An Empirical Analysis of Organizational External Factors on Construction Risk Management

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***Abstract*— Over the past years, construction risk management in projects execution is always associated with uncertainties because certain risk factors such as poor labour productivity, shortage of equipment, delay, cost overrun, time overrun are attributed to project delivery. These risk factors have been generating many research interests among the construction stakeholders and the policymakers, necessitating this present study. In addressing this issue, this study utilized Partial Least Squares-Structural Equation Modeling method to validate construction risk management (CRM) as a construct from the viewpoints of multi-national, local and national construction companies in Nigeria. Through a cross-sectional survey, data were collected from the construction companies with the use of a structured questionnaire. It was discovered that technology, political and economic factor have a significant influence on construction risk management (CRM) among the Nigerian construction companies. A substantial degree of convergent validity, discriminant validity and internal consistency reliability were also affirmed for each of these research constructs. It was also discovered that the indicators of organisational external factors dimensions (technology, political and economic factor) are important in evaluating these constructs for further exploration of the construction companies to enhance risk management practice in all stages of the project activities.**

Keywords*— *PLS-SEM; Technology Factor; Political Factor; Economic Factor; Construction Risk Management (CRM).

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1. Introduction

The achievement of every construction project is recognised when a project is made on the estimated time, cost, and the quality can be seen by clients with minimum conflicts attached to such project. Before a project can be successful, the stakeholders need to ensure that the project is functioning as effectively and efficiently as possible. Improving the effectiveness and efficiency of any project needs an agreement of cost factors which may affect the technical performance or practical approach in carrying out some processes that will reduce the chances of certain risk factors occurrence and buffer its management effectively [17] [8].

Ramasesh and Browning [35] affirmed that majority of the previous studies show that management of risk in construction projects is full of restrictions affecting their effectiveness, and on the long run, impact projects' success. Management of risk in construction projects has been approached with the use of a reductionist method for over decades which has produced poor results and decreased the quality of project management.

Several empirical studies in Nigeria have shown that industries that apply construction services on a periodic basis do not systematically apply risk management practices in projects, which has resulted in low project performance such as the total abandonment of project [1]. Also, research conducted by Ojo, [18] on claims and contract

disputes in a number of construction projects, had reflected the event of risks occurrence that was not well analyzed or integrated by either clients, contractors or consultants as one of the main causes of claims and disputes in construction projects.

This paper further proposed a definition of risk based on different opinions of prior studies such as Lo et al. [29]; Andi [12] and Larson & Gray [28] as "the probability of occurrence of any unexpected or ignored event that can hinder the achievement of project objectives, which may be in the form of management, materials, design, finance, labour and equipment risks," following [8]. Lastly, this study investigated the influence of organizational external factors on construction risk management.

2. Literature Review

2 . 1 Construction Risk Management (CRM)

This paper conceptualized construction risk management with five (5) dimensions which are management risk, material risk, financial risk, design risk, labour and equipment risk, following [6] [3]. According to Johnston et al. [25], lack of adequate management concerns in Iranian construction projects was responsible for lack of productivity of construction workers while working on the construction sites. Ghoddousi & Hosseini [19] also concluded that these issues include poor housekeeping, poor lighting in the work area, excessive movement of skillful people from one project to another, inadequate ventilation, uncontrolled breaks, inadequate tools and equipment, high employee turnover, shortage of restrooms and drinking water and impromptu decisions making by the supervisors have found to be the leading factors caused by management during construction project in Iran. Zavadskas *et al.* [42] also claimed that the contractor's assessment and the selection stages should be exposed to taking into consideration some factors that influence the process of construction efficiency.

Likewise, poor management within the Nigerian construction industry is also a major issue, leading to high dependence on raw materials importation, whereas, Nigeria has abundant raw materials. Studies have also indicated that while the country' abundant resources and raw materials could be converted into new building materials with reasonable price to the growing population, little efforts have been made till date to transform the construction industry [40].

In the same vein, design stage has been identified as one of the most serious stages where risk could manifest since other related factors associated to it are also associated with major risks in construction projects [15].

Also, in the analysis of Askew et al. [11], finance is one of the most vital resources during project execution. More so, financial planning is the fundamental stage for any construction company to survive. This is important because lack of fund has been branded to be the common causes of most project failure.

Problems from manpower are linked to labour risk such as lack of skilled labour and shortage of available workers, while factors associated with equipment are quality, availability and reliability of the equipment [39]. Studies like Manavazhi and Adhikari [30] also established the fact that contractors' attitude of hiring unskilled workers to cut the cost mostly affects the quality of the project outcomes.

2.1 Technology Factor

According to Akanni, Oke & Akpomiemie [4], technology is the views of an environment that must be considered in a country's strategic plans. A suitable and proper construction technology can be measured by the presence of plant and equipment that are made locally, the magnitude of local material resources and the level of utilization of the local construction resources, and the skilled labour [34]. The shortage of managerial man-power and inadequate technological know-how were conceived to be some of the major problems confronting the nation. In justifying the aforementioned empirical evidence, this study investigates the technology factor of Nigerian construction companies with its effects on construction risk management (CRM). Thus, this hypothesis is formulated:

H1: Technology factor will significantly influence construction risk management (CRM).

2.2 Political Factor

The influence of environmental variables such as safety, community perception, and legal acceptability, political and social impacts on the project is mostly high [20]. The author further highlighted discriminatory legislative, covering tax regimes, riots, strikes, civil unrest, wars, terrorism, invasions and religious turmoil as derivatives of political factors.

Construction project encounters political forces which refer to the influence of the government policy on the projects. For instance, reduction in the degree of investment and the provision of finance may affect the labour market productivity.

The antecedent role of political factor in construction risk management has not been previously established within the Nigerian construction companies. In line with the above discussion, this hypothesis is formulated:
H2: Political factor will significantly influence construction risk management (CRM).

2.3 Economic Factor

Construction firm's economy and finances are influenced not only by the global economic activities but also on resource availability to execute the work, which includes the economic competition of several levels around the appointment of all parties involved in building projects. Financial shortage seems to occur on the building project. Obalola's study depicted that financial environment drives are discerned from economic factor on the basis that economic is connected with the deployment of resources, while, the financial shortage is strictly linked with money [34]. Nevertheless, there is a dearth of empirical findings within the construction industry on the relationship between the economic factor and construction risk management. Hence, this study proposes to initiate this relationship by putting the following hypothesis forward:

H3: Economic factor will significantly influence construction risk management (CRM).

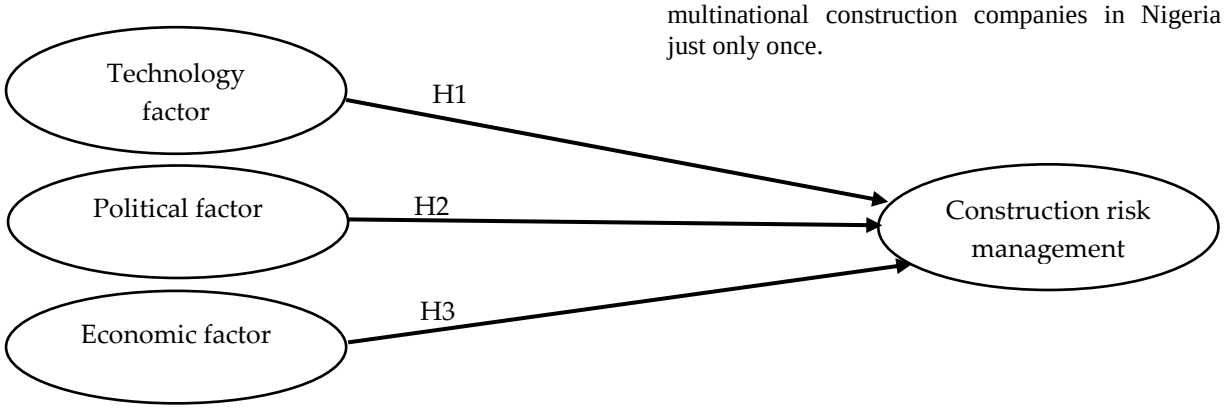

Figure 1. Conceptual model

3.0 Methodology

3.1 Data collection and sample

This study is a cross-sectional design in nature. Data were gathered at one point in time. Based on the recommendations of [31] that pilot studies sample size should
be moderately smaller, ranging from 15 to 30 respondents, which can be further increased depending on individualities. Thus, fifty (50) copies of a questionnaire are reasonable in determining the internal consistency of this study's variables. A five-point Likert scale was used to measure all the variables, anchored with 0.1 = 'very low,' 0.3 = 'low', 0.5 = 'medium', 0.7 = 'high', 0.9 = 'very high. In the pilot study, the feedbacks from the construction companies were used to measure the internal consistency reliability for each of the research variables through Cronbach's alpha coefficient. The result indicated that the internal consistency of reliability for all the variables ranged from 0.840 to 0.868, showing the high reliability of all the scales [36].

After the pilot test, the questionnaire was restructured to develop the final version. Actual data collection was carried out using personally-administered survey methods with the aid of a close-ended structured questionnaire. Going by the recommendations of Krejcie and Morgan's [27] sample size parameters, a sample size of 181 is expected from a population of 238 contractors (i.e., contract manager, executive director, marketing manager, project manager and engineers) operating in Abuja and Lagos among the local, national and multinational construction companies in Nigeria just only once.

More so, local, national and multinational construction companies were selected following [2] [37]. Thus, 331 copies of the questionnaire were administered, and a total of 238 copies were retained for analysis. Incomplete and invalid responses were responsible for the exclusion of 10 responses, which gives a total of 75% response rate and 72% valid response rate was considered for this study.

4.0 Analysis and Results

The descriptive statistics show that, out of the total respondents of 238, the contract manager, executive director, marketing manager, project manager and engineers, were 10.9%, 3.4%, 5.0%, 31.5%, and 30.3% respectively. Likewise, their working experience ranges from 1 to 47 years, while the male and female respondents were 76.5 and 23.5 respectively. Furthermore, the company's specialization were apartment buildings, roads and bridges with 36.6%, 54.7%, and 6.7% respectively. The types of company owners are local, national and multinational with 63.0%, 6.3% and 30.3% severally. Their company business location was local market areas, within a few states, regional, across Nigeria and international markets with 60.1%, 3.8%, 2.5%, 16.8% and 18.4% severally. While the company employee ranges from 10 to 7000 within the organizations.

4.1 Measurement Model

Measurement model assessment (the outer model), which is the first step in assessing PLS- SEM analysis was carried out. Hence, in order to validate the construction risk management (CRM) in the context of Nigerian local, national and multi-national construction companies, this study employed PLS measurement model to ascertain the individual item reliability, internal consistency of reliability, content validity, discriminant validity and convergent validity of all the constructs in this study as depicted in Figure 1 [22] [24].

4.2 Indicator/Item Reliability and Internal Consistency of Reliability

Individual item reliability assessment in this study was carried out by investigating the outer loadings of every latent variable [14]. Fornell & Larcker [16] rule of thumb allocates the holding of items with loadings between .40 and .70, therefore, every item in this model meets the threshold of 0.40, so none of the items was deleted. Hence, from the model, the items depicted the loadings ranging from 0.8557 and 0.6423 respectively as depicted in Table 1. Based on Table 1, the internal consistency reliability also ranges from 0.8044 to .7541 which follows the rules of thumb.

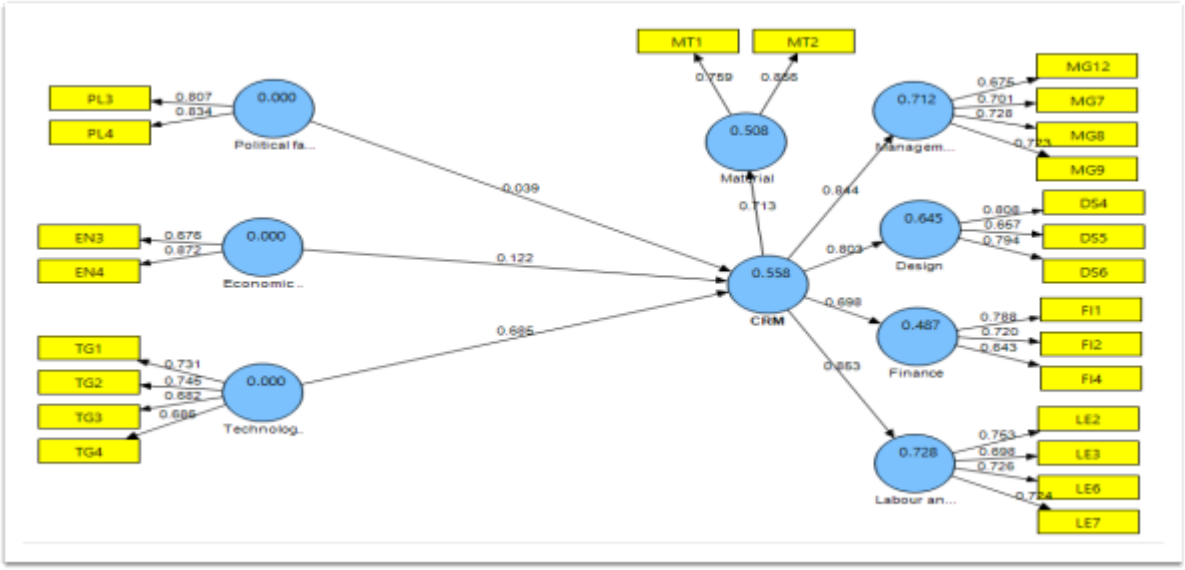

Figure 2. Measurement model

Table 1. Measurement model assessment result.

Constructs	Items	Outer Loadings	AVE	CR
Political factor	PL3. Our construction projects are not affected by government instability.	0.8062	0.6729	0.8044
	PL4. Government subsidies on construction materials are beneficial to our company.	0.8341		
Economic factor	EN3. In our company, inflation has no impact on construction materials.	0.6767	0.6091	0.7541
	EN4. In our company, exchange rates do not affect construction materials.	0.8719		
Technology factor	TG1. Our company makes use of new construction materials.	0.7307	0.5063	0.8038
	TG2. In our company, we use the new construction method.	0.7448		
	TG3. In our company, there is technology simplicity.	0.6823		
	TG4. In our company, we use new technology.	0.6862		
Management risk	MG7. In our company, there is safety during construction.	0.7009	0.5001	0.7999
	MG8. In our company, there is a database for estimating activities.	0.7280		
	MG9. In our company, there are proper site management and supervision.	0.7230		
	MG12. In our company, there is a contract negotiation.	0.6757		
Material risk	MT1. In our company, we experience adequate materials in the markets.	0.7585	0.6538	0.7901
	MT2. In our company, there is a fast delivery of materials.	0.8557		
Design risk	DS4. Complete designs are used in our company.	0.8083	0.5721	0.7992
	DS5. In our company, there are no delays in design information.	0.6576		
	DS6. In our company, there is adequate design team experience.	0.7942		
Finance risk	FI1. In our company, there are no delays in payment.	0.7878	0.5178	0.7619
	FI2. In our company, there is no financial failure.	0.7213		
	FI4. In our company, there is no price escalation.	0.6423		
Labour and equipment risk	LE2. In our company, there is adequate equipment productivity.	0.7529	0.5259	0.8160
	LE3. It is adequate equipment in our company.	0.6976		
	LE6. In our company, there is a fast maintenance of equipment.	0.7260		
	LE7. There is new equipment in our company.	0.7234		

4.3 Content validity and Convergent Validity

These study items were sent out to four experts who are familiar with the constructs of this study. One of the experts was selected from the School of Technology Management and Logistics, University Utara Malaysia. While another three constructions companies' practitioners were also contacted for the same validation. All their recommendations were integrated into the last draft of the instrument which had a great impact on the items in this study.

According to Hair et al., [22] the validity of a specific measurement scale is convergent when items/indicators load with 0.5 and above on their respective constructs. Likewise, items are not supposed to load higher on another mother construct than on the main constructs that it is expected to measure.

4.4 Discriminant Validity

Fornell & Larcker [16] suggests that an AVE score of .50 or higher is considered adequate in a given model, which has been achieved and as depicted in Table 1. Also, in Table 2, a comparison was carried out among the square root of the AVE (appearing in bold) and the latent constructs' correlations, and it was glaring that the AVE square roots for all the constructs along the diagonals are higher than the corresponding off-diagonal coefficients both in columns and rows and columns, suggesting adequate discriminant validity for this study as shown in Table 2.

Table 2. Discriminant validity coefficients for the total sample

	1	2	3	4	5	6	7	8
1. Design	**0.756**							
2. Economic factor	0.243	**0.780**						
3. Finance	0.476	0.261	**0.720**					
4. Labour and Equip	0.584	0.277	0.502	**0.725**				
5. Management	0.607	0.300	0.485	0.606	**0.707**			
6. Material	0.471	0.218	0.385	0.556	0.534	**0.809**		
7. Political factor	0.267	0.313	0.208	0.260	0.314	0.316	**0.820**	
8. Technology factor	0.581	0.290	0.509	0.656	0.608	0.511	0.390	**0.712**

Note. Entries shown in boldface represent the square root of the average variance extracted.

4.5 Structural model results

In order to better explain, predict, and improve risk management implementation among the Nigerian construction companies, it is important to understand why some construction companies choose to know certain factors that are attributed to their risk during the project execution. Fundamentally, the R^2 value was to assess the predictive power of the dependent variable in the whole model [23]. Consequently, the path coefficients together with the variance explained (R^2) specified how well the data is in support of this study's model with a number of 5,000 bootstrap samples and 238 cases [23] [21].

The pictorial illustration of the structural model analysis output aims to test the hypothesis and the causal relationship between the latent variables as depicted in Figure 3 and the numbers depicted along the arrows are the *t* values. This study's hypotheses were designed in a directional form which is the power of the one-tailed test following Kimmel, [26].

As proposed in Hypothesis 1, results indicated that there is a significant relationship between these variables, implying that technology factors play a major role in construction risk management among Nigerian construction companies. Therefore, Hypothesis 1 was strongly supported with ($\beta = 0.4695$, $p < 0.00$). In Hypothesis 2, it was proposed that political factor will significantly influence construction risk management (CRM). Against this prediction, the results showed that there is no significant relationship between these variables.

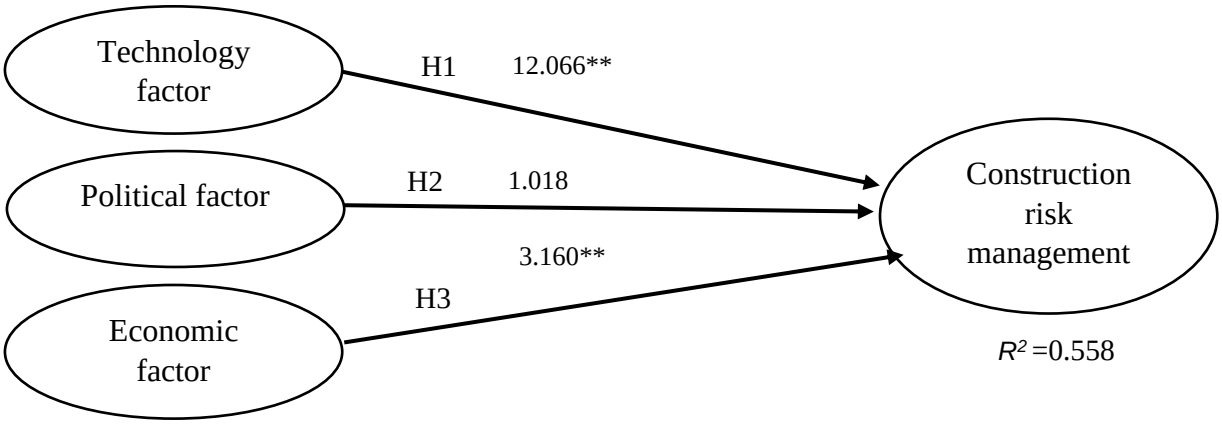

Figure 3. Results of the path coefficient with loadings, significance and R^2.

Note: **significant at 0.01 (1 -tailed), *significant at 0.1 (1 -tailed), CRM (construction risk management) endogenous variable.

Hypothesis 3 was also supported which shows that there is a significant relationship between economic factor and construction risk management (CRM) with $\beta = 0.085$, $p < 0.00$). The independent variables jointly explained 55.8% of the variance in construction risk management (CRM).

5.0 Discussion, Conclusion and Implications

The main aim of this study was to investigate the influence of organisational external factors dimensions (technology, political and economic factors) on construction risk management among Nigerian local, national and international construction companies. Contrary to what was anticipated with Hypothesis 2, that political factor will significantly influence construction risk management was not statistically significant. Therefore, this assertion warrants more discussion. The likely enlightenment for this non-significant relationship might be that data collected for the purpose of this study does not have enough power to discover the relationship in this instance. However, this result deviates from the previous study of Jaafari [20].

It was hypothesized that technology factor would have a significant positive relationship with construction risk management (*H1*). As anticipated, the results indicated a significant positive relationship between technology factor and construction risk management. The implication of this is that the higher the technology during construction process, the lesser possible risk that may occur as a result of technology on the projects, as indicated in previous studies [9] [13] [38]. With regard to hypothesis 3, economic factor showed a significant positive relationship with construction risk management. This result indicates that economic factors such as inflation, deflation, exchange rate, and importation charges have a vital role to play in every construction project in Nigeria and it may also determine the type of risk that might occur as a result of economic factors, in line with the study of [38] [41] [10].

In summary, this study's results show that the measurements for the four constructs comprising of technology, political, an economic factor with construction risk management are valid and acceptable measures of their individual constructs in line with their parameter estimates. The findings also indicated that all the measured items were good measures and reliable in explaining their individual constructs. This was shown by the high loading of the items, composite reliability, average variance extracted (AVE), and square roots of the AVE for all the constructs which are also in line with the previous study of [7].

Nevertheless, this study has shown some understanding of the role of organizational external factors (technology, political, economic factor) on construction risk management, this is not without limitations. First, since the present research adopted a cross-sectional design, underlying inferences cannot be made to the study population. Consequently, a longitudinal design can be used in the future research to ascertain changes over time. Second, future study can as well increase or widen the study area within Nigerian construction companies. Hence, the future researcher should try to increase the study sample from the 238 being used in the present study for a better result. It should be noted that the total variance explained by the exogenous latent variables on construction risk management (the endogenous variable) is 55.8%, hence future study can be conducted to improve this variance.

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