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UNDERSTANDING AND IMPROVING CHANGE MANAGEMENT CAPABILITY: ASSESSMENT MODEL FOR CONTRACTORS IN BUILDING PROJECTS.

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Abstract. In construction projects, change is considered to be one of the major risk factors and its consequences include, time and cost overruns disputes, safety issues, and quality defects. However, previous researchers have probe into identification of causes, effects, and management systems of change and their findings have helped to mitigate the occurrence of the effects of changes. Contractor's high change management capability maturity level is an indication of contractor's proper understanding of the change problems and how to manage them. This paper seeks to develop a change management capability assessment model for building contractors in Nigeria. The research used five attributes of; leadership, application, competencies, standardisation and socialisation to test the different aspects of contractor's change management capability. A questionnaire survey was conducted with relevant contractors in the south-western part of Nigeria using fuzzy synthetic evaluation method for analysis. The empirical survey findings reveal that the overall change management capability maturity of building contractors can be considered to be "Moderate" at 3.29. Moreover, the building contractor's present change management capability in leadership is more matured than other capabilities. Consequently, contractor's capability in socialization is relatively less matured than other capabilities. Therefore, the assessment of the current change management capability of building contractor can be adopted for identifying building contractor's strength and weakness areas which improvements are to be prioritized.

Keywords Change management, capability, maturity, Fuzzy, contractors

1.0 INTRODUCTION

Assumptions based on personal experience and incomplete information usually forms the bases of decision making every day in construction processes [4]. However, project changes are common phenomena and inevitable at all stages of a project life-cycle. The occurrence of project change comes from different sources and is caused by various drivers at any stage of a project. Its occurrence do have great negative consequences on such items like cost, schedule time, re-estimation of work, additional equipment, materials, overtime demand from workers and contract disputes [9].Many project failures are attributable to the occurrence of this risk factor which demands for effective management by contractors. Research on project management reveals that the need for process improvement in the software industry has through the process improvement methodologies brought about the development of capability maturity models (CMM). Capability maturity model is a well-known comprehensive software Engineering improvement model [15]. However, the central idea about CMM is that it represents a generic framework for continuous process improvement in the engineering sector. Based on the concept of process improvement, a number of generic project management capability models were developed with the primary intention of establishing and improving the project management quality standard of construction organizations.

A review of literature indicates that over the years, many sophisticated change management tools, generic frameworks/models and IT support systems have been developed. Moreover, many of these tools and frameworks have provided process support for the management of project change in construction, nevertheless they are not capable of providing a systematic way of assessing and improving the change management capability maturity and hence they cannot be seen as gradual process improvement tools. Therefore, this study seeks to provide an assessment and improvement tool tagged; change management capability maturity model that can be employed by building contractors for assessing and improving their change management capability maturity level.

Change management capability maturity is a direct reflection of an organization's understanding of the change management portfolio and how to

manage them coupled with the internal business continuity system required to cope with and recovered from their eventuality. It is however, necessary for an organization to have a clear view of their current management process capability in order to define goals and manage progress in increasing their change management capabilities. The need for effective implementation of change management in construction organizations cannot be over emphasized. Currently change management practices in organizations and projects are not common; hence establishing change management capability maturity in an organization should be a starting point when embarking on a review of change management practices or systems. This is highly needed in construction organization because of the risk which project changes can impose on their business.

2.0 CMM DEVELOPMENT PRINCIPLES

According to Paulk et al (1991),the concept of capability maturity model (CMM) was first proposed by the software Engineering Institute at Carnegie Mellow University as a means of improvement suggested for software organizations that which to improve their software process capability. Other frameworks/models were developed by researchers to assess the quality of organization's software process development. However, it should be noted that all these frameworks/models seeks to improve organizational performance in terms of cost, time and quality [13].

Against this background, a number of research has been conducted with respect to change management capability maturity by organizations and researchers such as change management maturity audit [13], change management maturity model (CM3) by Sun et al [16]. Others process improvement models developed for the construction industry includes; programme management maturity model (PMMM, 2001), Organizational project management maturity (OPM3, 2002), Project management process maturity model (PM2, 2002), Standardized process improvement for construction enterprises (SPICE, 2005. Moreover, the development of these models originated from the capability maturity model (CMM) general principles. Therefore the change management capability maturity model proposed in this paper was derived from several literature, existing models highlighted above and careful analysis of quantitative data collected.

After thorough and careful studying of the characteristics and functions of the existing models, the suitable attributes and maturity levels was chosen as elicited in table 1 and 2 below. The proposed model is characterized to have five attributes and five maturity levels.

Table 2.1: Attributes of change management capability maturity

ATTRIBUTES	SUB-ATTRIBUTES
Leadership:	This capability area focuses on the leadership commitment, activities and messages around the importance and value of change management, including the effort to build organizational capabilities and competencies.
Application	This entails the extent of use of change management and tools on projects, percentage of projects on which it has been applied and resource availability for applying it on projects and initiatives.
Competencies	This capability looks at the training, development and demonstrated competencies as leading change by the key group of employees, supervisors, managers, leaders, project team and practitioners that must apply change management tools and principles.
Standardization	This capability area looks at the mechanisms and systems that can be used to institutionalize change management e.g integration with project management.
Socialization	This capability too focuses on building commitment and buy-in for change management throughout the organization.

Adapted from Prosci (2007) change management maturity model Audit

Table 2.1: Interpretation of Maturity levels

Level 5	Organisational competency.	Change management competency is clearly shown at all levels of the organisation. It forms part of the organisation's intellectual property and competitive edge.	Continuous process improvement in place.	Highest profitability, responsiveness and project success rate is at the optimum.
Level 4	Organisational standard.	Organisational-wide standard and methods are largely deployed for managing and leading change.	Selection of common approach	
Level 3	Multiple projects	Comprehensive approach for managing change is being applied on multiple projects within the organisation.	Examples of best practices evident	
Level 2	Isolated projects	In isolated projects some element of change management are being applied.	Inconsistent use of many different tactics	
Level 1	Absent or Adhoc.	Little or no change management applied	No formal plans or practices	Highest rate of project failure, and productivity loss.

Adapted from Prosci (2007) change management maturity model Audit

3.0 FUZZY SYNTHETIC EVALUATION

In this research fuzzy synthetic evaluation was applied to determine the synthetic evaluation of an object relative to an objective in a fuzzy decision environment using a number of factors [5]. According to Xu et al (2010) a fuzzy synthetic evaluation model needed three basic elements thus [17, 18]:

i. A set of basic factors/criteria f = $\{f_1, f_2 \dots\dots\dots\dots, f_z\}$, f_1 = what is the level of support from your leaders towards establishing change management across your organisation, f_2 = Are your leaders showing any sense of belonging to spread change management in your organisation……f_z = Rate the degree of importance attached to value of managing change effectively by your organisation.

ii. A set of grade alternatives; E = $\{e_1, e_2 \dots\dots\dots\dots e_n\}$, e.g e_1, = very low, e_2 = low e_3 = moderate, e_4 = high, e_5 = very high.

iii. For every object $u \notin U$ (This shows that the fuzzy subset u doesn't belong to the fuzzy set), we have an evaluation matrix R = (r_{ij})m x n. In fuzzy environment, r_{ij} shows the degree to which alternative e_j satisfies the criterion f_j. This is presented by the fuzzy membership function of grade alternative e_j with respect to the criterion f_j.

With the preceding three elements, for a given $u \notin U$, the result of its evaluation can be derived.

The adopted fuzzy synthetic evaluation was used to compute the overall CMCML of contractors in Nigeria. The assessment involves multi-attributes and dimensions. However, the evaluation process involved the attributes and dimensions to be properly scrutinised, hence it will be highly desirable if the synthetic evaluation method used in this study can solve the problems with multi-attributes and multi-levels. Fuzzy synthetic as an application of fuzzy set theory has been applied in many fields. Mu et al (2013) adopted fuzzy synthetic in assessing risk management capability of contractors in subway projects in mainland, China. In addition Fukami et al (2011) gave an assessment of eye opening and closure base on time variation using fuzzy synthetic evaluation method. Based on the foregoing, it can be seen that fuzzy synthetic evaluation can effectively solve complicated evaluation concerning multi-attributes and multi-

levels. Hence, it is considered as the most appropriate tool for developing a fuzzy assessment model for contractors in this study [3, 10].

4.0 RESEARCH METHODOLOGY

The methodology adopted in this study involved comprehensive literature review with questionnaire survey for collecting data, mean scoring combine with normalization, and fuzzy synthetic evaluation as quantitative techniques for analyzing the data [18]. The population for the study comprises of the contractors and the construction projects. However, the defined sample for the study is the contractors pre-qualified and directly appointed to execute the building projects in the study area. Moreover, the study area comprises of the federal Tertiary Institutions in each state of Oyo, Ogun, Ondo, Osun, Ekiti, and Lagos of Nigeria. A total of 14 Federal tertiary institutions and 55 building projects were discovered for the study.

To complement the efforts of survey questionnaire developed for this study a literature review was carried out and the developed questionnaire was piloted with couple of project managers, and contract managers using the initial draft of the questionnaire to ensure the correctness of the questionnaire that it is going to measure and establish the most productive form of data analysis. The questionnaire was eventually refined based on the input and the results generated from the pilot survey. Cronbach's alpha test was performed on the research instrument to test the internal consistency of the instrument and the alpha value was found to be 0.973 indicating that the instruments adopted for the study was reliable for the analysis to proceed [11].

The questionnaire consists of two major sections A and B. Section A includes those questions meant specifically to profile the respondents and their organizations. In section B, respondents were asked to rate the states of change management capability (CMCML) maturity level of their own organisations based on the 32 change management capability indices using a five-point Likert type ordinal scale with 1 = Very Low, 2 = Low, 3 = Moderate, 4 = High, 5 = Very High, Long et al (2008). A total of 80 survey questionnaires were hand distributed to Project Managers, Contract Managers and Project Quantity Surveyors in each contractor's organisations in the study area. However, a total of 55 valid and duly

completed questionnaires out of 80 were returned, representing a response rate of 68.75% which was above the norm of 20 – 30% with most questionnaire surveys [1].

5.0 RESEARCH FINDINGS AND DISCUSSION

5.1 Respondents' profile

According to table.5.1, 12.73% of the respondents were directors of organisations while 32.73% were contract managers, and 45.45% were project managers. 9.09% were project quantity surveyors. However, based on table 3, all the respondents had significant years of experience in construction industry. However, 83.64% of the respondents have more than 15years of experience, which ensures that responses gathered from them, were accurate and can be relied upon for data analysis.

Table 5.1: Demographic characteristics of respondents

Classification	**Frequency**	**Percentage**	**Classification**	**Frequency**	**Percentage**
Academic qualification			Respondents designation		
Classification	**Frequency**	**Percentage**	**Classification**	**Frequency**	**Percentage**
			Directors	7	12.73
	5	9.09	Contract manager	18	32.73
HND	20	36.36	Project manager	25	45.45
BSc	30	54.55	Project quantity surveyor	5	9.09
MSc					
Professional qualification			Working experience (in years)		
Classification	**Frequency**	**Percentage**	**Classification**	**Frequency**	**Percentage**
MNIQS	15	27.27	1 – 5 years	2	3.64
FNIQS	5	9.09	6 – 10 years	7	12.73
MNISE	25	45.45	11 – 15 years	6	10.91
FNSE	10	18.18	16 – 20 years	15	27.27
			Above 20 years	25	45.45

However, it is generally acknowledged that importance index is calculated by multiplying frequency index with severity index [7]. This approach was used to calculate the importance indices of the 32 sub-attributes identified on the survey form. In addition, only those sub-attributes whose normalized values were equal to or greater than 0.5 were considered as important for the analysis. Table 4, shows that 15 sub-attributes emerged to be very important and were selected and used for this study.

Table 5.2: The mean ratings and weightings of CMC attributes for contractor's organizations

S/N	Attributes and sub-attributes of contractor's organization change management capability	Mean scores	Total mean	Weightings	Total weighting in Group
CMC 1	**LEADERSHIP**		**32.78**		**0.61**
QI.1.1	What is the level of support from your leaders towards establishing change management across your organization?	3.50		0.11	
QI.1.2	Do the leaders of your organization use to discuss freely and directly with the employees at all levels?	3.75		0.12	
QI.1.3	How loyal to the course of establishing change management in your organization by the key leaders?	3.50		0.11	
QI.1.4	Are your leaders showing any sense of belonging to spreading change management application in your organization?	4.00		0.12	
QI.1.5	Does change management application has a great deal of meaning to the leaders of your organization?	3.55		0.11	
QI.1.9	How often the funding for other resources (materials, equipment etc.) is made available for change management capability?	3.75		0.12	
QI.1.10	Can the leaders of your organization be freely reached and discussed with?	3.75		0.12	
QI.1.11	Do leaders involve other staff in decision making?	3.43		0.11	
QI.1.12	Do your leaders usually work with the project team working to establish change management in your organization?	3.55		0.11	
CMC 2	**APPLICATION**		**4.00**		**0.07**
QI.2.4	Assess the extent of availability of tools for managing the people side of change in your organization?	4.00		1.00	
CMC 3	**COMPETENCIES**		**3.75**		**0.07**
QI.3.11	Please rank the level of effectiveness of training programs adopted for change management?	3.75		1.00	
CMC 4	**STANDARDIZATION**		**3.33**		**0.06**
QI.4.10	How effective is the change management built into project delivery process?	3.33		1.00	
CMC 5	**SOCIALIZATION**		**9.74**		**0.18**
QI.5.2	What is the degree of understanding of the value of change management within your organization?	3.28		0.33	
QI.5.5	Does your organization usually inform employees about change management developments?	3.23		0.33	
QI.5.8	Rate the degree of importance attached to value of managing change effectively by your organization?	3.23		0.33	

Based on the results of the normalization, a taxonomy was developed for the sub-attributes which thus classified them under the five principal attributes of leadership, application, competencies, standardization and socialization. The five groups of attribute derived are most important attributes for assessing the change management capability of contractors in building projects in Nigeria.

5.2 Developing appropriate weightings for the principal attributes and sub-attributes

In order to develop the fuzzy assessment model for the change management capability of contractors, appropriate weightings for each principal attribute groups and sub-attributes are determined by adopting the equation below. The results in table 5 above shows the principal attributes and the sub-attributes

together with their corresponding weightings for assessing contractor's CMC in building projects.

$$W_j = \frac{M_j}{\sum_{j=1}^{m} M_j}$$

Where;

W_j represents the weightings of a particular sub-attributes or principal groups of attribute. M_j represents the mean rating of a particular sub-attributes or principal groups of attribute. $\sum M_j$ represents the summation of mean ratings of all the sub-attributes or principal groups of attribute.

5.3 Determination of membership functions for each of the CMC principal groups of attribute and sub-attributes.

As stated earlier, a total of 15 sub-attributes were identified for measuring the overall change management capability level of contractor's organisations. Therefore, consider that the set of basic criteria adopted in fuzzy change management capability assessment model to be f = $(f_1, f_2, \ldots\ldots\ldots\ldots f_{32})$, and the grade for selection for the CMC level are defined as E = {1, 2, 3, 4, 5} where 1 = very low, 2 = low, 3 = moderate, 4 = high, and 5 = very high. However, for each sub-attribute, the membership function can be formed using the result of the questionnaire survey. For instance the results of survey on "Do leaders involve other staff in decision making" shows that 5% of the respondents opined the maturity of this capability to be very low, 32.5% as low, 25% as moderate, 32.5% as high and 5% as very high. Therefore, the membership function of this capability maturity level is set by equation below.

$$D1 = \frac{0.05}{very\ low} \quad \frac{0.33}{low} \quad \frac{0.25}{moderate} \quad \frac{0.33}{high} \quad \frac{0.05}{very\ high}$$

$$= \frac{0.05}{1} \quad \frac{0.33}{2} \quad \frac{0.25}{3} \quad \frac{0.33}{4} \quad \frac{0.05}{5}$$

This can as well be written as (0.05, 0.33, 0.25, 0.33, 0.05). Following the same procedure, the membership functions of all the sub-attributes and the five principal groups of attribute are computed as shown in Table 5.

Table 5.3: The Membership function of all the CMC attributes

S/N	Attributes and indicators	Weighting	Membership function of level 3	Membership function of level 2
CMC 1	LEADERSHIP			
QI.1.1		0.11	(0.10,0.13,0.23,0.35,0.20)	(0.10,0.19,0.27,0.310.20)
QI.1.2		0.12	(0.10,0.18,0.20,0.38,0.15)	
QI.1.3		0.11	(0.15,0.28,0.43,0.10,0.05)	
QI.1.4		0.12	(0.05,0.28,0.38,0.13,0.18)	
QI.1.5		0.11	(0.10,0.10,0.23,0.35,0.23)	
QI.1.9		0.12	(0.20,0.23,0.20,0.33,0.05)	
QI.1.10		0.12	(0.05,0.10,0.15,0.45,0.25)	
QI.1.11		0.11	(0.03,0.35,0.23,0.23,0.18)	
QI.1.12		0.11	(0.08,0.10,0.20,0.30,0.33)	
CMC 2	APPLICATION			
QI.2.4		1.00	(0.05,0.43,0.03,0.38,0.13)	(0.05,0.43,0.03,0.38,0.13)
CMC 3	COMPETENCIES			
QI.3.11		1.00	(0.05,0.13,0.35,0.35,0.13)	(0.05,0.13,0.35,0.35,0.13)
CMC 4	STANDARDIZATION			
QI.4.10		1.00	(0.03,0.15,0.38,0.25,0.20)	(0.03,0.15,0.38,0.25,0.20)
CMC 5	SOCIALIZATION			
QI.5.2		0.33	(0.03,0.38,0.10,0.38,0.03)	(0.09,0.30,0.22,0.24,0.10)
QI.5.5		0.33	(0.00,0.15,0.33,0.20,0.23)	
QI.5.8		0.33	(0.23,0.33,0.20,0.13,0.03)	

5.4 Development of a fuzzy synthetic evaluation of a CMC assessment model

After establishing appropriate weightings for the 15 sub-attributes and five principal attribute groups including fuzzy membership functions for each sub-attribute, 4 models were previewed to assess the outcomes of the evaluation, Lo (1999) cited in Chan et al (2011). The models can be viewed thus:

Model 1 : M $(\wedge, \vee)$, $aj = V_{i=1}^{m}(X_i \Lambda \text{rij}) \quad \forall \text{bj} \in B$

Model 2 : M $(\bullet, \vee)$, $aj = V_{i=1}^{m}(X_i \Lambda \text{rij}) \quad \forall \text{bj} \in B$

Model 4 : M $(\wedge, +)$, $aj = \sum_{i=1}^{m}(X_i \Lambda \text{rij}) \quad \forall a_j \in B$

Models 1, 2, 4 have their shortcomings. For instance 1 and 2 is appropriate for use with single item problems simply because it considered only the major attributes, hence other minor attributes are left out unconsidered. Model 4 has the disadvantage of missing some information in respect of smaller weightings. Model 3 is considered suitable when it involves many criteria and the differences between the weightings of each attribute are not great (not significant). Therefore, since the computation of the overall change management capability maturity

involves multi-criteria then it means all the sub-attributes needs to exercise their influence on the overall CMCML. This implies that Models 1-4 cannot be considered for this study and model 3 below is found to be more appropriate for use in the study [17, 18].

Model 3: M (•, $\oplus$), $a_j = \min\left(\sum_{i=1}^{m} X_i * r_{ij}\right) \quad \forall\, a_j \in A$

Where;

X_i indicates the weighting of a particular CMC attribute;

r_{ij} indicates the membership function of a particular CMC attribute.

Moreover, the addition of the product of weighting and membership function is represented by this symbol $\oplus$. However; there are three levels of membership functions in fuzzy synthetic evaluation model. Level 3 refers to each of the 15 sub-attributes. Level 2 shows each of the five principal attribute groups (PAGs) and Level 1 refers to the overall change management capability (OCMC). Therefore, it should be noted as well that the membership functions of all the states of CMC attributes for contracting organisations are derived from the above model 3. However, having derived the membership function of level 1, the overall change management capability maturity level (CMCL) is calculated using equation below.

$$\text{CMCL} = \sum_{k=1}^{5}(X * R_k) * \text{L}$$

Where;

CMCL indicates the change management capability maturity level (CMCML)

X indicates the weighting of each quantitative indicator. R indicates the degree of membership function of each quantitative indicator. L indicates the linguistic variable where 1 = very low, 2 = low, 3 = moderate, 4 = High, 5 = very high.

Overall CMC Maturity level. 0.05 * 1 + 0.13 * 2 + 0.29 * 3 + 0.33 * 4 + 0.17 * 5 = 3.29

Similarly, the change management capability maturity level of a particular principal attribute group can also be calculated using the same procedure. For instance the capability maturity level of “Competencies” is;

$$0.05 * 1 + 0.13 * 2 + 0.35 * 3 + 0.35 * 4 + 0.13 * 5 = \quad 3.41$$

Table 5.4: The membership functions of overall CMC level for Contracting Organizations.

CMC Capability Area	Weighting	Membership function of Level 2	Membership function of level 1
Leadership	0.61	(0.10,0.19,0.27,0.31,0.20)	(0.08,0.22,0.24,0.30,0.17)
Application	0.07	(0.05,0.43,0.03,0.38,0.13)	
Competencies	0.07	(0.05,0.13,0.35,0.35,0.13)	
Standardization	0.06	(0.03,0.15,0.38,0.25,0.20)	
Socialization	0.18	(0.09,0.30,0.22,0.24,0.10)	

Table 5.5: Overall CMC and capability of principal attributes

Change Management Capability	**Level**
Leadership	*3.53*
Application	3.17
Competencies	3.41
Standardization	3.47
Socialization	2.81
Overall CMC Capability	**3.29**

Table 7 shows the summary of fuzzy synthetic evaluation as carried out in this study. However, the results from table 7 shows "Leadership" as the most relatively matured than other capabilities with a capability level of 3.53 and this is regarded as between "moderate" and "high". "Standardisation" was ranked second with capability maturity of 3.47; it is also considered to be "moderate". Similarly, "Competencies" is perceived third in maturity, the capability level is 3.41 which is seen as "moderate". Moreover, "Application" and "Socialisation" are fourth and fifth with capability level of 3.17 and 2.81 respectively which is seen to be "moderate" for application and "low" for socialisation. However, the empirical research findings clearly shows that the overall change management capability level of contractors in building projects in Nigeria was 3.29 which is considered to be "moderate" and this is considered as "multiple project" in the maturity level. Hence the capability level of the contractors can be viewed as not far from maturity. This means that the contracting organisations in Nigeria may have paid more attention to specific leadership activities around the institutionalisation of change management capabilities and competencies. Moreover, the findings indicates that the weakest capability area is "Socialisation" for which improvements is prioritised. This may be attributed to the absence of leadership total commitment and supports for change management at all levels of the organisation. It is therefore necessary for contracting organisations to pay more attention to building capabilities and competencies via effective commitment

throughout the organisation. Moreover, these findings can be said to be in accord with the findings of, Prosci [13], who reported leadership as a capability area most ranked, followed by standardisation, application, competencies and socialisation in his research study.

6.0 CONCLUSION

The research has adopted an innovative approach in developing a robust and reliable change management capability assessment model using fuzzy synthetic evaluation approach for contractors dealing with building projects. The major contribution of this research is that it has provided a comprehensive and practicable solid framework for assessing and improving the change management capability level of contractors in building projects. The development of the model has further provided a good platform for contracting organisations in identifying the change management capability areas of strength and weaknesses of their organisations with the aim of providing needing improvement where necessary in order to increase performance. Finally, the developed model will serve as a solid yardstick particularly for clients in assessing contracting organisation's change management capability maturity level for pre-qualification exercise during tender evaluation. Further study is to be conducted to assess the relationship between the change management capability of contractors and cost and time performance of building projects.

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