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Title Page

Critical Success Factors for Kaizen Implementation in the Nigerian Construction Industry

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Critical Success Factors for Kaizen Implementation in the Nigerian Construction Industry

Abstract

Purpose: Kaizen in construction is a new paradigm stemming out of lean production systems. Construction companies in developing economies, such as Nigeria, have a task to innovate to liquidate in certain cases. With the aid of kaizen, which encompasses the benefit of stakeholder relationship improvement and management, profitability enhancement and delivery of projects to satisfied clients, construction companies can realise expected growth. An exploration of the critical success factors and associated drivers within the limits of the scope is essential.

Methodology: Exploratory factor analysis statistical tests categorised the critical success factors identified in the literature review section. A detailed sampling approach extracted 135 questionnaires under the 5-point Likert scale format from a larger population in Nigeria. An exploration of important drivers and iteration of eigenvalues combined with asymptotic significance of the drivers provided the critical success factors and significant drivers.

Findings: Construction management function (CMF), operational efficiency (OE), construction business ethics (CBE) and construction cost management (CCM) were the critical success factors established from the exploratory factor analysis tests. It was confirmed that kaizen can be adopted in Nigerian construction companies with reflections on the principal drivers for the critical success factors.

Practical implications: The exploration of the critical success factors and drivers associated with kaizen implementation can be applied to other developing countries with considerations of implementation in terms of cost and time.

Originality/value: The identification of critical success factors provides ample opportunity for consideration of kaizen in construction companies. The findings of this study are a basis for investigations into cost and time implications of kaizen adoption in construction companies.

Keywords: Construction, Continuous improvement, Developing economies, Implementation, kaizen.

1. Background of the study

Causalities of cost and time overruns have been studied without much impact on the construction industry. An introspective look at what is obtainable for the construction industry from the manufacturing and business management sectors provides new approaches in the form of kaizen (Kaur and Kaur, 2013; Khanna, 2009). Innovative management approaches stemming from lean production systems, such as just-in-time, total quality management and kaizen, may be applied in the organisational management of construction companies (Awad and Shanshal, 2017; Cheng, 2018). The concept of lean construction and kaizen have been a subject of intense debate in the construction industry, due to underlying application constraints. Kaizen is an innovative concept which is also known as continuous improvement in construction (Omotayo and Kulatunga, 2015; Vivan, and Ortiz, Paliari, 2015). Considering the prevailing concomitant drawbacks of ensuring project success within the construction industry, kaizen has a major role to play in terms of managing cost, time and quality (Kaur and Kaur, 2013; Junker, 2010). These drawbacks seem to transcend construction economies of developed and developing countries. Nonetheless, the circumstantial differences between the categories of construction economies in relation to studies on the aforementioned drawbacks have peculiarities which should be investigated when change and innovation are being discussed.

In developing countries such as Nigeria, the need for innovative and modern mechanisms of managing construction companies is currently imperative. The economy of Nigeria is out of recession at the moment and the construction industry requires efficient managerial approaches for an uplift. Productivity of construction companies in Nigeria is at its lowest ebb and waste reduction mechanisms are urgently required (Funso et al., 2016; Guerrini et al., 2011). This is why the exploration of the potential that kaizen has in the current economy is essential. In recent studies of project performance, the aforementioned challenges are evident in the UK and other developed construction economies. Hence, the application of kaizen has a vast transferrable import in undermining the vagaries of project success.

Kaizen is a part of the lean production system which essentially addresses waste reduction incrementally (Jin and Doolen 2014; Junker 2010; Kapur et al., 2016; Khanna 2009). The benefits of kaizen are improved productivity, waste reduction, profit, client satisfaction, quality enhancement and increased competitive advantage (Kumiega and Vliet, 2008; Macpherson et al., 2015; Maarof and Mahmud, 2016). Although kaizen was originally developed as an integral part of the Toyota production system, understanding and use of kaizen in the construction industry is still new (Cheng, 2018; Singh and Singh, 2018). Unlike lean construction, which has been studied extensively in the built environment research milieu, kaizen has only been researched by very few authors in the construction industry. Some of the few research works carried out in the construction industry were done by Omotayo and Kulatunga (2017); Vivan et al. (2015); Kaur & Kaur (2013); Martin (1993) and Smadi (1993). Over the years, the focus of kaizen researchers has been its application in the areas of manufacturing, food production and the health sector. The potential benefits of kaizen can improve the present condition of small and medium scale enterprises.

The application of kaizen in the construction industry begins with its implementation in the workplace. Therefore, the management of a construction company requires adequate training on kaizen implementation (Dakhli et al., 2017; Singh and Singh, 2018). However, there are some requirements which have to be in place for kaizen to be implemented. In developing countries such as India, China, Brazil and Malaysia, kaizen has been adopted in the manufacturing sector for continuous improvement and productivity enhancement (Shang and Pheng, 2013; Arya and Jain, 2014; Puvanasvaran et al., 2010; Vivan et al., 2015). Studies about continuous improvement in the construction industry will be elucidated in the next section. The case studies of continuous improvement in the construction industry focus on the research methodology adopted by the researcher. The process of implementing kaizen as a tool for incremental reduction of construction cost, quality and profitability enhancement will also be taken into consideration.

2. The potential application of kaizen in the construction industry

Kaizen is concerned with reducing waste in a particular process by incrementally addressing the existing process before they occur or when they occur. The processes here may be in the project planning or construction phase. Although kaizen has not been used in most construction industries, a kaizen model was developed by Vivan et al., (2015) based on an action research strategy using seventy-six (76) building projects in Brazil. The results showed that the overall cost of the building reduced drastically over the phase of the project. Kaizen was applied during construction to reduce cost. Kaizen costing is the cost reduction mechanism of kaizen during production. The model developed by Vivan, et al. (2015) also eliminated the myth of standardisation for production in construction during the action research process.

Other authors such as Kaur and Kaur, (2013); Martin, (1993); and Smadi, (1993) identified the use of kaizen and kaizen costing for offsite manufacturing of building components and construction. The case studies were conducted in a metal industry, a large construction and concrete company by Savolainen (1999), discussed the understanding and adoption of kaizen processes empirically. The findings reveal that the kaizen adoption process is iterative and the speed of implementation differs in these two companies. Omotayo and Kulatunga (2017) developed an IDEF0 model for the application of kaizen in the construction process. Omotayo and Kulatunga (2017) proposed a plan-do-check-act approach in the key construction process phases such as interim valuation, cashflow calculations, monitoring of building material cost, plant and labour. These implementations of the aforementioned construction process were not considered from a case study point of view. Imai (2012) authored a comprehensive approach of how kaizen can be applied in the workplace in the form of gemba kaizen. The continuous improvement approach is a managerial strategy in deciphering key problems within the workplace before they occur. Further studies of gemba kaizen in construction were conducted by Omotayo and Kulatunga (2017) within the confines of business process modelling and notation for improving small and medium scale construction businesses.

The use of new techniques in enhancing productivity of construction companies is crucial in the current economic climate. Consequently, criteria for adopting kaizen must be explored. The critical success factors (CSF) for analysing the adoptable mechanisms for kaizen in the construction economies of developed and developing countries may be similar. However, previous research and application indicated a vast acceptance of kaizen in developing countries.

3. Scope of the study

Researchers in developing countries such as India, Brazil, Malaysia and China have been investigating the application of kaizen in the construction industry. Hence, this research will focus on Nigeria as part of the wider scope of construction countries which are developing. The CSF in this study will be based on managerial and building construction site applications in Nigeria. Construction cost management has a major role to play in implementing kaizen. This is due to the enormous benefit of kaizen, which is centred on cost reduction, waste reduction and profitability. In addition to this, cost management in construction has a major influence on planning and executing construction activities in developing countries (Aibinu and Jagboro, 2002; Odeh and Battaineh, 2002). The CSF for kaizen implementation intricately advances the course of struggling construction organisations after application.

Exploring the potential implementable CSF for kaizen in the Nigerian construction industry as a transferrable panacea in construction industries of developing economies is the research aim in this study.

4. Drivers for implementing kaizen in the construction industry

The strategies other researchers have suggested for implementing kaizen in countries around the world can be applied to the Nigerian construction industry. These strategies can be categorised as they relate to the various sections of the kaizen process within a construction industry for the company and construction process. Additionally, the critical success factors in this section are from third world countries (such as China, Brazil and India) similar to the Nigerian construction industry. Most third world construction industries have similar challenges, such as cost overruns, project financing and small and medium scale construction companies, which are facing stiff competition from multinational construction companies. The challenges faced in third world construction companies are, therefore, very similar (Ballesteros-Pérez et al., 2015; Dada and Jagboro 2007; Guo et al., 2016; Amoatey et al., 2015) and this allows for consideration of strategic transferability.

Shang and Pheng (2013) investigated the challenges facing the implementation of kaizen in Chinese construction companies, by interviewing project managers. The findings show that Chinese construction organisations do not have the culture of exposing the problems within the business because it can lead to losses. The nature of organisations in China is such that minor

problems can be perceived as major problems and this leads to covering up minor problems. Kaizen demands the identification of difficulties which can lead to waste and eliminate them (Suárez-Barraza et al., 2011). Shang and Pheng (2013) further stated that most project managers in China decide to compress the duration of the project even though the projects cannot be completed in such an unrealistic time frame. The author also stated that kaizen could not work in this instance because there would be intense pressure to finish a project without considering the quality. The final challenge involves the inadequacy of construction professionals with the pertinent understanding of how kaizen works. It was noted that Chinese construction companies are facing the challenge of few construction professionals with an understanding of kaizen. Although most construction companies envy the Japanese production success stories, they do not have the required kaizen skills.

Borrowing from the experiences of Shang and Pheng (2013) in implementing kaizen in construction companies in China, the critical success factors are related to identified strategies for the implementation of kaizen as a strategy and kaizen costing in a company. Although there are no direct identified implementation strategies for the Nigerian context, there are basic requirements for kaizen implementation in terms of critical success factors in developing countries such as Brazil, China and India.

Shang and Pheng (2013); Arya and Jain (2014); Puvanasvaran et al. (2010); Berger (1997); Chukwubikem et al. (2013) and Magnier-Watanabe (2011) have identified several critical success factors required for the implementation of kaizen costing in a company. Some of these strategies could be referred to as enablers or critical success factors required for kaizen costing. These critical success factors have been categorised as thus:

- a) *Organisational structure*: Magnier-Watanabe (2011) noted that “*kaizen required a horizontal organisation structure and opportunistic knowledge acquisition*”, kaizen requires a lot of communication and teamwork and a less bureaucratic management structure. This allows a lot of information to flow within the organisation. This fosters improved relationship between the employer and the employees. There is a need for an ad-hoc, collective and innovative system within the organisation for kaizen costing to be effective.
- b) *Construction process standardisation*: There is a need to improve the process of construction to a more standardised method if kaizen costing will be used (Shang and Pheng, 2013). Most construction companies’ modus operandi depends on the nature of the project, organisation policy and regulatory bodies.
- c) *Government and regulatory bodies*: Government policies, politics and construction regulatory bodies influence various construction industries around the world. If these bodies do not approve kaizen costing as a means of post-contract cost control, they cannot be used. However, some construction regulatory bodies are very flexible and do not get involved in innovation within construction companies.

- d) *Contract documentation and procurement*: The type of procurement process adopted can affect the cost of the project. A design and build system will be different from the traditional procurement system. Therefore, contractors can have more resources at their disposal to implement kaizen costing during a project and create their own team. Also, the level of involvement of stakeholders in the project goes a long way during the construction process. Clarity of exclusions and accuracy of estimates can also influence the time available for kaizen activities.
- e) *Financial risk management*: The quantity surveyors and project managers are mainly involved in managing the financial risk which can arise as a result of price fluctuations, inflation, changes in the building design, variation, claims, theft, fraudulent practices, kickbacks, payment delays, suppliers' and sub-contractors' cost. These factors along with the preliminary items of work can affect the financial position of a construction project, thereby affecting the success of kaizen costing.
- f) *Communication and teamwork*: Kaizen costing activities on site cannot involve the cost or project managers alone, but a *kaizen team*. This team will have to work with every stakeholder, including the suppliers of building materials, clients and sub-contractors. Communication is essential during the implementation of kaizen costing. Therefore, regular site meetings and post-project review meetings are necessary. In most cases where BIM is implemented during the pre-tender process, communication can be easier with other stakeholders.
- g) *Decision making*: The decision made by the cost or project manager during kaizen implementation and follow-up can affect the overall performance of kaizen costing. The contractor or management function in cost management has to be involved in making some final decisions about claims or litigation that can affect the implementation process of kaizen costing. Shang and Pheng (2013) noted that the construction company needs to see "*problems as opportunities*" in order to make the best decisions during kaizen activities.
- h) *Relationship management*: In most situations where claims are raised by the subcontractor or contractor, there is a need for relationship management between the stakeholders. The availability of resources to execute kaizen costing during construction depends on the relationship between the contractor quantity surveyor and the client.

Based on the eight (8) major sections associated with implementing kaizen, the drivers in Figure 1, have been identified.

>>>Insert Figure 1<<<

The categorisation of the CSFs was identified through an extensive literature review search, which identified some cogent drivers when implementing kaizen.

5. Methodology

A survey research strategy was used with a large number of the population involved within the scope of this study. A survey research strategy provides an opportunity to explore and extract large data sets from the existing population (De Vaus, 2013). The CSF for the adoption of kaizen in Nigerian construction companies began with an extensive literature review. This culminated into the development of a Likert scale questionnaire for quantitative questionnaires, targeting building contractors, quantity surveyors and project managers. The research gaps identified in the literature review were modified to provide the focus on the main challenges of developing a good understanding of continuous improvement in Nigerian companies. The opinions and perceptions of key building contractors in the Nigerian construction industry were essential to gain a better understanding of construction industries in Nigeria.

A random sampling technique was adopted for the questionnaire survey. According to Bray and Rees (1995), “*random sampling is defined as one for which each measurement or count in the population has the same chance (probability) of being selected*”.

In this study, eighty-four (84) construction companies were contacted for data collection purposes, this is the company sample size. Two hundred and fifty (250) respondents in these companies were chosen as the broader sample size in order to cover one-third of the population. Overall, two hundred and fifty (250) questionnaires were distributed to the eighty-four (84) companies, and one hundred and thirty-five (135) were returned. The response rate is 54% and this was achieved by following-up the respondents. The questionnaires which were not properly completed were returned to the respondents for amendments.

5.1 Questionnaire survey

A quantitative questionnaire provided relevant details for an exploratory factor analysis addressing the research objective of shaping the CSF based on a 5-point Likert scale. The categorised drivers identified in Figure 1 were positioned in the 5-point Likert scale format of “*not important*” to “*extremely important*”. According to De Vaus (2013), survey questionnaires target a larger population for the purpose of deductive exploration. Hence, the primordial process of data collection was employed to extract the perceptions of construction stakeholders in Nigeria towards kaizen. The word “*kaizen*”, was not used as the main word during the data collection, “*continuous improvement*” was used instead, since the respondents may not have been used to the term “*kaizen*”, and so a brief participant information sheet was applied to educate the respondents on what continuous improvement in construction means and the associated benefits.

5.2 Exploratory factor analysis

According to Cornish (2007), factor analysis is data reduction through the multivariate method. Pallant (2016) also supported this by noting that factor analysis is a combination of various techniques with steps for reduction of the principal components. The author further advised that

principal component analysis and factor analysis are distinct. Both approaches use the correlation pattern to produce a smaller number of linear combinations. Yong and Pearce (2013) stated that the main purpose of factor analysis is to provide a structured pattern, which makes it easier for the researcher to understand the logic behind the relationship. The author also stated that factor analysis could be used for exploratory factor analysis and confirmatory factor analysis. For this study, an exploratory factor analysis was used. The critical success factors were identified using literature synthesis and the drivers were listed and categorised. The categorisation does not provide the critical success factors for the implementation of kaizen, but only classified the drivers for the respondents to answer the questionnaires. The process of factor analysis starts with the validity of the cases. There are one hundred and thirty-five cases in this study. According to Pallant (2016), 150 cases is the benchmark. However, smaller samples can be considered if the solutions have high loading marker variables above 0.80. Stevens (1996) and Bartlett (1954) as cited by Pallant (2016) stated that smaller samples with the good reliability of factor structures and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy would have an index of 0.6 for a good analysis. If the KMO is less than 0.6, the factor analysis is not reliable. Therefore, some variables were reduced. The reduction process starts with the reliability of data with KMO. The principal component factor extractor was used for this study; this considers the best factors which reflect the comparison of the variables (Pallant, 2016). Other types of factor analysis extraction are principal factors, image factoring, maximum likelihood factoring, alpha factoring, unweighted least squares and generalised least squares.

The extraction process is followed by the decision making which can be based on kaizer's criterion, parallel analysis and scree plot (Field, 2009). The scree plot was used for this investigation. The scree plot displays the eigenvalues of the factors. The factors above the elbow were retained. The factor rotation and interpretation was determined after the number of factors has been decided. This presents the pattern of loadings for easier interpretation.

6. Findings

The categorised drivers were tested using the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy to assess the adequacy of the data for factor analysis. This is based on the principal components. If the KMO is above 0.6, then the data is unreliable for the analysis. The first stage of the KMO test did not provide the required sampling adequacy. Four drivers were eliminated to give the KMO and Bartlett's test in Table 1. The four factors eliminated from this table are employee empowerment, availability of software packages, procurement method adopted and updating cost information during construction.

>>>Insert Table 1<<<

Therefore, some factors have to be eliminated. Some unimportant factors with less than 0.4 coefficient in the correlation matrix were eliminated. An eigenvalue of (1) was used for the principal components. The findings of the scree plot for the forty-eight (48) factors which were

later reduced to forty-four (44) factors for KMO adequacy provided four major categories from the elbow of the curve. This is illustrated in Figure 2.

>>>Insert Figure 2<<<

Eleven (11) eigenvalues were produced using the communalities. These values are above 1.0, and the scree plot in Table 2 indicates that the elbow breaks at the fourth point on the graph from the left. The component transformation matrix will be produced using the four identified factors.

>>> Insert Table 2<<<

The component transformation matrix from the principal component extraction also made use of the Varimax with the Kaiser Normalisation rotation method. This method extracts the four major components. The four components identified from the scree plot extraction method are correlated with each other for further analysis to prove their correlation. The rotated matrix provides the coefficients of the factors, which are categorised into the four categories.

>>>Insert Table 3<<<

The extraction method was based on the principal Component Analysis. The rotation Method employed Varimax with Kaiser Normalization. The rotation converged in 20 iterations. The four factors extracted with an eigenvalue greater than 1 were used to re-categorize the drivers into four major components as listed in Table 3.

The values of the factors which appeared in different components are selected based on the highest value. The drivers in Table 4 have been ranked based on the outcome of the asymptotic significance in sections 6.1 to 6.4.

>>>Insert Table 4<<<

The forty-four drivers have been allocated to the critical success factors based on the pattern matrix. The names given to the categories are based on the similarities between the drivers. The most important drivers in each category are now tested for their level of importance using Kendall's test for concordance. The four factors are management function, operational efficiency, construction business management ethics and construction cost management as discussed in the sections below.

6.1 Assessing the drivers for construction management function (CMF) critical success factor

In assessing the drivers for management function, Kendall's coefficient of concordance was used to address the asymptotic significance and for drivers within the critical success factors.

>>>Insert Figure 3<<<

Pallant (2016) noted that if the asymptotic significance is less than 0.050, then there is a high relationship between the drivers in relation to construction management function. In Table 4, CMF1 representing variations and rework during construction has $p=0.000<0.050$. This indicated that CMF1 is crucial in construction management function (CMF) and project success. Furthermore, CMF2 indicates excellent remuneration and motivation, and contractor/QS relationship are very important to implementing kaizen in the Nigerian construction industry. In Figure 3, CMF4 to CMF9 have $p<0.050$. Therefore, having excellent relationships between the stakeholders involved in construction projects presents an opportunity for kaizen adoption. Kaizen depends on relationship management within the workplace for successful continuous improvement.

6.2 Assessing the drivers for operational efficiency (OE) critical success factors

The asymptotic significance for the drivers under operational efficiency has four (4) drivers which are significant. OE1 has $p=0.001<0.050$, hence, excellent working conditions in construction companies within Nigeria is extremely important for implementing kaizen. OE2, OE3 and OE4 in Table 4, have p values, 0.006, 0.013 and 0.041 <0.050 as illustrated in Figure 4. The deductions here imply that contractors' decision, price and design risk and post-project reviews of cost information can propel the attainment of kaizen during construction processes.

>>>Insert Figure 4<<<

In Figure 4, there are seven (7) drivers which have p values of >0.050 . Drivers OE5 to OE11 in Table 4, are not important in driving construction companies towards continuous improvement. Continuous improvement processes require excellent working conditions and it is based on post-project reviews of cost information and the overall processes involved in construction. Decision making by the contractor in construction companies has a major influence on the day-to-day running of the organisation.

6.3 Assessing the drivers for construction business ethics (CBE) critical success factors

Suppliers' costs of building materials (CBE1) has a p value of $0.000<0.050$. This is crucial for construction business ethics because of associated kickbacks and corrupt practices between the subcontractor and suppliers. CBE2 and CBE3 in Figure 5 have p values of 0.002 and 0.029 respectively. The p values for CBE2 and CBE3 are therefore less than 0.050. In Table 4, political stability and the quality of cost information required for construction business ethics in Nigeria are connected to corrupt practices in the Nigerian political structure and construction industry. This connection does not imply a positive outlook for implementation, but non-causal drivers associated with existing realities of construction business in Nigeria. Therefore, there has to be a favourable political system, access to excellent cost data for kaizen to be implemented and the cost

information provided by the QS will aid the reduction of corrupt practices in the construction industry.

>>>Insert Figure 5<<<

The extent to which the three (3) most significant drivers can influence construction business ethics in the Nigerian construction industry presents an opportunity for the adoption of kaizen.

6.4 Assessing the drivers for construction cost management (CCM)

In Figure 6, the stability of market conditions (CCM1) has the highest p value of 0.006. From Table 4, CCM2 to CCM4 have p values of 0.009 to 0.043 which are below 0.050 grid in Figure 6; all indicate significance to the construction cost management CSF.

>>>Insert Figure 6<<<

Therefore, updating cost information and the QS decision before and during construction as a continuous improvement mechanism will make it easier for kaizen to fit into the project life cycle. Reduction of claims during construction projects is significant in the construction cost management driver for kaizen. Claims will be reduced when there is meticulous cost information.

7. Discussion of findings: Implementation of kaizen in the Nigerian construction industry

This section deduces the exploratory factor analysis and asymptotic significance findings for the adoption of kaizen in the Nigerian construction industry. The discussion below is also expanded to other developing countries. A general perspective of the findings in this discussion provides more insight into how the CSFs in Table 4 are justified.

7.1 Construction Management Function

The management of construction activities starts with the decision made by the contracting management, in this instance, the contractor or group of contractors. The contractor will make certain decisions based on the type of contract, duration and conditions of contracts. Yngve (1995) noted that an organisation could not exist alone, it has to interact with other systems, other organisations. Certain drivers within and outside influence construction companies. Some of these are flexible organisational policy; existing continuous improvement policy; government regulations; organisational structure and communication; architect/project managers' decision; project complexity; contractor/QS relationship; employee experience; variations and rework during construction; excellent remuneration and motivation; excellent employee/employer relationship; experienced QS and other staff; disputes and litigations and clarity of exclusions in the contract (please refer to Table 4).

Variation management in construction is an integral part of construction management. Variation management has a p value of $0.000 < 0.050$, indicating very high significance. Change management has been a major discussion point in construction management circles (Alaryan et al., 2014; Othman, 1997). In achieving kaizen in the construction process, variations and rework as part of the change management process should be minimised. This process can also be achieved through early adoption of kaizen in construction cost planning. Involvement of the design team in construction cost planning has an effect on the rapid attainment of cost reduction during construction. Hence, variations and rework is a significant driver for the construction management function within the sphere of kaizen realisation in the construction milieu.

Excellent remuneration and motivation, contractor/QS relationship and existing continuous improvement policy are all related to what is happening within the organisation. The aforementioned drivers had p values of 0.00, 0.003, 0.004 and 0.019 respectively. The interaction of the organisation with the external environment has to do with government regulations such as taxes, and financial incentives for construction companies in Nigeria. The major drivers for a successful business are the human resources, motivation and relationship management within the organisation. These factors are crucial for the implementation of kaizen within the organisation. The organisational strategy for kaizen implementation has to do with making problems visible, setting high targets and staying in touch with reality (Emiliani, 2005; Singh and Singh, 2015; Smadi, 2009; Suárez-Barraza et al., 2011). The owners of construction companies need the input of employees for better identification of problems. Therefore, adequate communication is required for kaizen in the workplace. Imai (2012) stated that kaizen in the workplace is known as gemba kaizen, this is important for good housekeeping and management for continuous improvement. Continuous improvement in the place of work can only exist when there is a form of motivation. The motivation of workers to keep track of what is wrong or requires improvement is crucial. Implementing kaizen, in this instance gemba kaizen, depends on the experience of the employees. It also depends on the relationship between the employer and the employee.

The findings in this study reveal that a proper consideration of government regulations before implementing kaizen is imperative. In Nigeria, there are no government regulations on construction cost management. Moreover, most construction companies have the obligation to advance the course of their project with any modern construction methods and standards available in the construction industry.

Findings from the empirical data suggest that there is a major impact of the abovementioned drivers which are significant to the success of the management function as key attributes for the application of kaizen in Nigerian construction companies. CMF as a finding under the CSF connotes a wider scope of how construction organisations can redress their performance in line with continuous improvement principles.

7.2 Operational efficiency

The modus operandi of most construction companies in the small and medium scale range depends on some drivers. These drivers are excellent working conditions; decisions made by the contractor; the experience of the Quantity Surveyor on site; training of inexperienced employees and other staff; regular site meetings; influence of construction professional bodies; improved teamwork; financial status of the company; price and design risk; standardized production process; and post project reviews of cost information. These drivers were also assessed in terms of their relevance to the implementation of kaizen during construction.

The findings indicate that excellent working conditions have a significant p value of $0.001 < 0.050$. The excellent working conditions entails health and safety standards, security, modern facilities and spaces in the workplace and construction sites. Crema et al. (2015) provided ways of improving the safety with lean and safety methods. Shang and Pheng (2013) also suggested the standardisation of the construction process for easier implementation of kaizen in the construction industry. The process of standardisation in construction does not have to do with the closed working environment as in a factory but a well-structured method statement, a work breakdown structure and information management system.

Contractors' decision-making skills having a p value of 0.006 is also a vital driver for operational efficiency. The decision made on construction sites by the contractor can be a positive or negative influence on the outcome of the construction project. The contractor makes very spirited decisions during variation management, claims and the cashflow. These decisions go a long way in influencing relationships between stakeholders and the final outcome of the construction project. Although the QS and architect also make these decisions, the final approval comes from the contractors.

The QS and Architect with a significant p value of 0.013, on site also influences the decisions the contractor makes; this is based on some level of experience. The site quantity surveyor's experience may not be of relevance to the operational efficiency of the site because the architect makes most of the decisions along with the contractor. The price and design risk is very significant to this study because the effect of fluctuations and variation are always influential. This affects the activities, which are related to incremental cost reduction. Design risks can lead to variations, which makes contractors claim for more work on the site.

The findings indicated a post-project review driver under OE with a p value of 0.041. Post-project reviews of construction cost information is an indication of the extent to which construction companies have been able to add some element of continuous improvement. Continuous improvement in construction can be established further with the aid of kaizen principles, such as plan-do-check-act. This process is circular and adds an incremental understanding to the processes which have to be improved. A transference of errors in the construction process should be avoided at all cost when using historical cost information for elemental cost planning. The elemental cost planning phase of construction projects may systematically include latent errors from previous projects when they have been used for multi-rate or single rate estimating. Furthermore, post-

project reviews can be applied to other planning phases of construction projects, such as design, stakeholder relationship management, schedule management and method statement.

Overall, the findings show that decisions made by the contractor; architect and QS; reviewing previous project details can be strengthened in the construction process to in other to establish kaizen within Nigerian construction companies.

7.3 *Construction business ethics*

This aspect of construction business has to do with communication, information management, relationship management with the client and ethical business policies during construction. This factor is related to the construction process phase. The drivers for this factor are improved contractor-client communication; subcontractors cost; political stability; payment delays; suppliers' cost of materials; fraudulent practices, kickbacks and price fluctuations.

The findings indicated a significance of 0.000 for suppliers' cost of building materials. Political stability with a p value of 0.002 and quality of cost information as 0.029. The empirical findings are aligned with the present unethical condition of construction practises in Nigeria.

The practices involved in the contractor - client relationship has to do with how the clients, who can be government, quasi-government private clients, and organisations or companies, make arrangements for procurement with the contractors to deliver a project. In Nigeria, certain classes of contractors are forbidden to take part in the submission of tender. Small and medium scale construction companies in Nigeria have a lot of challenges with competitiveness in the industry (Ayanda and Laraba, 2011; Bala et al., 2000; Chukwudi and Tobeckwu, 2014). This fact was corroborated with the result of the asymptotic significance. Suppliers' costs of materials is the most significant driver within the construction business ethics. In most developing countries around the world, building material cost has a major significant effect on the final cost of construction projects (Omotayo and Kulatunga, 2017). Bribery and corruption in construction business is not peculiar to developing economies. In the UK, several cases of bribery have resulted in persecution of contractors (Transparency International UK, 2011). Inflation of the cost of building materials has a direct relationship with final construction cost. Therefore, suppliers' building material cost has to be checked for unethical practices as part of kaizen implementation.

Political stability; this driver is more significant than subcontractors' cost. Political stability has a way of influencing construction business in Nigeria. Oyedele (2015) noted that political stability and security in the northern part of Nigeria would make construction business difficult. In the Southern parts of Nigeria, thugs are bribed in order to avoid unnecessary violence. These types of conditions affect the implementation of kaizen. The political situation in most developing countries are volatile, hence, a more proactive approach to managing construction business is imperative. Kaizen possesses this problem of detection approach. Furthermore, the political system impacts

on construction cost, due to government corrupt practices, deliberate padding of construction budget and institutionalised corruption.

The quality of cost information for the post-contract cost control process starts from the cost-planning phase and the working budget. Cost estimates are always very inaccurate (Park and Papadopoulou, 2012). Oyedele (2015) has also discussed the problems with cost estimates in Nigeria. The factors Oyedele (2015) identified are crucial and mostly unavoidable. Therefore, the quality of cost information seems more important compared to improving the contractor-client relationship. In recent time, most Nigerian auditing companies have adopted ISO 9001 (2015) as a quality management system for construction process improvement (The Knowledge Academy, 2018). ISO 9001 (2015), can be used in enhancing the quality of construction processes and products in Nigeria by associating the plan-do-check-act principle with quality control of cost data.

The findings indicate that in adopting kaizen, the construction business and environment have to be standardised. Kaizen can be used to maintain the quality of cost information and delivery time (Brunet and New, 2003; Colenso, 2000; Doolen et al., 2008). The challenges of business ethics with kaizen has not been considered fully, but unethical practices on construction sites have a way of influencing the delivery of the project and overall cost.

7.4 Construction cost management

The drivers for the factors highlighted were claims; updating cost information during construction; stability of market conditions; the accuracy of estimates; in-depth knowledge of production process; architect-quantity surveyors' relationships; quantity surveyors' decision; construction method; communication among project professionals; contractor/suppliers relationship; and management of overheads on cost. The asymptotic significant findings reveal that stability of market conditions, updating cost information, QS decisions and claims have p values less than 0.050 at 0.006, 0.009, 0.019 and 0.043 respectively as indicated in Figure 6.

The stability of market conditions can determine the outcome of final construction cost. This was investigated by (Adegoke, 2016; Odediran et al., 2013; Olatunji, 2008), the stability of market conditions affects the prices of building materials, particularly cement. Prices fluctuations, foreign exchange rate, bank lending rates and the state of the economy all influences construction cost. Olatunji (2008) noted that the tender sums of most construction projects in Nigeria are higher during unstable market conditions. The mean score for unstable market conditions is 23.85, while the significant value is 0.006. This proves that this driver is very significant for the factor.

Excessive claims have a way of leading disputes in construction (Lord and Gray, 2011; Olanrewaju and Anavhe, 2014). The process of updating cost information during construction in the cashflow is vital for cost monitoring and control. The cost information can arise from materials purchase, overheads relating to site office, maintenance of site utilities and payment of subcontractors, suppliers and labourers. The process of updating cost information is a corrective process, and it is carried out during variation management.

Decisions made by the QS may be opposed by the architect or contractor. Decisions to adopt a new building element based on design changes have cost, time and quality implications. The contractor's decision may contradict what the QS suggests. Most conflicts in construction arise as a result of financial differences between the budget and actual expenses. Variation management and rework may result in a number of disputes.

It can be deduced from the findings that additional details included during construction may jeopardise planned schedule and time. Thus, construction cost management as a CSF have to adopt kaizen for continuous cost improvement purposes. The aforementioned underlying drivers of construction cost management will have a major impact on the final account of a construction project.

8. Conclusion

Several organisations may have been making use of kaizen in the form of continuous improvement, however, it is still very new to the construction industry. With the wider scope and complexity of construction projects around the world, a more holistic philosophy into managing construction projects for enhanced productivity is sacrosanct. In developing economies, the gross domestic product growth rate is high, but infrastructure delivery has remained the same. Hence, an economy depends on the construction industry for growth. Most construction companies in developing economies have productivity and other associated issues which limit their growth. Continuous improvement has been proven to provide major impact on the growth of construction companies in developing countries. Implementing continuous improvement demands a lot of financial resources, cost and time. Nonetheless, certain CSFs need to be in place for construction organisations to adopt kaizen.

Construction management function, operational efficiency, construction business ethics and construction cost management covers the intricate drivers for a successful kaizen implementation. Within the Nigerian scope as an extrapolation for developing economies, the aforementioned CSFs demand attention for successful project delivery and kaizen. Construction management function explored the drivers which include financial motivation, relationship between the upper and lower management, change management in terms of handling variations and rework and the relationship between the organisation and external systems, in this instance government regulations. An exploratory view of these drivers indicate that construction companies in developing economies need a lot of good housekeeping for effective realisation of kaizen.

Operational efficiency in construction, business ethics and cost of construction has been emphasised in previous sections to indicate drivers that should be delimited and may establish a decline in the CSFs. Kaizen is concerned with waste minimisation and elimination for effective profitability. Therefore, drivers which propagate intense waste during construction should be of prime significance to the project life cycle and kaizen. Certain attitudinal challenges were highlighted in form of drivers. These are political stability, contract and QS decisions and

suppliers' material cost. These attitudes expressed by key stakeholders in the construction sector cannot be eliminated easily. Change management is essential in adopting kaizen.

Change management of organisational culture and perception towards innovation and new ideas is therefore needed. Kaizen in construction is definitely possible because it has been adopted in other developing countries. The construction economies which are yet to delve into this paradigm of continuous improvement require a change management strategy based on the identified CSFs. The possibility of adopting kaizen in Nigeria and other developing countries is high. However, careful consideration of implementation cost and duration is essential.

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Table 1: KMO and Bartlett's test after the second iteration

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.639
	Approx. Chi-Square	5008.688
Bartlett's Test of Sphericity	df	946
	Sig.	.000

Table 2: Component transformation matrix

Component	1	2	3	4
1	.612	.523	.443	.393
2	-.145	-.659	.480	.561
3	-.344	.306	-.522	.718
4	-.697	.446	.548	-.126

Table 3: Rotated matrix table for the drivers

Drivers	Component			
	1	2	3	4
Flexible organisation policy	.778			
Existing continuous improvement policy	.681			
Government regulations	.631			
Organisation structure and communication	.614			
Architect/project managers' decision	.598			
Project complexity	.590			
contractor/QS relationship	.585			.503
Employee experience	.572			
Variations and rework during construction	.541			
Excellent remuneration and motivation	.540		.409	
Experienced QS and other staff	.466			
Excellent employee/employer relationship	.459			
Disputes and litigations	.431			
Clarity of exclusions in the contract	.426			
Architect/QS relationship				
Employee empowerment				
Improved teamwork		.752		
Financial status of the company		.730		
Price and design risk		.700		
Excellent working conditions		.667		
Influence of construction professional bodies		.605		
Training of inexperienced employee	.404	.578		
Post-project reviews of cost information		.578		

Contractor decision making		.562		
Standardised production process		.483		
QS site experience	.409	.482	.414	
Regular site meetings		.472		.406
Stability of market conditions				.727
Quality of cost information			.704	
Fraudulent practices and kickbacks			.685	.403
political stability	.427		.684	
Subcontractors' cost			.672	
Payment delays			.643	.446
Price fluctuations			.639	
Suppliers' cost of materials			.571	
Improved contractor-client communication	.473		.538	
Contractor/subcontractor relationship				.727
Contractor/suppliers relationship				.720
QS decisions				.663
Communication among project professionals		.432		.662
Management of overheads on cost				.636
Claims				.618
In-depth knowledge of production process		.509		.564
Construction method		.433		.499

Table 4: Categorisation of drivers from Table 3 into CSFs

Construction management function (CMF)	Operational efficiency (OE)	Construction Business Ethics (CBE)	Construction Cost Management (CCM)
<i>Variations and rework during construction (CMF1)</i>	<i>Excellent working conditions (OE1)</i>	<i>Suppliers' cost of materials (CBE1)</i>	<i>Stability of market conditions (CCM1)</i>
<i>Excellent remuneration and motivation (CMF2)</i>	<i>Contractor's decision making (OE2)</i>	<i>political stability (CBE2)</i>	<i>Updating cost information during construction (CCM2)</i>
<i>contractor/QS relationship (CMF3)</i>	<i>Price and design risk (OE3)</i>	<u><i>Quality of cost information (CBE3)</i></u>	<i>QS decisions (CCM3)</i>
<i>Existing continuous improvement policy (CMF4)</i>	<u><i>Post-project reviews of cost information (OE4)</i></u>	Improved contractor-client communication (CBE4)	<u><i>Claims (CCM4)</i></u>
<i>Architect/project managers' decision (CMF5)</i>	Standardised production process (OE5)	Price fluctuations (CBE5)	Architect/QS relationship (CCM5)
<i>Clarity of exclusions in the contract (CMF6)</i>	Financial status of the company (OE6)	Fraudulent practices and kickbacks (CBE6)	In-depth knowledge of production process (CCM6)
<i>Government regulations (CMF7)</i>	Influence of construction professional bodies (OE7)	Payment delays (CBE7)	Accuracy of estimates (CCM7)
<i>Excellent employee/employer relationship (CMF8)</i>	Regular site meetings (OE8)	Subcontractors' cost (CBE8)	Construction method (CCM8) Contractor/suppliers
<u><i>Flexible organisational policy (CMF9)</i></u>	Training of inexperienced employee (OE9)		relationship (CCM9)
Disputes and litigations (CMF10)	QS site experience (OE10)		Management of overheads (CCM10)
Employee experience (CMF11)	Improved teamwork (OE11)		Communication among project professionals (CCM11)
Project complexity (CMF12)			
Experienced QS and other staff (CMF13)			
Organisational structure and communication (CMF14)			

*Note: Drivers **in bold italics** are considered important to the CSF based on rotated matrix data*



Figure 1: Categories of drivers for the implementation of kaizen in Nigeria

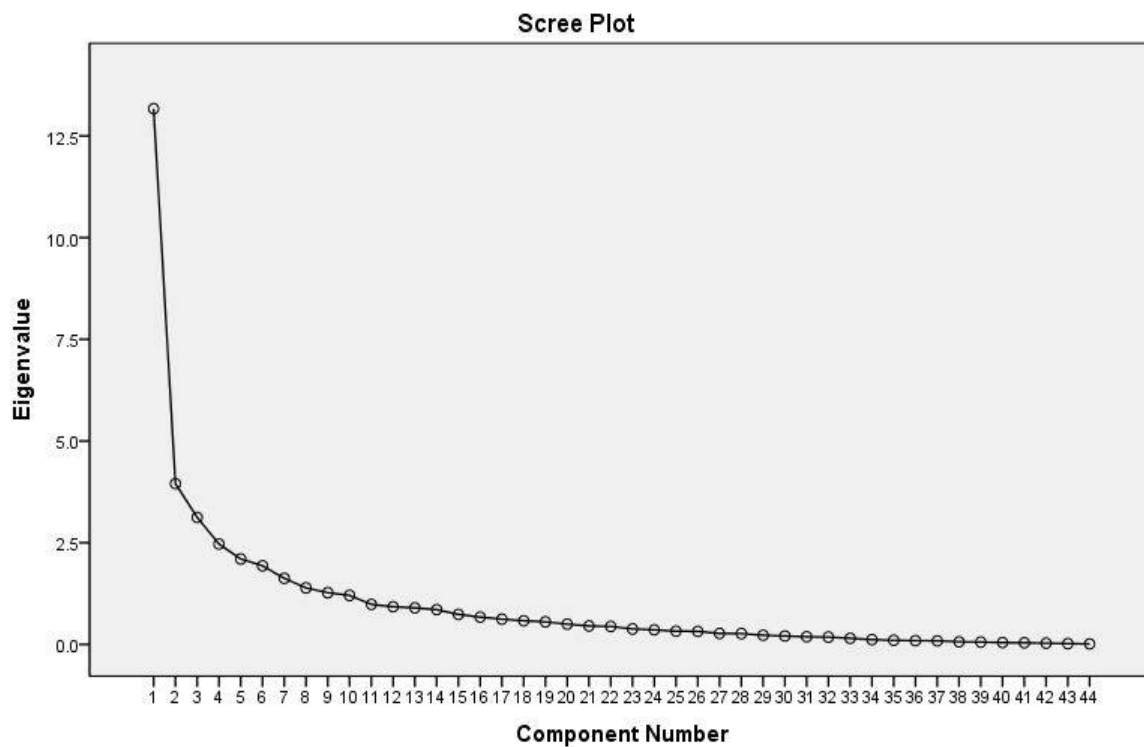


Figure 2: Scree plot showing the eigenvalues

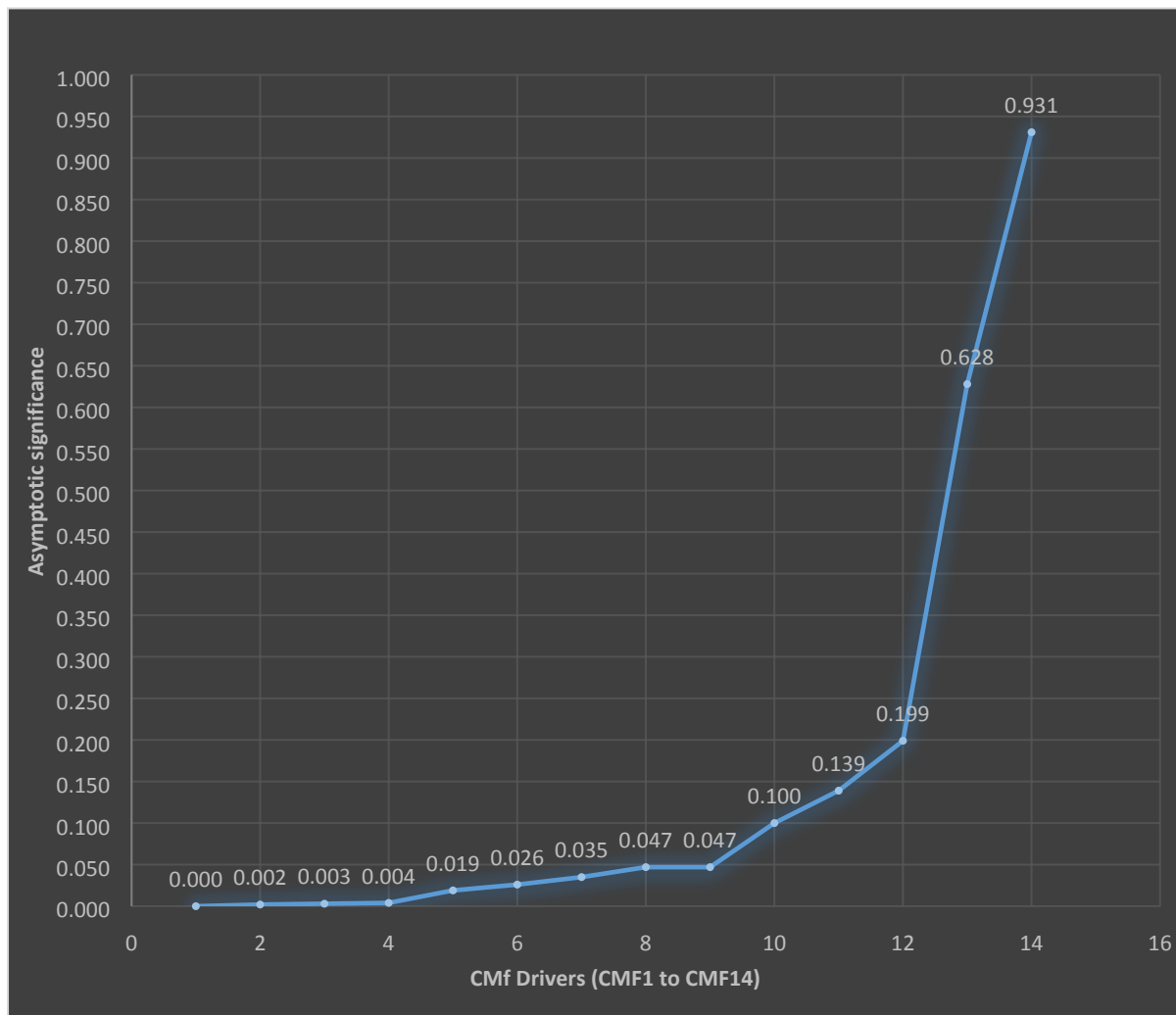


Figure 3: Asymptotic significance for construction management function drivers

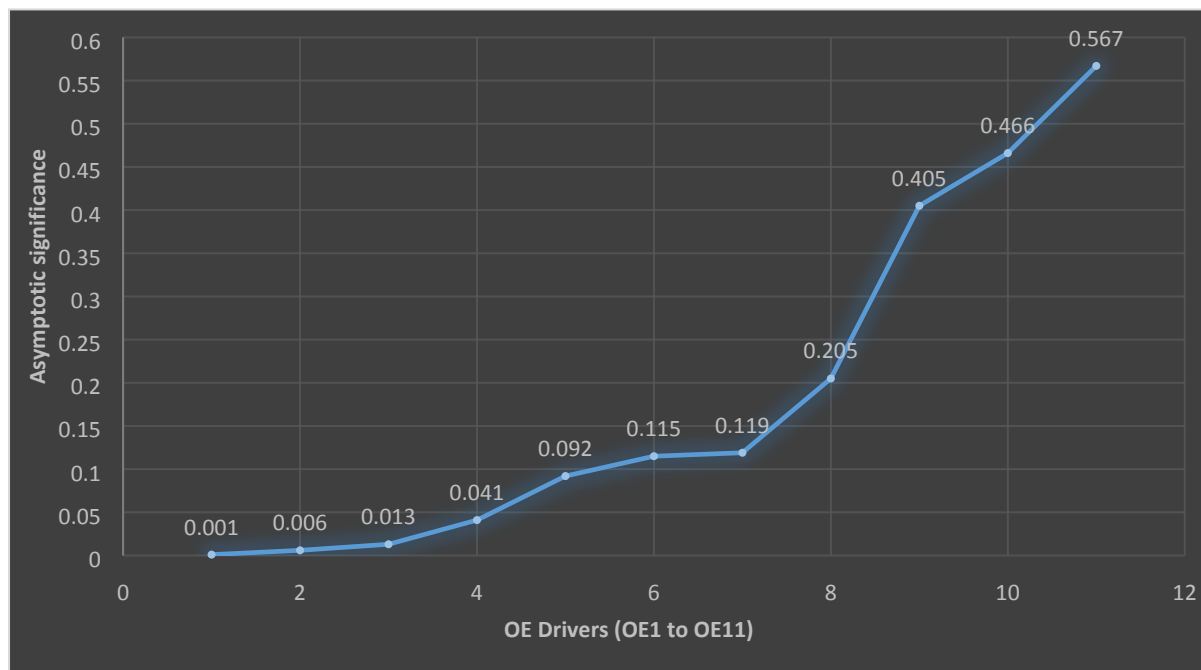


Figure 4: Asymptotic significance for operational efficiency drivers

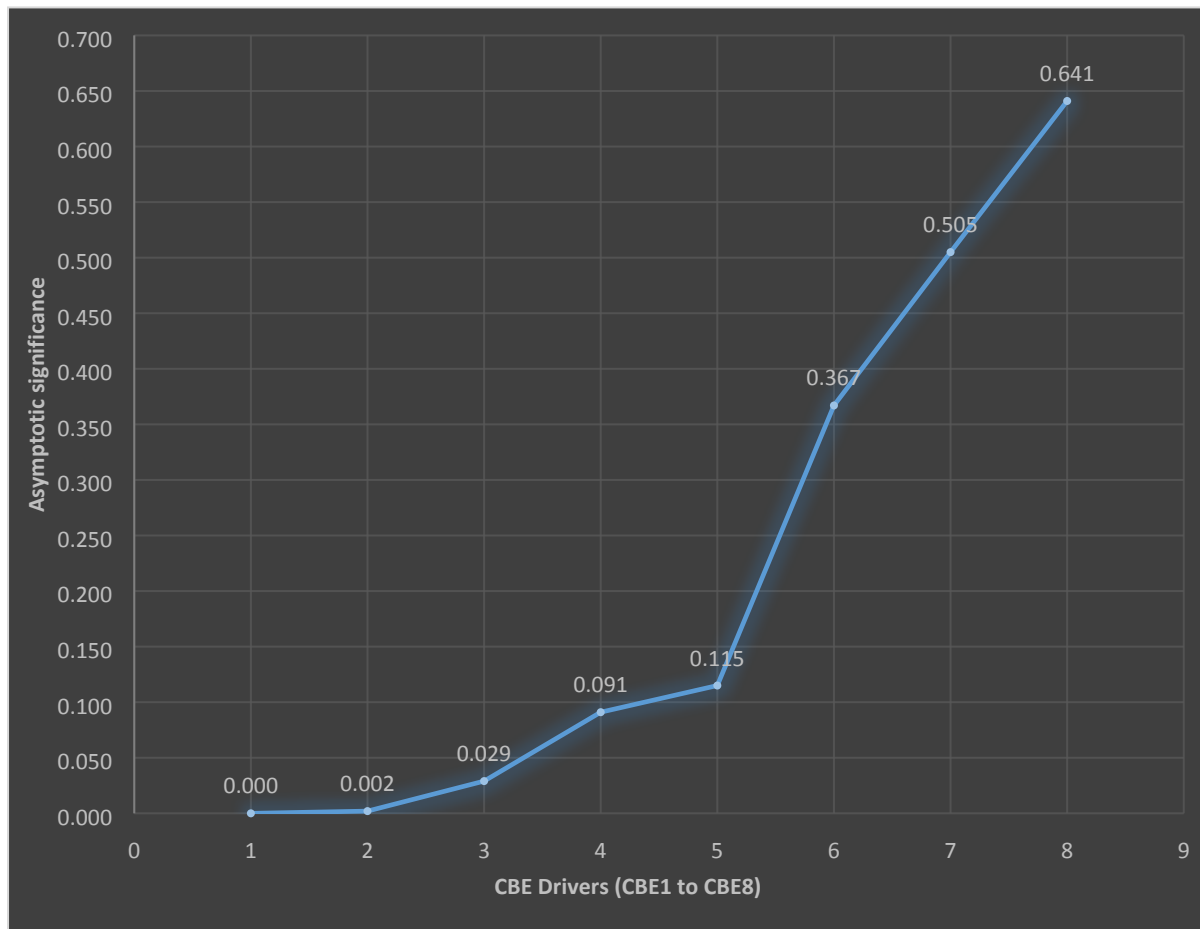


Figure 5: Asymptotic significance for construction business ethics

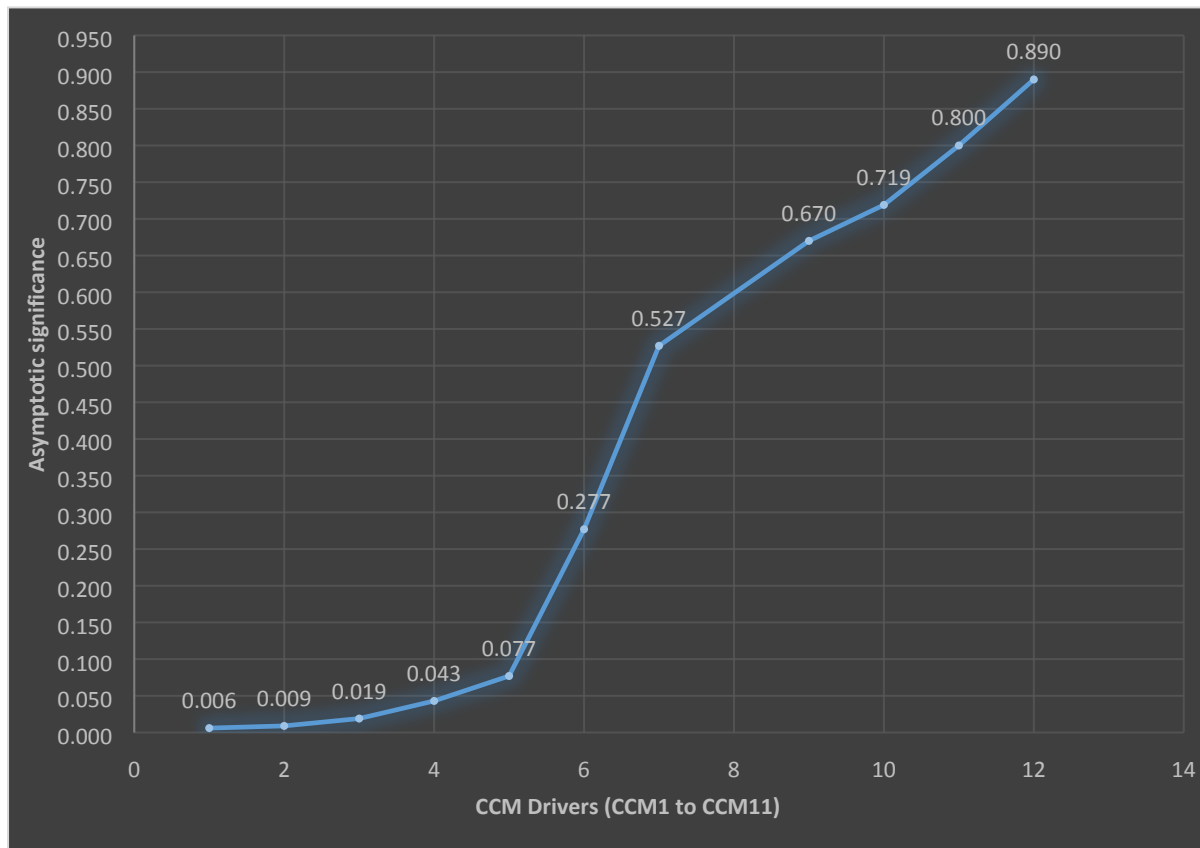


Figure 6. Asymptotic values for construction cost management drivers

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