

## Stakeholders Perspective of the Impact of Risk Factors on Cost, Time and Quality of Building Construction Projects

Calistus Ayegba<sup>1\*</sup>, Augustine Edoke Ijigah<sup>2</sup>, Adakole Edwin Agbo<sup>3</sup>,

1. Department of Building, Federal University of Technology Minna Niger State, Nigeria
2. Department of Building, Federal University of Technology Minna Niger State, Nigeria
3. Department of Building, Federal University of Technology Minna Niger State, Nigeria

### Abstract

The paper considers the stakeholders perspective of the impact of risk factors on cost, time and quality of building construction projects. In the study, stakeholders perceive of the impact of risk factors on cost of building construction projects as well as stakeholders perceive of the impact of risk factors on time duration of building construction projects and stakeholders perceive of the impact of risk factors on quality of building construction projects were assessed. Data for the study was obtained Data for the study was collected via a structured questionnaire administered to respondents in Abuja, Port-Harcourt, Kaduna and Lagos state. The questionnaires are designed to assess the views of respondents on the impact of risk factors on cost, time and quality of building construction projects. Respondents were asked to rate their perceptions regarding the severity of risk factors on a five point Likert ordinal scale where 5 = Very Severe, 4 = Severe, 3 = Neutral, 2 = Less Severe and 1 = Not Severe. Data obtained from the survey were analysed using Relative Severity Index (RII) method. The Relative Severity index (RII) was calculated using the formula:  $RII = \frac{\sum nW}{N}$  (for  $0 \leq RII \leq 5$ ) Where  $W$  = the weight assigned to each strategy by the respondents,  $n$  = number of respondents,  $N$  = the total number of respondents. The limits of definition of RII were:  $0 \leq RII \leq 1$  = Not Severe,  $1 \leq RII \leq 2$  = Less Severe,  $2 \leq RII \leq 3$  = Neutral,  $3 \leq RII \leq 4$  = Severe,  $4 \leq RII \leq 5$  = Very Severe. The mean relative severity index was then calculated and a rank ordering of these variables were then assigned based on the calculated relative index (RII). Findings revealed that 6% and 91% of the impact of risk factors on cost of building

construction projects were perceived to be very severe and severe respectively, 3% of these factors have neutral impact while none of the factors were seen to be of less severity or not having severe impact on the cost of building construction projects. Furthermore, on stakeholders perceive of impact of risk factors on time duration of building construction projects, improper planning and budgeting, inadequate forecast about market demand, increase of material cost, increase in labour cost and improper project organization structure were giving the overall top ranking with relative index of 4.290, 4.142, 4.110, 4.108 and 4.002 respectively while on stakeholders perceive of impact of risk factors on quality of building construction projects corruption/bribery, competition from other companies in form of employing lowest bid to get the contract, poor quality of procured materials, design changes and shortage of skilful workers were ranked overall as the top 34 risk factors identified from literature review.

**Keywords:** Risk Management, Risk factors, Cost, Time, Quality, Construction Industry.

### 1. Introduction:

Construction industry development is a common and contemporary goal of many urban development policies in various countries [2] and [3]. Development of the construction industry also requires knowledge of risk management policies. It is a well establish fact that every stage of the construction process, from initial investment appraisal through to construction and use of the built facility, is subject to risk for all the parties involved. Indeed, compared to other industries, the Nigeria construction industry has a particularly poor record in this regard with high number of construction related risks occurring each year [12] and [20]. In recent

times, the nature, incident and impact of risk in construction have become a topic of interest because of the effects on quality, time and cost of construction projects [9], [12] and [20]. Risk is important to contractors as well as clients and consultants within the construction industry; however, the problems of risk assessment are complex and poorly understood in practice [18]. In a related development [1] pointed out that construction activities are full of risk which include those that may relate to external, commercial, design, construction and operation. However, they have to be considered for effective management in order to retain the initial objective of the project. Risk is defined as the probability that an unfavorable outcome will occur [15]. According to [6], risk is the probability that an adverse event occurs during a stated period of time.

[1], [18] and [7] stated that projects have life cycles or a sequence of stages and activities from origin to completion and there is always a degree of risk associated with each stage. [11] and [23] pointed out that too often this risk is not dealt with satisfactorily which has resulted into poorly performed projects in the industry. They submit that the way out is the integration of risk management techniques into the estimation of construction projects cost and time, as this will help considerably to avoid excessive overrun.

Many approaches have been suggested for the classification of risks. However, all of them pointed to the identifying the primary source of risk central to construction activities which triggered the risk. [12] Identified physical, design, environmental, logistics, financial, legal political, construction and operational risk while [6] classified risks into natural and human risks, subdivision of each of these classifications were also listed. The classification of risk are therefore combined into physical, political, environmental, management, legal, technical and market risk. [16] Listed the following as six major processes involved in project risk management: Risk management planning, risk identification, qualitative risk analysis, quantitative risk analysis, risk response planning and risk monitoring and control. Each risk management process results in a specific deliverable which is used as the foundation for the subsequent process.

Track record of successful construction projects would have been greatly improved if more companies had included risk as an integrated part of the project control and quality system [12]. Therefore it is necessary to understand the nature or risks before any management of risk can occur as risk comes in many forms and often the nature of risk depends on the situation.

## 2. Statement of Problem

The Nigerian construction industry has been associated with repeated construction time overrun, construction cost overrun and low quality construction products in recent years but according to [5], [11] and [12] required attention to risk management will reduce project time overrun, cost overrun as well as improve the quality of products and cases of abandoned projects. Construction itself is prone to a variety of risks, such as financial, management, environmental and technical related risks, mainly because of the materials used, nature of design, methods of construction, locations and layout, physical structure and the use to which buildings are put [4]. Previous study by [14], [13] and [21] suggests the application of risk management model of project characteristic to manage the risks inherent in construction project but according to [16] quantitative analytical techniques for managing risk has been rarely used due to limited understanding and experience of the stakeholders in the construction industry. Risk management of construction projects gives the most emphasis to environmental, economic and social issues. Previous researches has identified what constitute risk factors on construction projects but stakeholders perspective on the impacts of these risk factors on cost, time and quality of construction projects as not been well looked into. Based on this the study set out to analyze stakeholders perspective of the impact of risk factors to the cost, time and quality of construction projects so as to reduce construction cost and time overruns as well as improve the quality of construction products.

## 3. Research Methodology

Data for the study was collected via a structured questionnaire designed to assess the views of respondents on the impact of risk factors on cost, time and quality of building construction projects. Respondents were asked to rate their perceptions regarding the severity of risk factors on a five point Likert ordinal scale where 5 = Very Severe, 4 = Severe, 3 = Neutral, 2 = Less Severe and 1 = Not Severe.

The study was carried out on building construction shareholders in Abuja, Port-Harcourt, and Kaduna and Lagos state. These places were selected due to the high rate of construction activities in these places. The population for the study comprised of clients/developers, contractors and consultants who are involved in construction risk management. A total of 70 questionnaires were distributed but 57 (81.43%) of the data were retrieved. Hinkel et al (1998) however believes that the minimum sample size that allows normal distribution assumptions to be

used rather than using a t-distribution is 30. Hence the sample size of 70 is justifiable.

Data obtained from the survey were analysed using Relative Severity Index (RII) method. The Relative Severity index (RII) was calculated using the formula:  $RII = \frac{\sum nW}{N}$  (for  $0 \leq RII \leq 5$ ) Where W= the weight assigned to each strategy by the respondents,

n = number of respondents, N = the total number of respondents. The limits of definition of RII were:  $0 \leq RII \leq 1$  = Not Severe,  $1 \leq RII \leq 2$  = Less Severe,  $2 \leq RII \leq 3$  = Neutral,  $3 \leq RII \leq 4$  = Severe,  $4 \leq RII \leq 5$  = Very Severe. The mean relative severity index was then calculated and a rank ordering of these variables were then assigned based on the calculated mean RII.

#### 4. Results and Interpretation

Table 1. Stakeholders perceptive of impact of risk factors on cost of building construction projects

	Client's Mean		Consultants mean		Contractors mean		Average Mean	rank
Increase of labour cost	4.210	5	4.435	2	4.627	1	4.424	1
Improper planning & budgeting	3.540	19	4.377	3	4.234	3	4.050	2
Inadequate forecast about market demand	4.345	2	3.568	9	4.021	5	3.978	3
Change of government policies	4.214	4	3.723	8	3.678	9	3.872	4
Design changes	4.022	6	4.563	1	3.490	15	3.858	5
Internal management problems	3.765	13	4.344	4	3.456	19	3.855	6
Improper project organization-structure	3.876	9	4.203	5	3.472	18	3.850	7
Material shortage & thief	4.432	1	3.276	24	3.798	8	3.835	8
Improper verification of contract document	4.231	3	3.387	23	3.566	14	3.728	9
Poor quality of procured materials	3.768	12	3.547	11	3.453	22	3.589	10
Rise in Fuel Prices	3.910	8	3.245	25	3.423	24	3.526	11
Increase of material cost	2.345	34	3.985	6	4.326	2	3.552	12
Bureaucracy	3.432	24	3.563	10	3.567	11	3.521	13
Poor communication	3.657	17	3.450	19	3.456	19	3.521	13
Fluctuation of Inflation Rate	3.456	23	3.442	21	3.567	11	3.488	15
Fluctuation of Interest Rate	4.002	7	2.458	30	3.985	7	3.482	16
Change of top management	3.573	18	3.210	26	3.650	11	3.478	17
Unknown site condition	3.432	24	3.457	13	3.434	23	3.441	18
Fluctuation of Exchange rate	3.789	10	2.453	31	4.000	6	3.414	19
Breach of contract by project partners	3.432	24	3.532	12	3.243	28	3.402	20
Corruption/ bribery	3.675	15	2.345	34	4.129	4	3.383	21
Change in climatic condition	3.218	28	3.423	22	2.457	31	3.327	22
Environmental Impact of the project	3.456	22	3.456	14	3.236	29	3.327	22
Law of arbitration clause in contract agreement	2.678	32	2.678	28	3.456	19	3.271	24
Improper project feasibility studies	3.456	21	3.452	18	2.888	30	3.265	25
Change in Bank Formalities & Regulations	2.721	31	3.456	14	3.567	12	3.248	26
Stiff environmental regulations	3.456	20	2.769	27	3.472	17	3.232	27
Dispute	3.671	16	2.345	33	3.657	10	3.224	28
Lack of enforcement of legal judgment	2.967	29	3.443	20	3.245	27	3.218	29
Absence of team work	3.772	11	3.456	14	2.345	33	3.191	30
Competition from other companies	2.453	33	3.453	17	3.423	24	3.110	31
Shortage of skilful workers	3.359	27	2.451	32	3.475	16	3.095	32
Accidents on site	2.789	30	3.983	7	2.234	34	3.002	33
Healthy working Environment for the workers	3.675	14	2.568	29	2.456	32	2.900	34

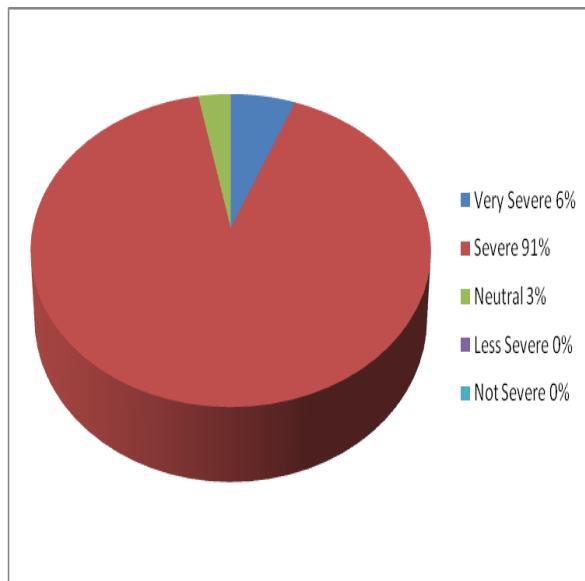


Figure 1. Stakeholders' perception of the impact of risk factors on cost of building construction projects

The study identified 34 major risk factors from literature to get the stakeholders' perception of the impact of these risk factors on the cost of building construction projects. The options "Very Severe", "Severe", "Neutral", "Less Severe" and "Not Severe" were used to evaluate the responses. The result is presented in table 2 and figure 1. Figure 1 indicates that 6% and 91% of the impact of risk factors on the cost of building construction projects were perceived to be very severe and severe respectively, 3% of these factors have a neutral impact while none of the factors were seen to be of less severity or not having a severe impact on the cost of building construction projects. As indicated in table 2, an increase in labour cost, improper planning and budgeting, inadequate forecast about market demand, change of government policies and design changes were ranked overall as the top 34 risk factors with impact on the cost of building construction projects. These findings are consistent with the results of other researches that have reported an increase in labour cost and improper planning and budgeting as a major risk factor on cost (Florence and Linda, 2006 and Windapo et al, 2010).

Table 2. Stakeholders' perception of the impact of risk factors on the time of building construction projects

	Client's Mean		Designers mean		Contractors mean		Average Mean	rank
Improper planning & budgeting	4.201	6	3.987	4	4.683	1	4.290	1
Inadequate forecast about market demand	3.987	9	4.210	3	4.230	3	4.142	2
Increase of material cost	4.214	5	3.876	7	4.241	2	4.110	3
Increase of labour cost	4.219	4	4.321	1	3.786	11	4.108	4
Improper project organization-structure	4.356	2	3.550	19	4.102	4	4.002	5
Improper project feasibility studies	4.100	8	3.893	5	3.800	10	3.931	6
Poor communication	4.106	7	3.567	17	3.890	8	3.854	7
Design changes	3.768	12	4.321	1	3.462	21	3.850	8
Change of government policies	3.982	10	3.890	6	3.670	15	3.847	9
Bureaucracy	4.243	3	3.245	9	3.876		3.788	10
Improper verification of contract document	3.765	13	3.569	16	3.988	6	3.774	11
Material shortage & thief	3.678	16	3.675	13	3.897	7	3.750	12
Shortage of skilful workers	4.400	1	3.256	29	3.567	18	3.741	13
Change in Bank Formalities & Regulations	3.524	21	3.592	15	4.029	5	3.715	14
Change of top management	3.567	19	3.560	18	3.672	14	3.599	15
Lack of enforcement of legal judgment	3.287	26	3.789	8	3.670	16	3.582	16

Dispute	3.725	15	3.241	30	3.684	12	3.550	17
Corruption/ bribery	3.478	22	3.450	22	3.674	13	3.534	18
Rise in Fuel Prices	3.743	14	3.420	25	3.435	24	3.532	19
Fluctuation of Exchange rate	3.561	20	3.651	14	3.247	29	3.486	20
Poor quality of procured materials	3.429	24	3.367	26	3.650	17	3.482	21
Absence of team work	3.456	23	3.478	21	3.456	22	3.463	22
Fluctuation of Inflation Rate	3.245	29	3.679	12	3.456	23	3.460	23
Unknown site condition	3.679	16	2.980	31	3.468	20	3.375	24
Fluctuation of Interest Rate	3.095	31	3.347	28	3.564	19	3.335	25
Law of arbitration clause in contract agreement	3.783	11	2.760	33	3.426	26	3.323	26
Change in climatic condition	3.574	18	2.876	32	3.430	25	3.293	27
Breach of contract by project partners	3.278	27	3.768	9	2.678	34	3.241	28
Stiff environmental regulations	3.324	25	3.432	23	2.967	32	3.241	28
Accidents on site	3.214	30	3.168	30	3.267	28	3.216	30
Environmental Impact of the project	2.984	32	3.768	11	2.870	33	3.207	31
Healthy working Environment for the workers	2.578	33	3.423	24	3.320	27	3.107	32
Internal management problems	3.276	28	2.659	34	3.103	31	3.012	33
Competition from other companies	2.245	34	3.493	19	3.241	30	2.993	34

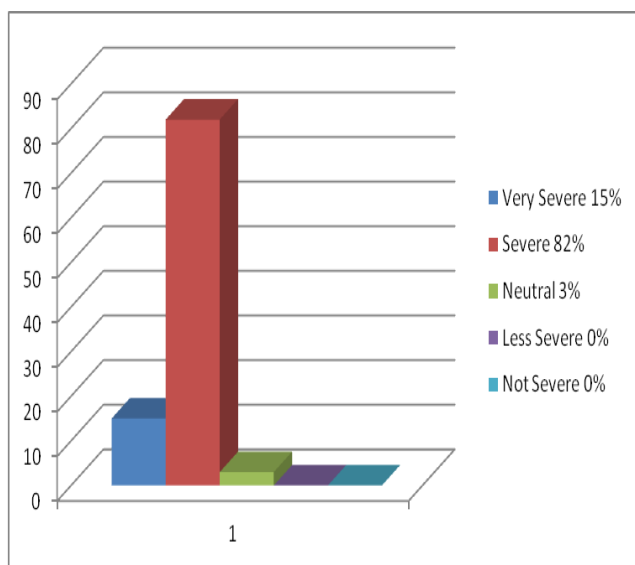


Figure 2 Stakeholders perceptive of the impact of risk factors on time duration of building construction projects.

To obtain respondents view on the impact of risk factors on time duration of building construction

projects. A range of risk factors from literature was presented to the respondents for them to decide on the impact of the risk factors on time duration of building construction projects. The rating value of 5, 4, 3, 2, and 1 were assigned to the options “Very Severe”, “Severe”, “Neutral”, “Less Severe” and “Not Severe” respectively. The results are ranked in table 3 in which shortage of skillful workers, design changes and improper planning and budgeting were ranked 1<sup>st</sup> by the client, consultants and contractor respectively. Improper project organization structure, increase in labour cost and increase in material cost were ranked 2<sup>nd</sup> with relative index of 4.356, 4.321 and 4.241 by the client, consultants and contractors respectively while improper planning and budgeting, inadequate forecast about market demand, increase of material cost, increase in labour cost and improper project organization structure were giving the overall top ranking. Considering the results in table 3, the

various high relative index of these factors shows that the respondents highly agree that these risk factors has very severe and severe impacts on the time duration of building construction projects in presented in figure 2 where only 3% of these factors has neutral impact while none of the factors were

seen to be of less severity or not having severe impact on the time duration of building construction projects.

Table 3. Stakeholders perceptive of impact of risk factors on quality of building construction projects

	Client's Mean		Designers mean		Contractors mean		Average Mean	Rank
Corruption/ bribery	4.201	6	3.987	6	4.683	1	4.290	1
Competition from other companies	3.987	10	4.210	4	4.230	4	4.142	2
Poor quality of procured materials	3.987	11	4.210	5	4.230	5	4.142	2
Design changes	4.219	5	4.321	3	3.786	13	4.109	4
Shortage of skilful workers	4.210	7	3.435	21	4.627	2	4.091	5
Unknown site condition	3.540	23	4.377	1	4.234	3	4.050	6
Poor communication	4.356	1	3.550	14	4.102	6	4.003	7
Improper verification of contract document	4.356	2	3.550	15	4.102	7	4.003	7
Absence of team work	3.765	15	4.344	2	3.456	25	3.855	9
Change of government policies	4.106	8	3.567	12	3.890	11	3.854	10
Improper project organization-structure	3.982	12	3.890	7	3.670	16	3.847	11
Improper project feasibility studies	4.243	3	3.245	28	3.876	12	3.788	12
Internal management problems	3.765	16	3.569	11	3.988	9	3.774	13
Dispute	4.231	4	3.387	25	3.566	23	3.728	14
Bureaucracy	3.524	24	3.592	10	4.029	8	3.715	15
Law of arbitration clause in contract agreement	3.287	30	3.789	8	3.670	17	3.582	16
Lack of enforcement of legal judgment	3.725	18	3.241	30	3.684	14	3.550	17
Improper planning & budgeting	3.743	17	3.420	24	3.435	28	3.533	18
Change in Bank Formalities & Regulations	3.910	13	3.245	29	3.423	29	3.526	19
Rise in Fuel Prices	3.567	22	3.560	13	3.672	15	3.510	20
Change in climatic condition	3.429	27	3.367	26	3.650	19	3.482	21
Fluctuation of Inflation Rate	3.429	28	3.367	27	3.650	20	3.482	21

Fluctuation of Interest Rate	4.002	9	2.458	33	3.985	10	3.481	23
Healthy working Environment for the workers	3.573	21	3.210	31	3.650	21	3.478	24
Stiff environmental regulations	3.456	25	3.478	18	3.456	26	3.463	25
Fluctuation of Exchange rate	3.245	31	3.679	9	3.456	27	3.460	26
Increase of material cost	3.432	26	3.532	16	3.243	30	3.402	27
Increase of labour cost	3.679	19	2.980	32	3.468	24	3.376	27
Change of top management	2.721	33	3.456	19	3.567	22	3.248	29
Accidents on site	3.324	29	3.432	22	2.967	32	3.241	30
Inadequate forecast about market demand	3.671	20	2.345	34	3.657	18	3.224	31
Material shortage & thief	3.772	14	3.456	20	2.345	34	3.191	32
Breach of contract by project partners	3.218	32	3.423	23	2.457	33	3.033	33
Environmental Impact of the project	2.245	34	3.493	17	3.241	31	2.993	34

Also the rating value of 5, 4, 3, 2, and 1 were assigned to the options “Very Severe”, “Severe”, “Neutral”, “Less Severe” and “Not Severe” respectively in obtaining Shareholders perceptive of impact of risk factors on quality of building construction projects. Table 4 below shows the ranking of the results in which corruption/bribery, competition from other companies in form of employing lowest bid to get the contract, poor quality of procured materials, design changes and shortage of skilful workers were ranked overall as the top 34 risk factors which impacts on quality of building construction projects while accident on site, inadequate forecast about market demand, material shortage and thief, breach of contract by project partners and environmental impact of the project were ranked as the risk factors that have the least (of the 34 risk factors from literature) impact on the quality of building construction Projects. Also the results in table 4 show that there is a positive nearness responds from the consultants and contractors than that of the clients which might be as a result of the professional views in their responses.

## 5. Conclusion and Recommendations

The study has established that among the impact of the various risk factors on cost of building construction projects, increase of labour cost, improper planning and budgeting, inadequate forecast about market demand, change of government policies and design changes top the list while among

the impact of the various risk factors on time duration of building construction projects, improper planning and budgeting, inadequate forecast about market demand, increase of material cost, increase in labour cost and improper project organization structure were giving the overall top ranking. Also, among the impact of the various risk factors on quality of building construction projects, corruption/bribery, competition from other companies in form of employing lowest bid to get contracts, poor quality of procured materials, design changes and shortage of skilful workers top the list.

Based on the outcome of the study the following recommendations are made towards improving risk management so as to reduce cost and time overrun and improve the quality of building construction project.

a. to reduce cost overrun of building construction projects, efforts should be made to mitigate increase in labour cost through adequate planning and budgeting and adequate forecast about market demand as well as taking into consideration other risk factors such as change of government policies and design changes .

b. Proper planning and budgeting, proper project organization structure, adequate forecast about market demand, practice of bulk purchase of construction materials in case of rise in cost of the materials as well as in-house ownership and management of labour to mitigate labour cost in case of increase in labour cost should be put into consideration to reduce time overrun of building construction projects.

c. to improve the quality of building construction projects, efforts should be made to curb corruption/bribery practices which most often will result in inadequate funds left for the actual project execution, encouraging the award of contract not just based on the lowest bidder but also based on some degree of quality assurances, providing detail construction material schedules as part of contract documents, involving all stake holders to have input during design stages of the projects and encouraging skill acquisition in construction trades and training of construction craftsmen so as to mitigate shortage of skilful workers in the construction industry.

## References

- [1] Ashworth, A and Hogg, K. W.(2002). Procedure for the Quantity Surveyors, 11<sup>th</sup> edition, Blackwell Science Ltd., Oxford, 2002.
- [2] Berke, P.R. and Conroy, M.M. (2000). Are we planning for sustainable development? *Journal of the American Planning Association*, Winter 66 (1) (2000), 21-33.
- [3] Chan, E.H.W. and Lee, G.K.L. (2008). A sustainability evaluation of government-led urban renewal projects, *Journal of Facilities*, Emerald Group Publishing Limited 26 (13) (2008), 526-541.
- [4] Chapman, R.J. (2001). The controlling influence on effective risk identification and assessment for construction design management. *International Journal of Project Management* 19 (2001), 147-160.
- [5] Dada J.O. and Jagboro, G.O (2007). An evaluation of the impact of risk on project cost overrun in the Nigerian construction industry, *Journal of Financial Management of Property and Construction*, 12 (1) (2007), 37-44.
- [6] Edward, P.J. and Bowen,P.A.(1998) Risk and risk management in construction: A Review and Future Directions for Research in Engineering and Construction.
- [7] Florence, Y.Y.L. and Linda, H.(2006) Risks faced by Singapore firms when undertaking construction projects in India. *International Journal of Project Management* 24 (38) (2006), 261–270.
- [8] Hyun-Ho, C.H.C. and Seo, J.W.(2004) Risk assessment methodology for underground construction projects. *Journal of Construction Engineering and Management* (ASCE), 12 (2004), 258-272.
- [9] Joshua, O.D (2010). Strategies for mitigating risk in construction projects. The 40<sup>th</sup> Annual General Meeting/ Conference of the Nigeria Institute of Building (NIOB), Asaba, Delta State, July, 7th-11<sup>th</sup> (2010).
- [10] Odeyinka, H.A.(2000). On an evaluation of the use of insurance in managing construction risks, *Construction Management and Economics*, 18 (2000), 519-524.
- [11] Odeyinka, H.A.; Lowa, J.G.and Kaka,A. (2008). On an evaluation of risks factors impacting construction cash flow forecast, *Journal of Financial Management of Property and Construction*, 13 (1) (2008), 5-17.
- [12] Ojo, G.K. (2010). An assessment of the construction site risk-related factors. The 40<sup>th</sup> Annual General Meeting/ Conference of the Nigeria Institute of Building (NIOB), Asaba, Delta State, July, 7th-11<sup>th</sup> 2010.
- [13] Osama, A.J. and Salman, A. (2003). Risk assessment in construction, *Journal of Construction Engineering and Management* (ASCE) 129 (5) (2003), 492-500.
- [14] Prashant, K. and Chris, H. (2001). Exchange rate risk management in international construction ventures, *Journal of Management in Engineering* (ASCE), 17 (4) (2001), 186-191.
- [15] Project Management Institute (PIM) (1996). Project Management Body of Knowledge, PA., Pennsylvania, (1996).
- [16] Shen, L.Y.(1997). Project management in Hong Kong, *International Journal of Project Management*, 15 (2) (1997), 101-105.
- [17] Shen, L.Y.; Wu, G.W.C. and Ng, C.S.K. (2011) Risk assessment for construction joint ventures in China. *Journal of Construction Engineering and Management* (ASCE) 127 (1) (2011), 76-81.
- [18] Shou, Q.W.; Mohammad, F.D. and Muhammad, Y.A.(2004). Risk management framework for construction projects in developing countries, *Construction Management and Economics* 22 (30) (2004), 237–252.
- [19] Tah, J.H.M. and Carr,V. (2000). A proposal for construction risk assessment using fuzzy logic.



*Construction Management and Economics* 18 (2000), 491-500.

[20] Thomas, A.V.; Stayanarayana, N. and Kalanindi, N. (2003). Risk perception analysis in India. *Construction Management and Economics*, 21 (2003), 393-407.

[21] Windapo, A.O.; Omeife, C. and Wahap, L.A. on stakeholder's perception of key risks in oil and gas construction projects. 40<sup>th</sup> Annual General meeting/ Conference of the Nigeria institute of building (NIOB), Asaba, Delta State, July 7<sup>th</sup> – 11<sup>th</sup> (2010).

[22] Seung, H.H.; James, E.D.; Young, L. and Jong, H.O. (2004) Multi criteria financial portfolio risk management for international projects. *Journal of Construction Engineering and Management* (ASCE) (27) (2004), 346-356.

[23] Ward, S. and Chapman, C. (2003). Transforming project risk management (RM) into project uncertainty management., *International Journal of Project Management*, 21 (2003), 97-105.

[24] Hinkel E; Wiersma, W and Jurs, S.G (1988): *Applied Statistics for the Behavioural Sciences*. Houghton, Mifflin, Boston.

IJERT