collaboration among the stakeholders to prioritized GB development. The results of this study also corroborates

the previous results of Bhoola et al., (2014), a study conducted on software project management, that evaluate *avoid, transfer, mitigate* and *accept* response strategies.

Therefore, in order to minimize the effect of risks identified, there must be effective collaboration between governments, public institutions management and other relevant stakeholders concerned on GBs development at public tertiary institutions. Soundness and in-depth knowledge and practical experience of green buildings and its nature by construction professionals are also important. Government support in green buildings development in public institutions would also increase chances of achieving sustainable development goals. The findings of this research will serve a baseline for the government and public tertiary institutions in preparing effective response strategies use to tackle top risks affecting adoption of GBP, thus increase chances of achieving sustainable construction at tertiary institutions.

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