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CRITICAL ORGANISATIONAL FACTORS AFFECTING THE ACCURACY OF CONCEPTUAL COST ESTIMATES IN AN ERA OF BIG DATA

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ABSTRACT

Purpose: This study seeks to identify organisational factors that affects the accuracy of early conceptual cost estimate then evaluate the influence of these factors so as to determine the organisational factors to be taken into account when preparing conceptual cost estimates.
Design/Methodology: Case studies have been used to identify the relevant contributing organisational factors affecting the production of accurate estimate. This identification process is undergirded by a careful review of literature. The literature related with organisational factors was used as a primary source to investigate the influences of organisational factors on achieving accurate forecast. Through semi-structured interviews and review of accessible company documents, 11 factors have been highlighted. The respondents involved were professionals who have been actively involved in the production of early cost estimate for different types of projects.
Findings: The outcome identified six critical factors among a host of others namely; organisation's estimating culture, management commitment, communication, IT support (infrastructure and analytic capabilities), capacity development and lastly cost information database and sharing capability. The effect of any of these factors is fundamental and thus have impact on the outcome of estimating process from an organisational viewpoint.
Research Implications: The use of interviews implies that the discussion of the result is largely subject to the researcher's understanding and interpretation which might not truly reflect the responded position, this fact has a tendency to affect the outcome of the study. This study contributes to knowledge through identified organisational (qualitative) variables considered to influence cost estimates at three levels of an organisation, that is, individual, group and organisation within the 'input-process-output' framework.
Practical Implications: This study recommends the need to consider organisational factors to ensure a more reliable cost estimate and by extension support decision making when determining the economic feasibility of construction projects.
Originality/Value: The study revealed that the interplay of organisational variables and the ability to extract valuable insight to support decision making hold a practical implication for improving accuracy of cost in the construction industry.

Keywords: Accuracy, big data early cost estimate, organisation factors.

1. INTRODUCTION

The Conceptual cost estimate constitutes a defining element for managing any construction project (Dursun & Stoy, 2016). The Association for the Advancement of Cost Engineering (AACE) published international recommended practice document in 2020

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where it defined five classes of cost estimates. The fifth class is the conceptual cost estimate at 0% to 2% complete project definition. Accuracy at this stage ranges between -20% to -50% and +30% to +100% for low and high variations respectively. Conceptual cost estimation which serves as the main stage of project planning is characterised by dearth of project information, high levels of uncertainty and risk (Elmousalami, 2020). It is recognised that in most cases, the conceptual cost estimate during the early stage of project initiation falls short of delivering the needed result that meet the expectation of clients. These shortcomings manifest in cost overrun in projects that are set out originally to achieve good performance.

According to Flyvbjerg, Holm, & Buhl (2007) the tendency of actual cost overshooting the estimated cost is 86% for most public works projects. Accurate forecast of construction cost is a desirable feat that can provide information necessary for planning, and mitigating failure in complex project (Sridarran, Keraminiyage, & Herszon, 2017). A key element of forecasting is identifying the financial resources necessary to accomplish the project objective (Energy, 2018). Beyond the professionals' confidence rating, reliable cost prediction will attract an increasing demand for budget planning by investors for their proposed investments. Planning cost requirement is achieved through cost forecasting. With cost modelling partly underlying the project review process, the accuracy of conceptual cost estimates is crucial to early decision making in deciding the economic feasibility of complex construction projects, as well as overall project success (Azrai and Ismail, 2013; Li, Baek, & Ashuri, 2021; Oshodi & Lam, 2018).

The era of being constrained to work with limited information is fast phasing out (Lu, Lai, & Tse, 2018). The current trend is that of huge amount of heterogeneous data constantly flooding into the construction industry as it is in other sectors (Oesterreich & Teuteberg, 2016). The rapid development in information and communication technologies (ICTs) suggests that more data is created and available for projects compared to the past (Xi Chen, Lu, & Liao, 2017; Lu, Lai, & Tse, 2018; Xu et al., 2020). It follows that data related to the construction industry is likely to rise exponentially with the progression of technologies like mobile devices and Internet of Things (IoT). With this development, practitioners are positive that big data will bring about possibilities in a wide range of areas including improvement in the accuracy of forecast for projects (Omran, 2016).

The role that organisations play in the generation of cost estimates crucial; this may result in the type and quality of information made available, degree to which scope is defined, time allowed to prepare the cost estimate, the purpose the estimate is intended to serve. As Trost & Oberlender (2003) observed, organisation who rely on estimated cost figure as the cost limit for their spending suffer when actual project cost overshoots the estimated budgeted. This has been proved in difficulties encountered in raising additional funds, missed development opportunities and mismanaged projects.

In a bid to improve construction cost forecasting accuracy, several studies have advocated the following: i) deployment of right tools will enhance the quality of forecast (Bala, Bustani, & Waziri, 2014; Cao, Cheng, & Wu, 2015; Elfaki, Alatawi, & Abushandi, 2014; Elmousalami, 2020; Elsawy, Hosny, & Razek, 2011), ii) variety of methods (Bayram & Al-Jibouri, 2016b, 2016a; Swei, 2020) such as parametric and non-parametric; iii) careful consideration of factors (Akinradewo & Aigbavboa, 2020; Lim, Skitmore, & Xiong, 2016) influencing the accuracy of cost estimates. However, precision in cost forecasting relies predominantly on a clearly defined project scope, with the right skills and the right information (Perera, Pearson, & Dodds, 2009; RICS, 2020). The significance of organisational factors in other construction areas like risk management (Adeleke,

Bahaudin, & Kamaruddeen, 2018; Adeleke, Bahaudin, Kamaruddeen, Khan, Yao, Sorooshian, Fernando, Nawanir, & Salimon, 2018), bidding decisions (Yan, Liu, & Skitmore, 2018), construction safety (Filho, Fonseca, Lima, & Duarte, 2012) have been acknowledged. However, the effect of organisational factors in achieving accurate cost estimate in an era of big data has rarely been considered. Suffice to say that in the context of big data, this study provides a novel contribution to the existing body of knowledge. To address this gap, this study seeks to identify organisational factors that affects the accuracy of early conceptual cost estimate then evaluate the influence of these factors so as to determine the organisational factors to be taken into account when preparing conceptual cost estimates.

2. LITERATURE REVIEW

Over the years, researchers have employed different techniques to develop tools with a view to improving the accuracy of cost forecasting. Chronologically, these studies can be partitioned into two segments. For the period between 1990 – 2010, out of a total of 15 articles, Regression techniques (Attalla & Hegazy, 2003; Lowe, Emsley, & Harding, 2006) and Artificial Neural Network (ANN) (Elhag & Boussabaine, 1998; Kim, An, & Kang, 2004; Wilmot & Mei, 2005) were the most predominantly featured tools representing between 40% and 25% respectively. Others include case-based reasoning (CBR) (Kim *et al.*, 2004), support vector machine (SVM) (An, Park, Kang, Cho, & Cho, 2007) and a combination of genetic algorithm (GA) and ANN (Kim, Yoon, An, Cho & Kang, 2004).

With growing interest in forecasting studies, the year 2011 to date saw a sustained application of the two prominent techniques in the earlier period with regression analysis however sliding behind ANN. From a total of 33 papers, the combined use of ANN and regression techniques in the construction domain represent almost 50% of the total tools used while the use of a combined techniques increased to about 38%. The remaining 12% popularity is shared between time series, CBR and SVM techniques. The newly introduced time series technique (Herbsman, 1986) is found to play a role in cost forecasting while others maintained same level of relevance. New approaches of regression have been used in many ways including automatic feature selection, handling highly correlated data and achieve stability of the model predictions (Zhang, Minchin, & Agdas, 2017). ANN have also increasingly been used to address a wide range of forecasting issues. Its distinct characteristics in term of nonlinearity, input-output mapping and adaptability (Cuilan & Deyong, 2017) makes it suitable in relating with more variables and reliable in face of insufficient details. The need to provide more accurate forecast instigated the current integrative approach called the hybrid system. So far, the result shown by this category outperform previous single tools as they have been able to complement one another while optimizing essential model features to provide excellent forecasting result (Cheng, Hoang, Roy, & Wu, 2012; Elmousalami, 2020; Kim & Shim, 2014).

Given the increasing volume of data generated at a high velocity from various sources, big data has emerged to support the construction industry with the capacity to make evidenced based decisions (Ngo, Hwang, & Zhang, 2020). Coupled with new computing models, the industry has gained capabilities to deal with extremely large data sets for predictive analytics. However, valuable cost forecasting exercise relies predominantly on a clearly defined project scope, right skills and the right information (Perera, Pearson, & Dodds, 2009; RICS, 2020). Success in the use of forecasting tools and techniques entails a recognition of the peculiarities associated with complex projects at the conceptual stage

(Austin, Newton, Steele, & Waskett, 2002) Yet, this aspect has rarely been given consideration. Poor forecasting accuracy have manifested either in underestimated or overestimated cost (Jumas, 2019). This is most evident in Mahamid and Amund (2010) who having reviewed a total of 169 projects revealed that the entirety of the projects suffered cost divergence; while 76.33% were underestimated, 23.67% were overestimated.

2.1. Identifying organisational factors

Literature contains various approaches of organisational theory which basically entail analysing social units of people that are structured and managed to pursue and or accomplish a collective goal. Research in cost estimation accuracy have recognised a number of factors affecting cost estimation accuracy (Adafin, Rotimi, Wilkinson, & Mbachu, 2019; Ahmad, Latif, Huda, & Hadi, 2018; Babalola & Adesanya, 2008; Bayram & Al-Jibouri, 2016b; Dandan, Sweis, Sukkari, & Sweis, 2020; Ji *et al.*, 2014; Karaca, Gransberg, & Jeong, 2020; Lim *et al.*, 2016; Liu & Zhu, 2007; Skitmore, 1986). For instance, in an earlier study, Akintoye (2000) identified project complexity, scale and scope of construction, market conditions, construction method, site constraints, client's financial position, buildability and location of the project as major factors out of a list of 24 factors. Dandan *et al.*, (2020) categorised a comprehensive list of factors affecting the accuracy of cost estimate into client characteristics, consultant characteristics, project characteristics and external market condition. This is corroborated by an earlier study by Ji *et al.*, (2014).

Apart from researches that evaluated generic factors affecting cost estimation accuracy, study on the organisational factors influencing accurate cost estimation had earlier been carried out by Ahmad *et al.*, (2018). The study which set out to conceptualize the factors affecting cost estimation accuracy concluded that, out of 25 factors, human-related factors have most significant influence on cost accuracy over the organisational support system. Many other studies have set out to evaluate the impact of organisational factors in other areas like safety work behaviours (Jitwasinkul & Hadikusumo, 2011), accidents in construction (Filho *et al.*, 2012), risk management (Adeleke, Bahaudin, & Kamaruddeen, 2018; Adeleke *et al.*, 2018). Having carefully investigated studies highlighting factors affecting cost in an age of big data - increased data volume generated at a high velocity from various sources – it became important to focus on how taking cognizance of organisational factors can improve accuracy of conceptual cost estimate. A comprehensive list of organisational factors affecting cost estimate accuracy at the conceptual stage is compiled from the following studies: (Adeleke, Bahaudin, & Kamaruddeen, 2018; Ahmad et al., 2018; Ji *et al*., 2014; Jitwasinkul & Hadikusumo, 2011). The rigorous review process adopted in this study generated a comprehensive list of 11 factors derived from the literature as potentially influencing cost estimating. They include; cost information database & sharing capability, organisational estimating culture, knowledge & experience, leadership, training & learning opportunities, communication, management commitment, IT support (infrastructure and analytic capabilities), quality benchmarking/standards, review of past mistakes for better performance and employees' attitude.

3. MATERIALS AND METHODS

3.1. Research paradigm and case justification

The explanation of paradigms from an epistemological stand point can be traced to the meaning of epistemology which refers to the questions about what does it mean to know

and how can we know? In this sense, the naïve realism paradigm and the case study approach are utilised to achieve the stated objective (Hancock & Algozzine, 2006; Kivunja & Kuyini, 2017). Furthermore, interpretivist paradigm has been argued to fit well when exploring incidents resulting from the interplay of underlying subjects and structures within complex systems that require the explanation of "how" and why cases (Jitwasinkul & Hadikusumo, 2011). Concern central to this study is the consideration of how the quality of this research can be ascertained while answering the question "what criteria should it satisfy?". Thus adopts the proposal of Miles and Huberman (1994) criteria of objectivity, reliability and validity credibility. By means of this paradigm, responses obtained from a reasonable sample, mirror the diversity of individuals, and represent a broad range of perspectives which helped to gain greater insight into the current research phenomenon by viewing it from every angle.

3.2. Data collection

The research approach follows a qualitative approach framed within the interpretivist paradigm. More so, to allow for credible, rich data collection, provide medium for direct discussion and flexibility to the subject of discussion, a semi structure interview is adopted. This study typifies a process through which a systematic series of steps is drawn to provide a careful analysis of factors affecting the accuracy of early cost estimation (which is the "case"). Two categories of respondents were interviewed; First, professionals in the construction industry (exception of quantity surveyors) including two architects, one structural engineer, one mechanical engineer, one electrical engineer, two project managers with experience in pre-contract stages of projects were selected. Secondly, 5 seasoned quantity surveyors within four consultancy firms in the Federal Capital Territory Abuja were selected to participate in the in-depth interview in order to reflect the real factors influencing cost estimates of construction cost.

3.3. Analysis of data

Typically, data analysis for case study research has witnessed successive level of developments, from developing a case description to relying on theoretical propositions and more recently, the use of thematic analysis. Text generated from the transcribed interviews was organised according to emerging patterns (themes) which were synthesized into 11 major themes from the organisational factor perspectives with a focus on its effects on accuracy. The themes bother on individual, team level and organisational level culture as it affects accuracy of cost estimates. Details of these are provided in the following sections.

The suggestions constitute the framework for the examination of its design. The use of pattern matching analysis allows the expression of empirical pattern to compare predicted result outlined in the proposal. The incidence of the two consolidates the internal validity of the outlined proposals meaning that the inclusion of cases optimizes the strength (Patton, 2002; Yin, 2009).

4. PRESENTATTION AND DISCUSSION OF RESULTS

Hancock & Algozzine (2006) noted that report of outcomes in case study research is generally narrative in nature, consisting of a series of illustrative descriptions of key aspects of the case. Adequate identification of critical organisational factors is crucial to improving the accuracy of cost estimate which in turn is vital for the operationalisation of works

throughout the project lifecycle. It also important in that it provides cost managers with fewer high impact factors to pay attention to and note the sensitivity in which they influence inaccuracy. Following the interviews and reviews of literature and privileged organisational information, case description, cross-case and within case analysis are supplied in Tables 1 and 2. The key components are discussed in the tables.

4.1. Organisational estimation culture

Professionals believe almost unanimously that a viable estimation system influence the production of a quality cost estimate. Many have also averred that estimation principles and belief at the different organisational level amounts to an organisation identity (Trinh & Feng, 2020). Quite a number of different theoretical frameworks of organisational culture have been put forward. Of these, Denison's organisational culture model (DOCM) is well recognized for analysing organisational culture and has been widely applied in construction (Cheung, Wong, & Wu, 2011; Denison & Mishra, 1995). Hence, DOCM is chosen in this study to investigate the factors affecting the accuracy of cost estimates. Denison's model comprises 4 main characteristics (Denison & Mishra, 1995). First, "adaptability" considers an organisation's ability to perceive and respond to the environment and involve creating change, and organisational learning. Secondly, "mission" takes into cognizance the extent to which organisations have a mission that informs employees why and how the services rendered contributes to an overall goal. This embodies strategic direction and vision. Thirdly, "consistency" provides a central source of integration, coordination, and control and helps organisations develop a set of systems that create an internal system of governance based on consensual support. Fourthly, "involvement" which has to do with creating a sense of ownership and responsibility in order to develop commitment to the organisation.

4.2. Management commitment

Cost estimate's process is well acquainted with the influence of management's action particularly on estimation accuracy. Employees have expressed that lack of thorough review or hasty encounters have turned out unsatisfactory estimate results. There no doubt that estimators' biases also affect accuracy (Ashworth & Perera, 2015). However, experience from related projects serve a great deal to minimise shortcoming from this aspect. Most of the professionals disclosed that through active and noticeable programs, management commitment has an intrinsic and direct bearing – a combination of formal and informal actions demonstrates to employee how concerned the management is about the tangible and intangible interest of the workers including the additional skills they require to effectively carry out their work. An interviewee response shows that obvious commitment efforts from the management is hinged on strong core value and understanding long held by management. The effect of management's commitment in an organisation is widely acknowledge in the construction sector (Ahmad *et al.*, 2018; Ji *et al.*, 2014; Jitwasinkul & Hadikusumo, 2011).

Table 1: Perception of influences and description of organisational factors deployed in each case

Cases	Narrative I	Narrative II	Narrative III	Narrative IV	Narrative V	Narrative VI	Narrative VII
Organisational estimating culture	Clan	market	pyramid	Clan	Clan	pyramid	clan
Knowledge & experience	Full attention	Indifferent	Full attention	Partial attention	Full attention	Full Attention	Utmost attention
Leadership	Transformational	Transactional	Transactional	Transactional	Transactional	Transformational	Result oriented
Training/learning opportunities	Fully practical	Partially practical	Wholly practical	Almost wholly	Almost wholly	Not practical	Fully practical
Cost information database & sharing capability	Updated	Up to date	Obsolete	Updated	updated	Updated	Up to date
Communication	Open	Incoherent	Formal	Clear	Persuasive	Formal	Clear
Management commitment	Responsive	Partially responsive	Responsive	Responsive	Responsive	Responsive	Fully responsive
IT support (infrastructure and analytic capabilities)	digitized	conventional	Traditional	digitized	digitized	conventional	digitized
Quality benchmarking/standards	Recognised	Recognised	Almost recognised	Almost recognised	Recognised	Partially recognised	Recognised
Review of past mistakes for better performance	Fully focused	indifference	Almost fully	focused	Almost fully	Almost fully	Fully focused
Employees attitude	Fully evaluated	Considered	Evaluated	Evaluated	Evaluated	Partially considered	Fully evaluated

Source: Field Survey (2021)

Table 2: Case profile & implications of selected organisational factors from professional directly involved in providing early cost estimates

Respondents	1	2	3	4	5
Job title	Project Quantity Surveyor	Senior Quantity Surveyor	Cost Manager	Project Quantity surveyors	Chief Quantity Surveyor
Age, Gender & Experience	39-Male: 14 years' work experience	49-Male: 24 years' work experience	32-Male: 9 years' work experience	37-Female: 12 years' work experience	54-Male: 27 years' work experience
Nature of project	28 Storey commercial building	200 bed capacity private hospital	Worship centre	Institutional building (lecture theatre)	Road project

Organisational estimating culture	Firm's established estimation culture has played major role in individual estimating practice and experience to ensure timely deliverables	Working under pressure has affected the outcome of accuracy more than anything else	Office strategic partnering and innovative approach has enhanced shared believes and value towards engendering positive values and thus generating credible estimates	Institutional minimum requirement for institutional building has in-turn impacted organisation way of providing necessary tools to support estimation reliability.	Effort is geared toward viewing the construction projects as tripartite system (Employer, consultants & contractors) to see that relationships are maintained to secure value for money while protecting the interest of all concerned.
Management commitment	Management's influence is felt in achieving a good estimating practice. A sufficient budgetary allocation to encourage sound estimating practice is made including sponsor to workshops	Management creates the needed environment atmosphere to enrich organisation's database specifically to achieve an efficient & effective estimates e.g. bonuses for extra work hours	Periodic performance evaluation is carried out so that employees can put the best use of their strength to work, highlight areas of weakness for improvement, identify opportunities and mitigate threat to good estimation.	There is a well-defined vision on the part of management to ensure proactive action for future changes; will encourage group members to take calculated risk during the estimation process.	A major influence is the ability to work with confidence knowing that the organisation supports estimators practice provided it is within the confines of the organisation. While focus is client-driven, workers are recognised as important vehicle.
Communication	Effective communication, horizontally among work colleagues/ group members and vertically to and fro the leadership is considered strongly will promote the information flow and improve the decision quality	The importance of quality estimates is communicated quite often. Specific actions that could jeopardize estimates outcome is discussed and evaluated giving workers the room to share concerns and explain ideas. In return management gives feedback to address concerns and indicate best practices	Other means of non-verbal communication is used to achieve needed reminders to check and double check estimates figure, encourage concentration, stick to schedules, relieve work tensions and motivate	Effort is constantly aimed at improving spoken and written communicative skills of both estimation team and leader. Where communication is electronic based, clarity is advised to be sought where necessary while maintaining prompt feedback mechanism	Unproductive conversations are discouraged as constantly talking is not necessary communication. Workers are on the need to adopt the right channel of communication and determine whether formal or informal.

IT support (infrastructure and analytic capabilities)	With information technology, awareness of estimation software has been on the rise; however, their application is gradual. Most data analysis are statistical-based	Sophistication in large scale project has necessitated the use of modern technique to analyse large volumes of data being generated to ensure good cost estimation.	Management's identification of new information technology components has not translated into the deployment of the needed tools and techniques. However, certain aspects of estimation have been greatly enhanced.	Many express fear that the negative impacts of technology in employees' personal lives damaging. For instance allowing electronic devise which many have attributed to work-life conflict	Working with modern analytics techniques provides a new world of opportunity in turning massive data into value. Insight have been gained from new techniques have enabled the processing of information to deliver accurate estimates. Confidence have been restored on our capability as estimators
Review of past mistakes for better performance	The role of the individual's participation in poor/inaccurate estimate is carefully considered to forestall future occurrences, consequently, a strong performance evaluation mechanism is in place to guide estimator's in producing quality estimates.	Workers are mandated to carry out after action review (AAR) on major estimation activity to give confidence in the entire process. Here emphasis is also given to how teamwork can reduce inaccuracies in cost estimates	Many within the organisation have attest to the fact that periodic review of past performance has greatly improved best practices and outwit the snare of unsuccessful action. Though a difficult process, this aspect has been known to serve a good recipe for improving cost estimates thus finding way	Senior management considers the review of past performance an important aspect toward improving cost estimate as failure in doing so is tantamount to making similar mistakes in the future. Result has drastically improve cost estimate's accuracy.	A structure way of reviewing past mistakes is recognised. However, the process is always viewed as time consuming hence hardly performed in reality.
Capacity development	The extent to which employee's development is stressed has influenced quest to deliver sound and precise estimate for future project. On the part of management, policy is designed to ensure timely sponsorship for development programs aimed at enhancing estimating skills	There is a great deal of emphasis to develop capacity needed to enhance quality estimating procedure. Except that the position is not backed up by funding.	Worker's competency and skills in producing good estimates is closely linked with incremental capacity developed over the years hence considered important to the organisation, including the additional skills the employee added to the project during exe	Staff has participated in numerous highly successful workshop aimed at fostering sound estimating practice. The provision of training materials has also proved to promote up-to-date the needed skill for best practices estimation	Collaboration and interactions with both local and international experts in construction estimation has broaden knowledge in civil and specialised construction work

Cost information database & sharing capability	A range of cost information covering concept to technical design phase is useful in coming up with a reliable estimate, yet not much is gotten to do a careful estimating task. The pressure to come up with estimate within a limited time has also been a limiting factors in curbing inaccurate estimates	With the shift in modern database and real time data analysis techniques, processing large quantity of data has shown promising advantage in predicting cost of construction works	The existence of complex relationships and large volume of data/information in mega-project has been considers a major obstacle in arriving at an accurate estimate. Quantity surveyors view that it will be a herculean task performing magic if modern data analytics tools are not deployed	Current and updated cost information and historical data to accurately estimate cost is hardly available. Nevertheless, staff painstaking make effort relate with colleagues in other organisation to generate cost estimates.	Procuring software that can manage large chunk of information is challenging due to expensive. Conventional databases are relied upon to process information and perform the cost manages duties. Modern technique is however indispensable for the demanding task

Source: Field Survey (2021)

4.3. Communication

Communication is an indispensable tool at every facet of an organisation. Effective communication, viewed as a two-way process creates mutual trust and understanding needed to facilitate the output of estimates. For example, Adeleke, Bahaudin, & Kamaruddeen (2018) concluded that communication injects a positive relationship within the organisation and lack of it will only fuel conflict that may negatively affect the robustness of estimates produced (Ahmad *et al*., 2018; Carrillo, Harding, & Choudhary, 2011). In the words of a project manager "the need to keep and open and honest communication cannot be over-emphasised; it affects every bit of process the eventually led to the estimate generated by the quantity surveyor. Ignoring the place of effective communication is like throwing away the opportunity to gain and integrate people's idea and knowledge sharing. Hence, good communication fosters good outlook towards the entire process of estimating accuracy for construction projects". A company emphasizing collaboration can build an open atmosphere for communication and promote resource sharing between group members from different backgrounds (Yan *et al.*, 2018). Responses from the interviews clearly show that most senior managers allude to the fact that success will be far-fetched where communication is not effective.

4.4. IT support (infrastructure and analytic capabilities)

The adoption of information technology (IT) in construction generally is rapidly extending beyond the era of piecemeal application for improving the daily-basis operational efficiency of discrete operations in individual organisations. This progression coupled with the growing number of the Internet-of-Things (IoT), the increase of affordable data storage and processing technologies lead to the rise of Big data (Ngo, Hwang, & Zhang, 2020). Big data analytics refers to the application of a series of analytical techniques on large data sets to identify patterns and derive insights needed for informed decision. "This usage will immensely benefit cost estimation exercise because at its core, big data is about making prediction" so said one of the IT savvy professionals. While big data engineering provides supporting functions like data storage and processing for analytics, big data analytics is mainly related to pattern identification and value creation (Bilal et al., 2016). Common types of analytics include descriptive analytics, diagnostic analytics, predictive analytics and prescriptive analytics in the order of ascending value and complexity (Ngo et al., 2020). To qualify for accurate cost estimates, the place of IT facilities is indispensable.

4.5. Capacity development

In one of the respondent's opening remark, "capacity development means a lot to every professional". The production of cost estimate requires knowledge in the form of training and practical experience; therefore, its accuracy can be improved upon. All the respondents agree that quantity surveyors training particularly in estimation related field are still relevant to the construction. So, on the part of the management, investing in employees' development will no doubt guarantee a high quality estimate. The success or failure of most consultancy firms is significantly connected with the ability (or lack of it) to carry out sound estimation (Adepoju & Aigbaboa, 2020). Yan *et al*., (2018) noted that when organisations places priority on empowerment and human capital development, it creates the view that their company pays attention to their future development and enhances

their image as important resources for competitive advantage, consequently improving their sense of belonging to the company and responsibility in their work. Hence, a construction company that values these traits will encourage and even sponsor professionals to find new ways to solve problems, increase their confidence to accomplish work tasks, and indirectly improve estimate's quality.

4.6. Cost information database and sharing capability

Notably, the importance of keeping an updated cost information database is a critical component that cuts across all quantity surveying practice (Ashworth & Perera, 2015). The technological aspect previously considered is believed to be a way forward for modern quantity surveying practice. Hence the use of building information modelling (BIM) has been encouraged to become an integral part of estimating activity as it enriches cost information in its libraries. Though BIM is defined as a digital representation of physical and functional characteristics of a facility. It serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions (Lu *et al.*, 2018); this repository include cost information related to the facility. Only about 37% of professionals interviewed claimed to have include the use of BIM as part of cost estimating process, the other 67% admits otherwise despite been aware of the its advantages. Poor scope definition together with lack of information usually define most projects at their onset. However, to establish a reliable cost estimate, as design information evolves, the methods of cost planning generally also change to conform building elements from design drawings and assigning cost information to each element to forecast the overall construction cost.

5. CONCLUSION

This study identifies inter alia six critical organisational factors that influence the accuracy of construction cost estimate namely; organisational estimating culture, management commitment, communication, IT support (infrastructure and analytic capabilities), capacity development and cost information database and sharing capability. These findings corroborate the effects of organisational factors from earlier studies as well as provide novel insight within the context of increasing volume of data generation. Accordingly, the influences of organisational factors on accurate cost estimate in an era of big data have never been investigated. Empirical findings from this case study indicate that participating factors can be expected to exert influence at different levels. It therefore becomes imperative to consider the effects of organisational factors at three levels i.e. individual, group and organisational levels within the "input-process--output" framework. This position is further buttressed by (Jitwasinkul & Hadikusumo, 2011) who noted that majority of such inquiry often disintegrate the multi-level instrument into three levels. From the foregoing, it can be established that three of the critical contributory factors at a leading level are behaviour oriented; i.e. organisation's estimating culture, management commitment, communication. Since these factors are identified at the top level, they can be explained as motivational drivers whose effect interplay between group and individuals. At the workgroup level, vises such as organisational custom, team autonomy translate to influencing individual values and beliefs concerning the importance of quality estimate (Robbins *et al.*, 2016). Thus, a theoretical causal relationship can be created by the proposed constituent factors and determined by the use of path analysis. Findings revealed that capacity development combined with work experience is one important factor with

far-reaching influence on accuracy of cost estimation. The two other critical variables identified relates to the tools and techniques required to produce accurate cost estimate. These include IT infrastructure and analytic capabilities and cost information database and sharing capability. Given the present era of big data, key technologies like BIM, Hadoop distributed file system (HDFS), MapReduce, NoSQL have been tipped to support data storage & processing technologies to improve cost estimates. Consequently, focusing on these critical factors will be valuable in producing reliable estimate in subsequent projects. The limitations of this study must also be acknowledged. While there are other factors that could be investigated, this study is confined to organisation factors only. It is believed that a holistic investigation of these factors will offer a robust insight at improving cost estimate accuracy.

6. LIMITATIONS OF THE STUDY

The limitations of this study must also be acknowledged. While there are other factors that could be investigated, this study is confined to organisation factors only. It is believed that a holistic investigation of these factors will offer a robust insight at improving cost estimate accuracy.

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