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MODELS FOR PREDICTING THE IMPACT OF RISK FACTORS ON CONSTRUCTION CONTRACTORS' CASH-OUT FORECASTS IN NIGERIA

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ABSTRACT

Purpose: Researches have shown that construction contractors face challenges when attempting to manage their present and future financial requirements via cash flow (CF) forecasting and/or the use of cash flow forecasting (CFF) models. Consideration for risk factors impacting on CF forecasts/CFF models has also been identified as a key issue affecting contractors' application of CFF models. This study developed models for predicting the impact of risk factors on CF forecasts by contractors in Nigeria. A list of risk factors that impact on CF forecasts were identified through the review of existing literature. The identified risk factors were then investigated in relation to the likelihood of occurrence and the impact on CF forecasts, if they occur.

Design/methodology/approach: Data was collected via a questionnaire survey of contractors operating in the Nigerian construction industry. Two (2) sets of questionnaire surveys were conducted. The first questionnaire survey focused on determining the likelihood of occurrence/impact of thirty-one (31) risk factors on cash-out forecasts respectively. Contractors were asked to rank on a scale of 0 to 5 the likelihood of occurrence/impact of the risk factors. The responses obtained were subjected to analysis with the use of IBM SPSS (version 21) software. The mean, standard error and standard deviation were computed. The computed means were used to rank the likelihood of occurrence/impact of the factors in descending order.

Findings: Sixteen (16) risk factors were found to significantly impact "cash-out" forecasts- "increased duration of the project", "change in currency exchange rates", "high cost of materials", among others. The models developed showed that construction contractors' cash-out forecasts vary with the actual expenditure by +20%, +25% and +25% at the 30%, 50%, and 70% completion stages respectively. Validation of the models shows a 77%, 69%, and 67% accuracy at 30%, 50%, and 70% completion stages respectively.

Research implications: The findings from the research imply that several risk factors have different degree of occurrence and impact on cash-out forecasts in the Nigerian construction industry.

Originality/value: Construction contractors practicing in the Nigerian construction industry should expect positive variations to their "cash-out" forecasts during the execution of projects. Major recommendation; contractors should carefully consider the sixteen (16) affecting "cash-out" before embarking on any construction project.

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1. INTRODUCTION

Managing cash out forecasts is an essential component of financial management in the construction industry. Cash out in construction contracts is concerned with the payments to subcontractors, suppliers and other activities to ensure smooth operation on a construction site. Construction Contractors know that there can be a significant lapse in time from the point at which they are granted a project, incur labour, material and other costs, to the time they are actually paid for completed work. Consequently, an inability to properly plan for the outflow of cash during the life span of a project may well result in the abandonment of the project (Kenley, 2003).

Several factors affect cash out to a contractor working on a project. These factors include (i) duration of the project (ii) retention conditions (iii) times for receiving payments from employers (iv) credit arrangement with suppliers, equipment rentals etc. and (v) times of payment to subcontractors (Park, Han & Russel, 2005). Other factors affecting cash out forecasting include the type of client, size of the project, the procurement route, type of the project etc. (Kaka and Khosrowshahi, 1996). Thus, the need for forecasting the cash out requirement of a project at the right time, in order to determine when and where to borrow or redirect funds cannot be over emphasised.

In an attempt to assist contractors and employers forecast their cash requirements, several researchers have made efforts to develop forecasting models. These attempts became popular over thirty years ago within the construction industry. The approach of early studies may be characterised as nomothetic- the studies attempted to discover general laws and principles across categorised or none categorised groups of construction projects (Kenley, 2003). Some of the techniques used for modelling cash flow forecasts include polynomial regression (Balkau, 1975; Bromilow and Henderson, 1978; Peer, 1982), Weibull-linear model (Tucker, 1986), Logit models (Kenley and Wilson, 1986, 1989), neural network (Boussabaine and Kaka, 1998) and fuzzy logic (Boussabaine and Elhag, 1999; Chen, Dan & Roy, 2013).

The nomothetic approach adopted by early researchers became unpopular because of several shortcomings that resulted in the inability of the models to yield realistic results. These short comings emanated as a result of the uniqueness of construction projects arising from difference in payment conditions (Chen et al., 2005), time lag between billing and actual payment (Park et al., 2005), type of project (Boussabaine and Elhag, 1999), procurement route (Kaka and Price, 1991; Kaka and Khosrowshahi, 1996), type of client and several other factors. This paved way for the introduction of the idiographic approach- the search for specific laws pertaining to individual projects.

Researchers have shown that models developed using the idiographic approach, are more accurate than the nomothetic models (Kenley and Wilson, 1986; Kaka and Price, 1991; Boussabaine and Elhag, 1999). Despite these improvements, forecasts by existing models continue to vary considerably with actual expenditure (Odeyinka, Lowe & Kaka, 2002, 2008: Ross et al., 2013, Zayed and Liu, 2014). According to Ross, Dalton and Sertyesilisik (2013), Odeyinka, Lowe and Kaka (2013), Zayed and Liu (2014), the variation between the forecasts and the actual is as a result of non-consideration of risk factors inherent in construction by the models developed. Hence, more researchers are advocating for understanding and evaluating the impact of risk factors on cash-out forecasts. Zayed and Liu (2014) in a comparative test of risk factors impacting on cash out forecasts in North America and China showed that the risk factors had regional dimensions. Results from Zayed and Liu (2014) showed that extent of impact of the risk factors are regionally endemic owing to geotechnical, cultural, attitudinal and other regional issues.

In Nigeria, authors have linked project abandonment to delays associated with payments (Ogunsemi, 2000; Aibinu and Jagboro, 2002; Ogunsemi and Jagboro, 2006; Olawale and Ming, 2009). These delays, according to the authors, were caused by cash out management problems and other factors like procurement route, availability of credit facilities, interest rates, retention rates, time lags between billing and actual payment, project type, type of client (public or private) etc. The cash flow management issues that have been linked to project abandonment in Nigeria are mostly risk issues impacting on cash out forecasts- interest rates, availability of credit facilities, procurement route, project complexity and the likes. Abdulrazaq, Ibrahim and Ibrahim (2017) found that sixteen (16) risk factors significantly influence cash-out forecasts for projects executed in Nigeria. These include- "charging of 'land dues' by locals (illegally)", and "Variations", "bureaucracy in processing payments (giving bribes to "speed up" payment) among others.

However, risk assessment models that are available in literature did not consider some risk factors like "charging of 'land dues' by locals (illegally)" (Dantata, 2007), "change in government officials" (Dusai, 2011), "bureaucracy in processing payments (giving bribes to "speed up" payment) (Aibinu and Jagboro, 2002; Dantata, 2007; Dusai, 2011), "change in activities' start time" (Ross et al., 2013), "bureaucracy in processing payments (giving bribes to "speed up" payment) (Abdulrazaq, Ibrahim & Ibrahim, 2017), among others. The purpose of this study is to develop models for forecasting cash out that will include these neglected risk factors.

2. Review of Related Literature

Researchers' interest in risks associated with cash flow forecasts was triggered when it became obvious that ignoring the risks associated with forecasting cash flows was a fundamental reason why inaccuracies were continuously obtained from cash flow forecasting models (Odeyinka, 2003). In the last two decades' efforts have been made to investigate and report risk and associated factors that are responsible for variations between forecast and actual cash out forecasts.

Kaka and Price (1991) attempted to develop a model capable of forecasting net cash flows at the tendering stage. They argued that generating cash flow forecasting models based on value curves was not ideal due to different "loadings" and "estimating" approaches. The contractor, they posited, rarely loads the cost of items in a contract with the same rate. The possibility of building an ideal cost curve was examined by building an average curve with data obtained from seventeen project. The average curve obtained was used to forecast net cash flows for five projects. It was discovered that the model performed well on the five projects used for testing its validity. In developing the model, the researchers took into account "all the effective variables". Theses effective variables as pointed out by Kaka and Price (1991) include- front end loading, error in measurement, inflation, retention rate and payment delay by clients, which effectively, can be considered as risk factors affecting cash flow forecasts.

Kaka and Khosrowshahi (1996) studied the effect of different procurement routes on contractor's cash flows. Historical data obtained from 150 construction projects were collected under four criteria - type of project, size of the project, company type and procurement route. The effect of these criteria on the S-curve was then examined. Several tests carried out on the curves generated revealed that different procured projects with different sizes produced different patterns. Company type and type of project did not significantly affect the shape of the S-curve. Results also revealed that, in some cases, the variation in procurement routes had a significant effect on contract cash flows. Three factors were particularly identified as the cause of the variation in cash flows-cash delays, retention condition and the procurement route.

Odeyinka, Lowe and Kaka (2002) argued that the models developed for cash flow forecasting have failed to consider the associated risk factors. Consequently, they identified and assessed the risk factors responsible for variations in construction cash flow profiles. The major risk factors affecting cash flow forecasts were found to be "changes in design or specifications", "contract conditions pertaining to cash flow", "interim valuations" and "certificates and construction programming" issues. However, the study was conducted in the UK where the researchers identified as having "a stable economy".

Odeyinka and Ojo (2007) developed a conceptual framework for assessing risk impacts on clients' cash flow. The framework proposed a step-by-step approach for developing a model to predict clients' risks in relation to cash flow. The framework suggested identifying risk factors affecting cash flow forecasting from existing literature and discussion with construction clients. This will be followed by identification of significant risk factors impacting on clients' cash flow. Cash flow data from various projects will then be obtained and grouped according to type, client, procurement and duration. The significant risk factors will then be used to determine the extent of occurrence of the identified factors in projects. The extent of risk occurrence responsible for variations between actual and forecasted cash flow will then be determined at different completion stages of the projects. The pair of data obtained will then inform the researchers to develop the model for determining impact of risks on client's cash flow. The model development will focus on clients' negative cash flow only as this appears to be the cash position of the client during construction.

Park *et al.* (2005) proposed a model for forecasting cash flow which considered time lag between cost incurred and value earned by the contractor during the construction stage. The model took cognisance of monthly actual costs incurred against planned costs during the construction stage. Moving weights were obtained via a series of ratios comparing cost categories and budgets (initial and final). These moving weights were used to forecast subsequent costs on monthly bases. The model developed was tested against existing fixed weight model (F.W.M). The tests show that Moving weight model (M.W.M) is more accurate than F.W.M. This research restricted itself to activities during construction and did not take into consideration cost activities before and after the construction stage.

Kaka and Khosrowshahi (2008) developed a mathematical based model which sought to address the difficulties encountered by large companies when collecting data for use in computer based models. The research assumed that future works start at the middle of each year and by using a standard value build-up curve, average duration and total value of work needed, models for forecasting turn over and working capital required by Contractors at company level were proposed. The hypothetical models were tested using a previously developed and tested computer based model. However, the research did not capture how on-going works can be incorporated into the model. Neither was it able to address forecasting at individual project level.

Motawa and Kaka (2009) proposed a model that uses a series of integral equations to enhance cash flow through analysing alternative payment mechanisms (e.g. cost reimbursement, lump sum, cost-plus a percentage, target cost etc). The model also incorporates a system for paying off-site materials based on whether off-site materials are not to be considered, to be considered fully before provided on site and before construction starts or to be partially considered before provided on site, then fully considered once construction starts.

Buertey *et al.* (2010) developed a model for predicting construction cash flow in Ghana. Analysis of data gathered through a questionnaire survey of stakeholders showed that 18 factors significantly affected cash flow forecasts for contractors in Ghana. The factors include availability of credit facility, advance payments, period of honouring certificates by client, front/back end loading, etc.

Cui, Hastak and Halpin (2010) developed a model for the system analysis of cash flow management strategies. The strategies studied included front-end loading, back-end loading, overbilling, under billing and trade credits. The study concluded that by using an overbilling and under billing strategy a project management team could reduce project overdraft balance by as much as 11.4%. A properly implemented trade credit strategy would result in another 19% reduction in overdraft going by the developed model. The use of the model was limited by the fact that it can be used only when system parameters for specific projects are customised.

Jiang, Issa and Malek (2011) developed a multi-objective cash flow planning model, known as the Pareto Optimality efficiency network model, which considers typical banking instruments, the constraints of financial market, budget constraints and retention. A good view of cash flow management is provided by the model. However, other factors like client's progress payment, delayed payment and penalties for delays were not captured.

Lucko (2011) used singularity functions to model cash flow profiles. Singularity functions define ranges of behaviour between cut-offs and are yet to flexibly and accurately model profiles. The various payment terms and cash flow profiles of the data collected were modelled using the function. The study introduced new capabilities of singularity functions for financial modelling and optimisation by integrating different cost behaviours and payment terms.

Hoseini, Andalib and Gatmiri (2015) developed a stochastic, simulation-based framework for forecasting construction projects cash flow at the bidding stage, considering the effect of delay in payments. The authors developed the model using a beta-distributed random variable based on expert judgement, by considering the time between carrying out an activity and receiving its corresponding payment. Monte Carlo simulation was then performed to extract the cumulative probability distributions of maximum required finance and financial costs. Application of the model in a real life highway contract proved the its efficacy as there was variation between the model's performance and the contractor's initial forecast.

3. Research Methods

The sixteen significant risk factors identified by Abdulrazaq, Ibrahim and Ibrahim (2017) were adopted for this study. A two-stage field survey was carried out. The first stage consisted of investigating thirty-one risk factors identified from literature in relation to the likelihood of their occurrence and the impact, if they occur. A list of registered contractors was obtained from the government establishment saddled with the responsibility of registering and ensuring continuity of construction and other contractors in Nigeria. The Corporate Affairs Commission (CAC) is the sole organisation responsible for this. A comprehensive list consisting 61,893 construction contractors was obtained. This number represented both extant and extinct contractors as at April 2018. In order to obtain a list of contractors actively involved in the industry, the current list of contractors who had paid all taxes prescribed by the government was obtained from the Federal Inland Revenue (FIRS). This reduced the list of contractors to 10,213. This constituted the target population.

Probability sampling technique was adopted in order to identify the sample size. Cochran's (1977) table for determining minimum returned sample size for a given population size for continuous and categorical data was used for determining the appropriate sample size for this study (margin of error = 0.05, alpha level = 0.5). A total sample size of 370 was identified to be sufficient for the study. Contractors whose annual turnover ranged between "less than ₦100million" (small contractors) to "above ₦500million" (Large contractors) (see table 4.6) were considered.

In the first survey, the questionnaire was divided into two parts (sections A and B). This was done to make the questionnaire easy to understand and very clear to the respondents. Section "A" requested general information from the respondents. These include mainly information about the respondents such as name of organisation, type of projects commonly executed, position of the respondent in the organisation, the average duration of projects executed, average value of project executed, the procurement route commonly adopted in projects executed, the annual turnover of the organisation and the nature of the client served. The provision of the 'other (please specify)' option was included to each category of the questions to reduce rigidity which may artificially constrain the responses (Fellows and Liu, 1997). These pieces of information were to enable the grouping of the responses provided by the respondents.

In section B of the questionnaire, 31 risk factors derived from literature as potentially affecting cash-out flow forecasts were listed. Respondents were then requested to provide opinions regarding the likelihood (i.e. probability) of each factor occurring and the likely impact should the factor occur. Respondents were asked to score their opinion on a 0-5 Likert type scale, zero being included so as to accommodate the instances where the risk factor was not applicable (Holton and Burnett, 1997). The highest likelihood of a risk factor occurring and maximum impact was each assigned a score of 5. A third category was included in table 1 seeking for respondents' opinion of the variation between the forecasts and actual cash-in/cash-out at 30%, 50% and 70% completion of the projects. Respondents were requested to indicate whether the variation between the forecasts and actual were negative or positive.

In the second survey, the questionnaire was also divided into two parts (sections A and B). Section "A" requested general information from the respondents. These include mainly information about the respondents such as name of organisation, type of projects commonly executed, position of the respondent in the organisation, the average duration of projects executed, average value of project executed, the procurement route commonly adopted in projects executed, the annual turnover of the organisation and the nature of the client served. The provision of the 'other (please specify)' option was included to in each category of the questions to reduce rigidity which may artificially constrain the responses (Fellows and Liu, 1997).

In section "B" of the questionnaire for the second survey, two tables were presented. The first table consisted of 16 significant risk factors derived from analysis of the responses from the first survey as potentially affecting cash-out forecasts. Respondents were then requested to provide opinions regarding the likelihood (i.e. probability) of each factor occurring. On the second table, respondents were asked to approximate percentage difference between actual and forecasted expenditure in percentages, at 30%, 50% and 70% completions of executed projects as a result of the risks occurrence.

Sixty-one contractors that were conveniently sampled were asked to rank on a scale of 0 to 5 (Where 0= not applicable, 1= very low, 2= low, 3= medium, 4= high and 5= very high), the likelihood of occurrence of the identified risk factors. A second table requested the contractors to indicate, in their experience, the difference in percentages between actual cash-out and forecasted cash-out (i.e. actual minus forecasted) as a result of the occurrence of the risk factors. The retrieved questionnaires were used to develop the models. The numerical data were compiled and entered into the Statistical Package for Socials (IBMSPSS version 21) software. The scores for the sixteen significant factors obtained from 50 respondents were entered as independent variables (or "predictors") while the percentage variations between actual and forecasted "cash-out" at 30%, 50% and 70% completion stages were entered as dependent variables in the "neural network" section of the software. Seventy-nine percent of the questionnaires (38 number) were used for training the model, twenty percent (i.e. 10 number) for testing and the remaining one percent were excluded for having outlier inputs. The IBM SPSS neural network software did the training and testing automatically.

4. RESULTS AND DISCUSSION OF FINDINGS

4.1. Model architecture and models

Figure 1 depicts the Architecture for the Artificial Neural Network model. The figure is termed "feedforward" architecture because the connections in the network flow forward from the input layer to the output layer without any feedback loops. In this figure:

i. The input layer contains the sixteen significant factors, which are recognised by the neural network as the "predictors". Each predictor is represented by a different colour and the scores entered by the respondents are indicated in boxes. For example, the scores entered for risk factor number 1 (i.e. "change in currency exchange rates") range from 4 to 5 only. This means that the respondents scored the factor "high" or "very high" for the chances of it occurring in projects. While serial number 2 (i.e. "changes to initial design") had scores ranging from 3 to 5.

ii. The hidden layer contains 10 unobservable nodes. The value of each hidden unit is some function of the predictors generated by the network. The hidden nodes determine the relationship between the inputs and the outputs in what is termed a "black box" manner. This means that Apart from defining the general architecture of a network and perhaps initially seeding it with random numbers, the user has no other role than to feed it input and watch it train and await the output. The learning itself progresses on its own. The final product of this activity is a trained network that provides no equations or coefficients defining a relationship (as in regression) beyond its own internal mathematics. The network 'is' the final equation of the relationship.

iii. The output layer contains the 3 responses on the differences between the actual and predicted forecasts as depicted by the respondents, in percentages. Each output unit is some function of the hidden units. In this case, three output units are depicted. The network uses 70% of the data for training and 30% for testing, as shown on table 2. Table 2 shows the practical results of using the network. For each sample, Cells on the diagonal of the cross-classification of cases are correct predictions while cells off the diagonal of the cross-classification of cases are incorrect predictions. Thus, of the 34 cases held for training the network, 15 out of 17 cases for 20% were correctly classified, 7 out of the 9 cases for 25% were correctly classified and all the eight cases for 30% were correctly classified. Overall, 88.2% of the cases are trained correctly.

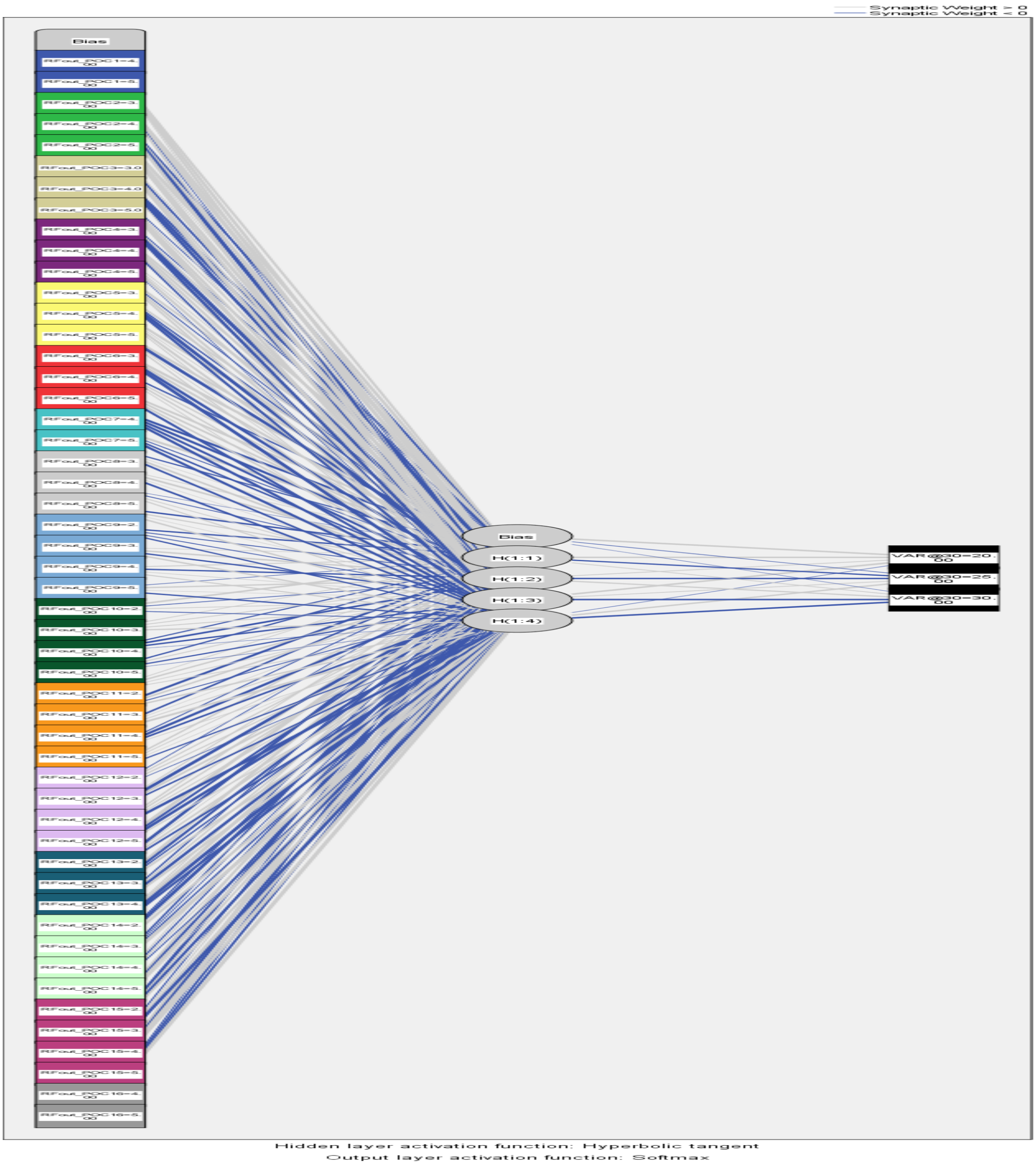

Figure 1: Artificial neural network model architecture and weight matrix from questionnaire survey

The testing sample shows an overall 52.9% correct classification of the cases. This implies that for five out of ten times the variation to the contractor's forecasts will be 20% (20% being the best forecast). Tables 2 provides the network's model for predicting the impact of the sixteen significant risk factors.

The testing sample shows an overall 69.2% (Table 3) correct classification of the cases at 50% completion of works. This implies that for seven out of ten times the variation to the contractor's forecasts will be 25%. The testing sample shows an overall 91.7% (Table 4) correct classification of the cases at 70% completion of works. This implies that for nine out of ten times the variation to the contractor's forecasts will be 25%.

Table 2: Model for predicting Impact of Risk Factor on cash out (at 30% completion)

Sample		Predicted 20.00	25.00	30.00	Percent Correct
Training	20.00	15	1	1	88.2%
	25.00	1	7	1	77.8%
	30.00	0	0	8	100.0%
	Overall Percent	**46.9%**	**53.1%**	**0%**	**88.2%**
Testing	20.00	3	2	0	60.0%
	25.00	0	7	0	100.0%
	30.00	2	0	0	0.0%
	Overall Percent	**64.7%**	**35.3%**	**0.0%**	**52.9%**

Table 3: Model for predicting Impact of Risk Factor on cash out (at 50% completion)

Sample		Predicted 10.00	25.00	30.00	40.00	Percent Correct
Training	10.00	1	2	0	0	33.3%
	25.00	0	13	1	0	92.9%
	30.00	1	8	2	0	18.2%
	40.00	0	5	2	0	0.0%
	Overall Percent	**5.7%**	**80.0%**	**14.3%**	**0.0%**	**45.7%**
Testing	10.00	0	1	0	0	0.0%
	25.00	0	8	0	0	100.0%
	30.00	0	1	1	0	50.0%
	40.00	0	2	0	0	0.0%
	Overall Percent	**0.0%**	**92.3%**	**7.7%**	**0.0%**	**69.2%**

Table 4: Model for predicting Impact of Risk Factor on cash out (at 70% completion)

Sample		Predicted 15.00	25.00	30.00	Percent Correct
Training	15.00	4	0	0	100.0%
	25.00	0	24	0	100.0%
	30.00	0	0	9	100.0%
	Overall Percent	**10.8%**	**64.9%**	**24.3%**	**100.0%**
Testing	15.00	1	0	0	100.0%
	25.00	0	9	1	90.0%
	30.00	0	0	1	100.0%
	Overall Percent	**8.3%**	**75.0%**	**16.7%**	**91.7%**

4.2. Validation of models

The remaining 11 data set were used to test the predicting ability of the models. A comparison between the predicted and the actual variation was made).

Table 5: Performance of Neural Network Models (at 30%, 50%, and 70% completion stages)

	at 30% completion			**at 50% completion**			**at 70% completion**		
Data set No.	Actual variation	Predicted variation	Relative absolute Percentage deviation	Actual variation	Predicted variation	Relative absolute Percentage deviation	Actual variation	Predicted variation	Relative absolute Percentage deviation
1	30.00	25.00	17%	35.00	25.00	29%	35.00	25.00	29%
2	30.00	25.00	17%	35.00	25.00	29%	35.00	25.00	29%
3	30.00	20.00	33%	15.00	25.00	67%	35.00	25.00	29%
4	35.00	20.00	43%	35.00	25.00	29%	40.00	25.00	38%
5	30.00	20.00	33%	35.00	25.00	29%	35.00	25.00	29%
6	30.00	25.00	17%	40.00	25.00	38%	45.00	25.00	44%
7	25.00	25.00	0%	30.00	25.00	17%	40.00	25.00	38%
8	25.00	20.00	20%	35.00	25.00	29%	45.00	25.00	44%
9	30.00	20.00	33%	35.00	25.00	29%	35.00	25.00	29%
10	35.00	20.00	43%	35.00	25.00	29%	35.00	25.00	29%
11	25.00	25.00	0%	20.00	25.00	25%	20.00	25.00	25%
	Mean Percentage Error=		**23%**		**Mean Percentage Error=**	**31%**		**Mean Percentage Error=**	**33%**
	Mean Percentage Accuracy		**77%**		**Mean Percentage Accuracy**	**69%**		**Mean Percentage Accuracy**	**67%**

From Table 5 it can be deduced that the highest accuracy level is achieved at the 30% completion stage (77% accuracy). The finding disagrees with Odeyinka *et al.* (2013) model, which was found to be more accurate at the 50% completion.

4.3. Discussion of results

The results obtained have variations with those obtained from previous studies. In a study of risk factors affecting construction cash flow forecasting in the UK, Odeyinka et al. (2013) identified “changes to initial design”, “inclement weather”, “variation to works”, “labour shortage” and “production time slippage” as the 5 top-most risk factors occurring. The same factors ranked 17th, 19th, 12th, 39th and 16th in the present study. Incidentally, “Client’s insolvency”, “Labour Strikes”, and “Civil Disturbance” ranked very low in both studies. This implies that the civil unrests and labour strikes rarely impacts on the cash-out forecasts by contractors in both the UK and Nigeria. Most significant factors impacting on the forecasts in Nigeria are either rating low or totally absent in the UK construction industry (e.g. “increase in duration of the project”, “change in currency exchange rates”, “shortage of key plant items” etc). This may have stemmed from the fact that the two economies differ considerably. A similar survey carried out by Shehu et al. (2014) revealed that in Malaysia “late payment from contractor to subcontractors and suppliers”, “dispute between contractor and subcontractor’, “late payment from client to contractor” and “bureaucracy in government agencies” are crucial factors affecting contractor’s forecasts. The present study has some similarities with that carried out in Malaysia. “Delay in payment from client" and "increase in the duration of the project" also ranked very high as in the study in Malaysia.

None of the factors highlighted by Zayed and Liu (2014) was found to be significant in the present study. Zayed and Liu (2014) emphasised on the impact of location on factors affecting cash flow forecasts. Data for the study was collected from North America and China. Result from the survey showed a significant difference in the impact of the following risk factors in the two locations- "contractor's personal relation with the consultant team", "contractor's personal relation with the owner", "lack of skilled labour", "change of progress payment duration", "change of labour and staff wages", "delay of making payments to suppliers", and "number of claims".

The findings from the research imply that several risk factors have different degree of occurrence on cash-out forecasts in, and different degree of impacts on cash-out forecasts in the Nigerian construction industry. Construction contractors practicing in the Nigerian construction industry should expect and be prepared for positive variations to their "cash-out" forecasts during the execution of projects.

5. CONCLUSION AND RECOMMENDATIONS

This paper set out to offer two contributions in the domain of "cash-out" forecasts in the construction industry. This was achieved by developing a predictive model based on sixteen significant risk factors found to impact on cash out forecasts by contractors. An attempt was made to show the variation between the actual and predicted cash-out at significant milestones of a project.

It can be concluded that sixteen risk factors significantly impact cash-out forecasts for contractors in the Nigerian construction industry. These factors include "increased Duration of the Project", and "charging of land dues by locals (illegally)", among others. A close look at the significant risk factors can be classified thus: client-related, Environment–related, market-related and contractor-related.

The second conclusion is based on the the predictive neural network models developed. It can be concluded that there are positive variations (between actual and forecatsed "cash-out") of 20%, 25% and 25% at 30% completion, 50% completion and 70% completion stages of projects, respectively.

The following recommendations were made:

i. Construction contractors practicing in the Nigerian construction industry should plan against positive variations to their "cash-out" forecasts during the execution of projects.
ii. Construction contractors in Nigeria should carefully consider the sixteen (16) significant risk factors affecting cash-out before embarking on any construction project.
iii. This study did not consider the risk factors along procurement routes and project types. It is therefore suggested that future research should be carried out to model the risk impacts along these divides.

REFERENCES

Abdulrazaq, M., Ibrahim, Y. M. and Ibrahim, A. D. (2017). Prioritisation of Risk Factors Impacting on Construction Contractors Cash Out Forecasts in Nigeria. Nigerian Journal of Technological Research (NJTR). 12 (2), 73 -79.

Aibinu, A.A., and Jagboro, G.O. (2002). The Effects of Construction Delays on Project Delivery in Nigerian Construction, International Journal of Project Management, 20, 593-599.

Balkau, B.J. (1975). A financial model for public works programmes. Paper to *National ASOR Conference,* Sydney, August 25-27.

Boussabaine, A. H., and Kaka, A. P. (1998). A neural networks approach for cost-flow forecasting. Construction Management and Economics, 16 (4), 471–479.

Boussabaine, A.H. and Elhag, T. (1999). Applying fuzzy techniques to cash flow analysis. Construction Management and Economics, 17 (7), 745–55.

Bromilow, F.J. & Henderson, J.A. (1978). Procedures for Reckoning the Performance of Building Contracts, 2nd ed. Commonwealth Scientific and Industrial Research Organisation, Division of Building Research, Highett, Australia.

Buertey, J. T. I., Adjei-Kumi, T. and Amoah, P. (2010). Construction cash Flow Prediction Model in Ghana: A Case Study of the District Assembly Common Funded Project. In: Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 27-28 July 2010, Accra, Ghana, 235-245.

Chaharsooghi, S. K., Sariqayab, M. S. and Rahimnezhad, F. (2019). Optimisation of Project Cash Flow under Uncertainty by Genetic Algorithm, International Journal of Industrial Engineering & Management Science, 6 (1), 24-37

Chen, M., WU, Y., Dan, L. T. and Roy, A. F. V (2013). Enhanced Time-Dependent Evolutionary Fuzzy Support Vector Machines Inference Model For Cash Flow Prediction And Estimate At Completion, *International Journal of Information Technology and Decision Making, 12 (169)*.

Cui, Q., Hastak, M. and Halpin, D. (2010). System Analysis of Project Cash Flow Management Strategies, *Construction Management and Economics, 28*, 361-376.

Dantata, S. (2007). *General Overview of the Nigerian Construction Industry*, M.Eng Thesis, Department of Civil and Environmental Engineering, B.S., Massachusetts Institute of Technology.

Dusai A. K. (2011). *An Appraisal of the Causes of delayed Payments in Public Construction Projects in Nigeria*, BSc Project, Department of Quantity Surveying, Ahmadu Bello University, Zaria-Nigeria.

Hoseini, A., Andalib, R., and Behrouz, G. (2015) stochastic Framework for Cash flow Forecasting Considering Owner's Delay in Payment by Use of Monte Carlo simulation. In: 51st ASC Annual International Conference Proceedings, 22-25 April, 2015, Texas A&M University, College Station, Texas. Association of Researchers in Construction Management.

Jiang, A., Issa, R. R. A and Malek, M. (2011). Construction Project Cash Flow Planning Using the Pareto Optimality Efficiency Network Model, *Journal of Civil Engineering and Management*, *17 (4)*, 510-519.

Kaka, A.P and Khosrowshahi F. (1996). Effect of Different Procurement Routes Contractors' Cash Flows. *Engineering, Construction and Architectural Management, 3(1, 2)*, 133 145.

Kaka, A. and Khosrowshahi, F. (2008). A Mathematical-Based model for Company-Level Budgeting Incorporating Future Unknown Contracts Construction Management and Economics, 16 (1), 48–60.

Kaka, A. and Price, A.D. (1991). Net cash flow models: are they reliable? Construction Management and Economics, 9 (3), 291–308.

Kenley, R. (2003). Financing Construction- cash flows and cash farming, Spon Press, New York.

Kenley, R. and Wilson, O.D. (1986). A construction project cash flow model—an idiographic approach. Construction Management and Economics, 4(3), 213–232.

Kenley, R. and Wilson, O.D. (1989). A construction project net cash flow model, Construction Management and Economics, 7, 3-18.

Motawa, I. and Kaka, A. P. (2009). Modelling Payment Mechanisms for Supply Chain in Construction. Engineering, Construction and Architectural Management, 16 (4), 325 336.

Odeyinka, H. A. (2003). The Development and Validation of Models for Assessing Risk Impacts on Construction Cash Flow Forecasts. Unpublished PhD Thesis, Glasgow Caledonian University, Glasgow.

Odeyinka, H. A, Lowe, J. G. and Kaka, A. (2002). A construction Cash Flow Risk Assessment Model. In: Greenwood, D (Ed)., 18th Annual ARCOM Conference, 2-4 September, 2002, University of Northumbria. Association of Researchers in Construction Management, 1, 3-12.

Odeyinka, H. A, Lowe, J. G. and Kaka, A. (2008). An Evaluation of Risk Factors Impacting Construction Cash Flow Forecasts. Journal of Financial Management of Property and Construction, 13(1), 5-17.

Odeyinka, H. A, Lowe, J. and Kaka, A. (2013). Artificial Neural Network Cost Flow Risk Assessment Model, Construction Management and Economics, 31 (5), 423-439.

Odeyinka, H. A, and Ojo, G. K. (2007). A Conceptual Framework for Assessing Risk Impacts on Clients' Cash Flow. In: The 3rd conference for Postgraduate Research of the Built and Natural Environment (PRoBE), Glasgow Caledonian University, Glasgow, UK… 10pp (Conference Contribution).

Ogunsemi, D. R. (2000). Cost Implications of Risk Factors on Construction Projects in Nigeria. Journal of Applied Sciences, 13 (2), 917-923.

Ogunsemi, D. R. and Jagboro, G.O (2006). Time-Cost Model for Construction Projects in Nigeria. Construction Management and Economics, 24 (3), 253-258.

Olawale, Y, and Ming, S. M. (2009). A Survey of Construction Project Cost and Time Control Practices in the UK. In: Dainty, A. (Ed) Procs 25th Annual ARCOM Conference, 7-9 September, 2009, Nottingham, UK, Association of Researchers in Construction Management, 877-86.

Park, H.K., Han, S. H. and Russell, J. S. (2005). Cash Flow Forecasting Model for General Contractors Using Moving Weights of Cost Categories, Journal of Management in Engineering, 2 (4), 164-172

Peer, S. (1982). Application of cost-flow forecasting models. ASCE Journal of Construction Division, 108(2), 226–32.

Ross, A., Dalton, K. and Sertyesilisik, B. (2013). An Investigation on the Improvement of Construction Expenditure Forecasting, Journal of Civil Engineering and, 19 (5), 759 - 771

Shehu, Z., Endut, I. R. and Akintoye, A. (2014). Factors Contributing to Project cost Overrun in the Malaysian Construction Industry, *Journal of Financial Management of Property and construction, 19 (1)*, 55-75.

Tucker, S.N. (1986). Formulating construction cash flow curves using a reliability theoryanalogy. Construction Management and Economics, 4 (3), 179–88.

Zayed, T., Liu, Y. (2014). Cash Flow Modelling for Construction Projects, *Engineering, Construction and* Architectural Management, 21 (2), 170-189.