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Information Technology as Catalyst for Value Re-Engineering Implementation in the Nigerian Construction Industry

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Abstract: Technological development has placed pressure on construction industry. Reviewing its activities due to an increase in a globally competitive market has manifested from the construction environment's changing need to meet customer satisfaction. These pose challenges to many construction industries in developing countries to improve the quality of the product produced to meet the customer's needs. The study aims to examine the impact of information technology (IT) application on value re-engineering (VRE) implementation that gives rise to customer value addition, through enhanced profitability performance and cost reduction for the construction industry to offer benefits for customers to achieve satisfaction. Using purposive sampling techniques, the subjectivist methodology was utilised to establish critical success factors in 40 purposefully sampled building construction operators within Abuja, Nigeria. The result further revealed that quality design and collaborative working among the VRE practitioners help the customer to derive the benefit of waste reduction by achieving a value-added perspective using high technology that influences both design and construction operations for the project. Early dissemination of information and design adequacy reduces pressure on both materials and labour scarcity. Finally, there is a significant need for the construction process to be re-engineered through the utility of change enablers and the introduction of assistive technologies like IT as drivers of VRE implementation on value addition that give rise to customer-derived benefits.

Keywords: Value re-engineering, Construction industry, Information technology, Value addition, Purposive sampling

INTRODUCTION

Globalisation of information technology (IT) that transforms customers' needs, choices, awareness and preferences are all affected by perceived value (Noor and Yi, 2018). Abdul-Samad and Kulandaisamy (2022) reveal that most of the value techniques around the globe are challenging, especially in terms of IT application and implementation. Therefore, the concept of re-engineering emphasises the radical rethinking and redesigning of the process by which value is created for customers (Madane and Joshi, 2018). The construction industry required value re-engineering (VRE) processes to improve the efficiency of their operations in meeting the customer's needs (Jibrin and Shakantu, 2021). The construction industry decides to improve its efficiency in gaining investments opportunity through the implementation of IT (Noor and Yi, 2018). However, Alumbugu, Shakantu and Tsado (2020) stress that efficient construction of IT is of crucial importance for customer

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satisfaction in achieving VRE. Anand, Wamba and Gnanzou (2013) equally advocated that to achieve higher efficiency in the construction industry, the value of IT will be required.

Although the problem with the Nigerian construction industry is that customers get value for their products which fails, sometimes total collapse of the product. Adoption of VRE therefore, can be seen as a breakthrough that would overcome the challenges of dissatisfaction of the customers. Shakantu, Jibrin and Saidu (2022) posit that the adoption of VRE could result in a breakthrough solution in resolving the challenges of customer dissatisfaction in the industry, with the improvements in new techniques that will give customer satisfaction. Hence, the study aims in looking at the influence of IT by the Nigerian construction industry and how it acts as a catalyst in VRE implementation in meeting the needs of dissatisfied customers. It plays a crucial role in VRE adoption in construction industry by identifying the mechanisms which add value to the customer (Harini, Erizal and Widyarti, 2018). Emuze, Smallwood and Han (2014) opine that construction activities can impact project performance negatively in the form of cost and time overruns as a result of non-value adding activities (NVAAs) that are prevalent. Egwunatum and Oboreh (2022) equally believed that good performance of IT applications, especially in the area of time, cost, quality and safety is hinged on the rigidity and inflexibility of the adoption of modern management techniques like VRE, hence the need to understand the relationship between IT and VRE in redesigning processes.

The construction industry, state of art IT is part of the re-engineering effort, as an essential enabler that permits the construction industry to re-engineer their customer value needed. Ding et al. (2017) however, express that digital integration of IT application awareness for the CI, on project delivery would resolve the challenging issues that would enhance customer value in the sector. However, after the global recession of the early 1980s, many construction industries across the world made attempts to rejuvenate their performances (Mlay, Zlotnikova and Watundu, 2013). Hence, the extent to which these reforms provided the changes needed, remained difficult to determine. Berawi and Susantono (2013) emphasises that performing analysis functions to achieve the best value for a customer, is to define the functions required to achieve the target value that must be desired by the operators in the industry. Kembuan (2016) expresses that it is necessary to have a value so that the value of the cost of the project can be reduced without reducing the functionality and quality of the product.

Dramatic improvements and radical redesigns in the performance process in IT have led to a competitive market facing construction industry today. Therefore, the influence of IT on the construction industry has drastically changed over the past decade from supporting roles to building and shaping new strategies to uphold the value desired to achieve. Construction industries seek to be more agile in the developments of IT such that it can be implemented to produce better services to its customers. It is found that almost 46% of all capital investment in the United States (US) economy is being made in the improvement of organisational efficiency through IT (Anand, Wamba and Gnanzou, 2013).

The vast majority of construction industries seeking to get better construction value utilisation using IT, as IT continues to penetrate and impact the operational and management process of the construction industries. Once this is achieved, it

automatically changes the business value of IT and also increases its efficiencies simultaneously in the industry. Chandra (2014) believes that aspect of an improvement is through redesigning the processes which often results in the betterment of organisational structures, resulting in enhanced services and efficiency provided to the industries. Therefore, industries should continuously redefine construction value using IT. Application of IT is clearly showing that IT is acting as a tool or catalyst for VRE implementation in the construction industry. Shakantu (2012) stated that the change catalyst could be from a cost-related issue where 30% of construction costs go to finance inefficiency and waste and another catalyst of change is in the area of health and safety.

VRE implementation in construction activities became much easier with the integration of IT into the system (Puruhita, 2018). However, the main drivers of change that shift construction industry from tradition into project integration are the advent of the design-build concept, the development of the Building Information Modelling (BIM) concept and the need to incorporate more value and less waste into construction projects known as a lean concept (Zahrizan et al., 2013; Soares, 2013). It holds a key integral factor in developing data integration strategies in various construction operation systems and technology frameworks (Rahali et al., 2008).

According to Dumas et al. (2017), customer satisfaction is the necessity of the VRE conditioned by the advanced dynamism of the contemporary world. After VRE implementation, the enterprise becomes the object of permanent transformations (Suzanne, 2018). Asif, Islam and Uddin (2010) argue that to achieve VRE success, a fresh perspective and approach are required for the construction industry to develop and optimise the process of creating satisfied customers' needs. Ding et al. (2017) reiterate that VRE in construction-related activities and processes is by which the construction industry that exists today is retired and the optimal version of the new one is constructed to satisfy customers' needs. "VRE can be defined as the fundamental rethinking and radical redesign of construction processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, health and safety, service and speed in construction operations" (Jibrin, 2021).

REVIEW LITERATURE

Impact of Information Systems on Construction Industry

The introduction of software systems to construction industry activities will change people's perceptions as well as their behaviour and when such systems are implemented in a networked structure, it will have a far-reaching impact on the fundamental behaviour of construction industries as shown in Figure 1.

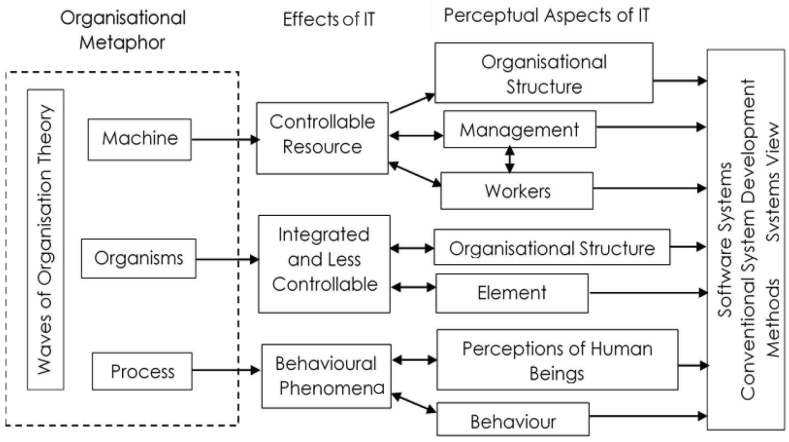

Figure 1. Impact of IT on construction industries

The perceptions of the construction industries and the relationships between IT and industries may be different, depending on which model is used. Budiono and Loice (2012) state that the three metaphors for construction industries to achieve VRE implementation in construction firms are: machines, organisms and processes, which represent three waves of industry theory. The first wave, to perceive an industry as a machine, suggests that IT can be seen as a controllable resource (the tool for management use) that is not part of the industry and is used to achieve certain objectives. The introduction of IT does not affect the organisational structure but only the relationship between management and workers. The second wave, when an industry is seen as an organism, regards IT as more integrated and less controllable, that is, IT is an element of the industry and a determinant of organisational structure which cannot be predictable like a resource. The ownership of it is with the workers rather than the management. The third wave perceives an industry as a process and IT as a behavioural phenomenon. It is managed by the users and determines the perceptions of human beings and thus affects their behaviour.

Conventional systems developed a method, as a reductionist approach, considering an industry as a machine, whose behaviour is merely determined by the behaviour of individuals within the industry. This tends to ignore the perceptual aspects of IT and concentrate only on its physical parts (i.e., the system itself) because it is hard to cope with abstract things such as the perception and interaction of human beings. Such methods are not suitable for the analysis of VRE because they only reflect the situations before and after the implementation of the systems, but do not emphasise the change in people's behaviour affected by it.

Thus, from a system view, an industry has more meaning as a whole than just as a sum of parts. One cannot find the characteristics of an industry merely by identifying its components. Today the essential resource of industries is the skill and knowledge of people. Individual knowledge and technology are not only on their own but also part of the industry. Thus, the behaviour of industries can

be regarded as a pattern of interactions between people. After the introduction of software systems into industries, the behaviour can further be understood as a pattern of interactions between people, between people and software systems and between software applications.

Therefore, changes in the industry will have an impact on people's perception of the industry if analysing VRE and one finds that people interact with each other within the process and are also influenced by that process. Today IT plays an important role in the construction industry because people use their systems to interact with others and the environment. Hence, any changes in IT may cause changes in organisational structure. Shakantu (2012) opines that key drivers of change might produce a high-technology industry with systems, technology, people, products and levels of performance that today's construction management cannot handle. He further reiterated that the winds of change are blowing over the industry, thus construction management faces challenges that are likely to be urgent, exciting and risky but very rewarding.

IT Application as Drivers of VRE in the Construction Industry

During the VRE implementation process, IT plays a major role and today without IT, VRE cannot work properly, since IT is one of the most important drivers of VRE. Madane and Joshi (2018) argue that drivers of change require innovation in the composition and functionality of IT products used in VRE adoption in the construction industry. However, this does not mean that using IT alone can be as useful as VRE. Nelson et al. (2014) express that IT is the principal driver that distinguishes factors between process re-engineering and automation of tasks and functions. It is the base of the methodology for redesigning and even evaluating the processes (Demirkesen and Ozorhon, 2017). IT systems used at the construction industry level are mainly related to construction programming, data processing on construction finances, procurement processes, design integration, communication strategies and investment decisions (Abanda et al., 2013; Mark and Mordechai, 2011).

Kassim (2012) and Jamil and Fathi (2016) express that IT systems deployed at the construction industry level include geographical information systems, expert systems, inter-organisational information sharing and communication systems. Other areas of IT systems application at the project site level shown in Table 1 include those that encompass project or site planning, scheduling, cost-benefit, project management, construction methods and human resource management (Ozorhon et al., 2010). Adriaanse, Voordijk and Dewulf (2010) argue that areas of IT in construction include web-based tendering processes and web-based construction monitoring. Huang et al. (2007) and Chen, Yang and Tai (2016) however emphasise IT application in e-procurement processes while Crotty (2012) reiterates IT application in BIM. Park and Ryoo (2013) express that the deployment of IT at industry levels recorded several empirical impacts on the industry performances.

Table 1. IT application areas in construction projects (sites)

Primary Activities	Application
Construction planning	The planning system, decision support system, bidding strategy and integrating simulation with expert systems.
Engineering design	Planning and scheduling of works, cost estimation, quality control and safety in the workplace, computer-aided design (CAD) systems and BIM.
Procurement	Construction material information, material specifications, delivery and expediting, e-sourcing and electronic data interchange (EDI), web-based and e-procurement.
Construction and commissioning	Reinforcement bar-coding, radio frequency identification (RFID) and CAD systems.
Maintenance and operation	EDI, maintenance history RFID tags.
Project (site) management	Project or site monitoring, cost estimation and data communication.

IT Drivers

According to Hammer (1990), IT is considered the key driver of VRE in construction operations which was viewed as "radical change". Value needs increase the demands for amplified capabilities of IT applications to enable VRE implementation in construction a success. Datti et al. (2022) therefore, challenge researchers in the built environment to come up with a robust VRE awareness framework to be implemented by the construction industry that would enhance the efficiency exponentially. Davenport and Short (1990) attribute a lack of appreciation of the deeper issues of IT, major stress influencing the awareness of the capabilities of IT on VRE implementation in the construction industry in achieving value redesign process through its impacts as shown in Table 2. Chen (2001) argues that IT may sometimes have a negative impact by merely automating the existing processes, but it could also have a positive impact if deployed correctly in appropriate industry arrangements. Budiono and Loice (2012) further stress that IT is the enabler to re-engineer or improve the valuation process in the construction sector and this form an important driving force for value redesign transformation. The cyclic improvement process as designed by Hammer in 1990 is demonstrated in Figure 2.

Table 2. IT capabilities awareness and the organisational impact

Capability	Organisational Impact
Transactional	The unstructured stock control and procurement could be transformed into the process of a routinised transaction.
	IT can be used in inventory management in making the list of items running out and the number of stocks to be ordered as the input for the purchase process.
Automation	IT can be used to make a sales note and automatically calculate the amount that should be paid by customers that could help in the process of supplier selection.

(*Continued on next page*)

Table 2. *Continued*

Capability	Organisational Impact
Analytical informational	The search process for a spare part price can be faster than the manual search.
	IT could provide information on stock availability, product substitution and storage location
Sequential knowledge	IT can enable changes in the sequence of tasks in the sales process.
Management tracking	IT allows the capture and dissemination of product knowledge from experienced labour to minimise error and improve overall service quality (SQ).
	IT allows the detailed tracking of task status, inputs and outputs in the sales and service process.

Source: Budiono and Loice (2012)

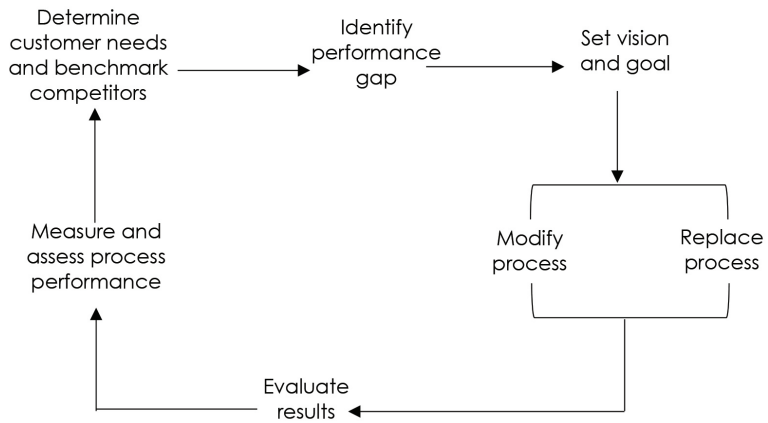

Figure 2. Process improvement cycle (Hammer, 1990) adopted by Budiono and Loice (2012)

Moreover, increasingly advanced IT is being utilised in more and more sophisticated ways to enable value to survive in the current competitive environment. Furtherance to this, IT plays an important facilitating role. It has evolved from its traditional orientation of administrative support role towards a more strategic role within an organisation and more specifically within the construction industry. Akinradewo, Bamidele and Ogunsemi (2022) posit that there should be a strong understanding between the implementers of VRE and IT managers in the construction industry to increase the level of compliance that would enhance adequate monitoring as well as cross-checking the unethical practices by the operators. IT enabler involves these five important operations.

Automation

Automation implies the strengthening of the structure of value processes or the entire replacement of manual labour with computerised machinery (Petrovic and Zsifkovits, 1994). The enabling factor of automation is effective in two areas of the redesign of value processes. Firstly, an IT-based process is more likely to be less time-consuming and less costly for the industry. The time and cost reduction can bring dramatic cost savings to a firm. Secondly, the structure of the value processes is modified so they can be standardised and, therefore, easily automated. As a result, errors can be minimised, routine duties can be avoided, training of new employees is easier and internal and/or external communication is facilitated.

Enhancing the information

Another enabling factor is the use of IT to increase information about individual value needs, enhance the information potential of employees and provide access to knowledge and experience (Zuboff, 1988). The automation of value processes leads to increased information about these processes.

Time and location

A further enabling factor of IT is the reduction of time and location limitations. Individual tasks can be performed at different times and places and therefore the number of potential partnerships is expanded beyond the physical location of the industry. Subsequently, the response to customer or partner demand is easier and faster mainly through electronic integration which is based on EDI.

Parallelisation

Parallelisation is a very important factor that enables tasks previously handled sequentially to be carried out simultaneously. The condor approach is a justification of this use of IT since it promotes information and document sharing by various actors collaborating concurrently on projects.

Integration

Finally, the increased information, the reduction of time and location limitation and the parallelisation led to the fifth enabling factor which is the integration with effects on both internal and external processes. Through access to information without time or location limitations and a better understanding of the entire business process, cooperation and communication within and between industries are enabled.

Benefits and Use of IT on Construction VRE to Customers

The rapid changes in the economy and increasing competition has placed importance and demand on increased efficiency, effectiveness and value for money over the past few decades (Oke, Aghimien and Olatunji, 2015). Ferrada and Serpell (2013) emphasise that the derived benefits of customer value in achieving optimal satisfaction are client value and focus end, quality design and whole life

and health and safety. These form the main influence while offering value in the construction industry. However, Nawi et al. (2014) view customer value as being derived from modern methods, attitudes and awareness, IT, lean and sustainability wastes.

Olanrewaju (2013) argues that though derived benefits according to customers during construction are numerous, the effects of integration and collaborative working, continuous and business performance may be insignificant to the customer due to minor influence. The first benefit of IT applications in the construction industry is related to cost savings. IT applications save the costs of paper and space if everything is stored electronically. The second source of benefits is the reduction in the number of people employed which is the major cost in the industry. The third major benefits are the potential to enhance an industry's effectiveness in terms of quantity or quality of work. The possibilities for using IT applications to aid, support, or facilitate are numerous. It can also be used to improve access to valuable information to support decision-making.

Customer Value-Added Perspectives in the Construction Industry

A customer-based perspective on the quality that is used by services, construction and public sector organisations involve the concept of value (Foster, 2017). Habib (2013) contends that construction marketers need to consider new variables such as customer value to enhance the predictive power of SQ, the relationship of customer value with price and perceptions of performance, most nations grow through high performance, achieving excellent work, minimising the cost of services and products and adding value to the customer through a good understanding of their requirements (Abdellatif, Farhan and Shehata, 2018). Hence, in doing so they need to be efficiently and continually redesigning in a world of new technology, changes and strong competitors. Redesigning to actualise strategic and operational success is important if the construction business is to continue (Chen, 2019).

Wu et al. (2014) posit that the perceived value perspective primarily focuses on the provision of relational benefits through value-inducing features in construction, while the transaction cost economics (TCE) perspective focuses on the requirement of transaction cost that occurs in the risky electronic environment like electronic order of construction materials by contractors. According to Stylidis et al. (2015), perceived quality is one of the most important factors underlying the success of construction manufacturing today. Furthermore, it is believed that if the functional quality perspective as given by Foster (2017) is strictly adhered to from the conception of the project, it should drive the industry to global competitiveness in re-engineering, thereby creating value addition.

RELATIONSHIP BETWEEN IT AND VRE

Hammer (1990) advocates the use of IT to challenge the assumption inherent in the work processes that have existed since long before the advent of modern computer and communication technology. He further contends that the heart of re-engineering is the notion of discontinuity and breaking away from the outdated rules and fundamental assumptions about technology, people and the firm's objectives that no longer hold. Akingbade (2014) argues that IT is a strategic

resource that facilitates major changes in industry operation, needs and customer satisfaction. Because of these, IT enables a firm to achieve competitive advantages.

According to Davenport and Short (1990), VRE requires taking a broader view of both IT and value activity and the relationships between them. It should be viewed as more than an automating or mechanising force to fundamentally reshape the way value is achieved. IT and VRE have a recursive relationship as illustrated in Figure 3. Davenport and Short (1990) further refer to this broadened, recursive view of IT and VRE as the new industrial engineering value process that represents a new approach to coordination across the firm. Given the growing dominance of services, their recursive relationship requires further analysis and redesign. IT promises and their ultimate impact is to be the most powerful tool for reducing the cost of coordination.

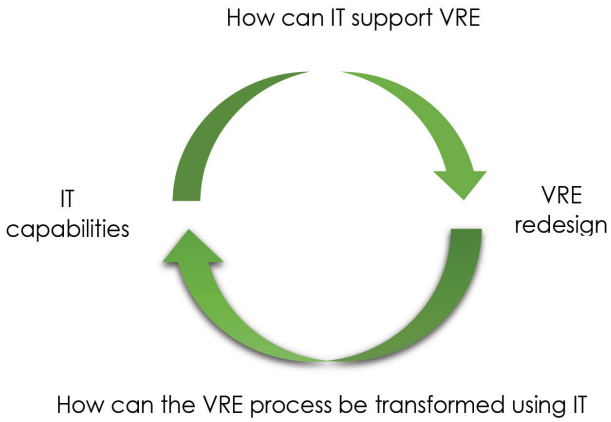

Figure 3. The recursive relationship between IT capabilities and VRE redesign
Source: Adapted from Davenport and Short (1990)

IT has evolved from its traditional orientation of administrative support role towards a more strategic role within an organisation and more specifically within the construction industry. Combining, VRE and IT has the potential to create more flexible, team-oriented, coordinative and communication-based work capabilities (Ringim, Razalli and Hasnan, 2011). In leading-edge practices, IT makes VRE possible and worthwhile. VRE and IT are natural partners, yet their relationships have not been fully explored (Mao and Zhang, 2008; Ringim, Razalli and Hasnan, 2012).

IT has the potential to enhance industry efficiency and effectiveness by eliminating delays, administrative intermediaries and errors by providing better access to information (Teng, Grover and Fiedler, 1994). Davenport and Short (1990) argue that VRE and IT are related and each is the key to thinking about the other. VRE should be considered in terms of the capabilities that IT can provide and IT capabilities should support value process and value should be in terms of the capabilities IT can provide. On the other hand, IT should be considered in terms of how it supports new or redesigned processes rather than other value functions.

RESEARCH METHODOLOGY

The study adopted a mixed method of both qualitative and quantitative techniques to examine the impact of IT application as a catalyst for VRE implementation on the construction industry. The interviews were conducted with key professionals (10 architects, 10 project managers, 10 quantity surveyors and 10 engineers) totalling 40 participants using semi-structured interviews through the qualitative method. The typical research sample size of the phenomenological study ranges between five and 25 participants in unstructured interviews (Leedy and Ormrod, 2015). Hence, 40 participants' interview is adequate for the study. Based on the nature of this research, the study adopted the phenomenological paradigm as it is the most appropriate approach for the study.

Data for this research was collected from an interview in connection with a tick-box questionnaire. An interview guide and a tick-box questionnaire were developed on separate documents. As interviews were conducted with the respondents, the researcher ticks the factors highlighted in the questionnaire, to assess the rate of occurrence of these factors. Therefore, the results of the tick-box questionnaire are presented and analysed in this article. Interviews were mostly at the interviewees' offices and these lasted from 45 to 75 minutes or more.

Among the firms engaging in both building and civil works, 10 different construction firms that have a capital base of about USD4.6 million (NGN1.8 billion) and above were purposively selected. The selection of the construction firms is based on the listed firms in the Federation of Construction Industry (FOCI) and licensed by the Corporate Affairs Commission (CAC) to operate in the Nigerian built environment under the Companies and Allied Matters Act 1990, (National Bureau of Statistics, 2019). However, the rationale behind the selection of the purposive sampling technique was employed, to enable the researcher to select participants (operators) from different construction firms based on the perceived experience and survival in business that is likely to give the ideal information on the relevance of IT application as a driver of VRE implementation in the construction industry. The construction industry domicile in Abuja, north-central Nigeria, is selected because of the huge and a lot of construction activities taking place in the new national capital city and these firms are expected to be aware of VRE implementation and how IT aid the activities of the various construction industry in achieving the global competitive market with IT drive for VRE implementation process.

Primary and secondary sources of data collection methods are employed in the study. The type of primary data generated in this research was interview data collected by the researcher through unstructured and in-depth interviews with participants. However, the secondary data for this study were sourced through published and unpublished books, dissertations and thesis, texts, local and international academic journals, articles and conference papers.

The interview data were analysed using the deductive method. The recorded, transcribed and interpreted interview data were analysed using a deductive approach and the quantitative data was analysed using the descriptive method which includes percentiles. Data generated in this research were interpreted and presented through descriptive and narrative analysis, hence, analyses of data are done by qualitative data from the interview results obtained into quantitative data.

Limitations of the Research

The study is limited to IT as a catalyst for driving VRE implementation in construction and specifically targeted the practising professionals, in other to explore the level of application technique as a tool that aids the VRE implementation in the industry. Despite the assurance of anonymity and confidentiality, the researcher was refused entrance to some organisations within the study area. Other organisations did not respond to the researcher's requests for participation; it was explained that information in their organisations is confidential. This came to a head during the research process as the adoption of in-depth face-to-face interview approach made respondents nervous. In some cases, where access was allowed, tracking the targeted respondent for the interviews and other related information was a major challenge for the study. Moreover, some of the confirmed and booked appointments for interviews were cancelled upon the arrival of the researcher at the interview premise.

FINDINGS AND DISCUSSION

Impact of IT Application on Construction Industry Performance

The percentage was used to assess the level of impact of the IT application on the construction industry performance by respondents in the construction organisations in Abuja. The outcome of the results in Table 3 indicates that all the respondents interviewed was emphatically optimistic about how IT improves the CI's performance and competitive position. IT is considered the key driver of VRE in any construction organisation in meeting customer satisfaction. The result further elucidates that 85% of the respondents believed the advantage granted by IT is short-lived because such advantages are easily replicated by rivals. While 80% of the respondents however view theoretical and empirical evidence as an indication that construction industries implementing IT-enabled strategy can gain a competitive advantage over their direct competitors. This is the reason, why the vast majority of the people interviewed considered IT as short-lived, that it is easily replicated by rivals in the industry.

Table 3. Impact of IT application in the construction industry

S/N	Impact of IT Application in Construction Industry performance	Architects										Project Managers										Quantity Surveyors										Engineers										Total	%
		R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10		
1	Improve the construction industry market share and profitability through innovative use of IT	×	×	×	×			×			×					×	×	×		×			×	×			×				×						×		×	×	×	18	45
2	Possible role in creating sustained competitive advantages for the construction industry						×	×			×			×		×	×				×	×	×				×				×						×					12	30
3	Achieving a competitive advantage through the application of IT		×				×	×			×		×					×					×				×			×		×		×			×					12	30
4	IT can improve the construction industry performance and competitive position	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	40	100

(*Continued on next page*)

Table 3. *Continued*

S/N	Impact of IT Application in Construction Industry performance	Architects										Project Managers										Quantity Surveyors										Engineers										Total	%
		R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10		
5	Advantage granted by IT is short lived because such advantages are easily replicated by rivals	×	×	×	×	×	×	×	×	×	×	×	×	×		×	×	×		×	×	×	×	×	×	×	×		×		×		×	×	×	×	×	×		×	×	34	85
6	Theoretical and empirical evidences indicate that construction industries implementing IT enabled strategy are able to gain competitive advantage over their direct competitors	×	×	×	×	×	×	×	×	×	×	×		×	×	×	×	×		×	×		×	×	×		×		×		×		×	×	×	×	×	×		×	×	32	80
7	Sustained competitive advantage through barriers to entry, switching costs, and mobility barriers	×	×	×	×		×	×		×	×		×	×		×	×	×		×			×	×		×	×		×		×		×	×	×	×			×		×	26	65

(*Continued on next page*)

Table 3. *Continued*

S/N	Impact of IT Application in Construction Industry performance	Architects										Project Managers										Quantity Surveyors										Engineers										Total	%
		R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10		
8	Sustained competitive advantage would require bundling IT with differences in the value chain	×	×	×		×		×			×		×	×		×	×						×			×	×	×			×				×	×			×		18	45
9	Sustained competitive advantage would require bundling IT with tangible or human resources	×	×	×		×		×		×	×			×		×	×	×		×	×			×		×	×	×	×		×		×		×	×			×	×	24	60
10	IT can bring competitive advantage to industries within an entire supply chain	×	×	×		×	×	×			×		×	×								×	×				×	×			×		×		×	×			×		18	45
11	IT-dependent strategic initiatives contribute to sustained competitive advantage	×	×	×		×	×	×		×	×			×		×	×		×			×	×		×			×	×	×			×			×	×	×		×		24	60

However, 65% of the respondents observed that sustained competitive advantage through barriers to entry, switching costs and mobility barriers are other critical factors they believe affect the performance of IT applications in most of the construction industry. These support the result of Mandičák, Mésároš and Spišáková (2021) on the highly significant impact information and communication technology has on a sustainable chain and cost reduction of waste management in various construction works and this is what creates the rivals in the industry. Both sustained competitive advantage that would require bundling IT with tangible or human resources and IT-dependent strategic initiatives that contribute to sustained competitive advantage are viewed by the respondents to be 60%, respectively.

Similarly, 45% of the professionals interviewed stress that improving the construction industry market share and profitability through innovative use of IT sustained competitive advantage that would require bundling IT with differences in the value chain and IT which brings competitive advantage to industries within an entire supply chain has less impact on IT application in construction industry performance. These results were further supported by Mandičák, Mésároš and Spišáková (2021) by minimising the consumption of materials, costs and optimally setting up the supply chain and logistics, using materials and funds efficiently and optimising waste management. Furthermore, 30% of the respondents believed that the possible role in creating sustained competitive advantages for the construction industry as well as achieving competitive advantage through the application of IT has less impact on industry performance concerning VRE. These results were argued by Mesároš and Mandičák (2017) as the impact of IT exploitation on the performance of the construction industry through the use of appropriate techniques or tools like BIM tools, ERP systems and controlling systems on cost and profit enhances the competitive advantage in the industry.

The competitive advantage of the construction industry is a major challenge faced as a result of IT application in the industry. This has made multinational organisations take advantage of the indigenous firm operating in the same environment. The possibility of creating a sustainable competitive advantage was also depressed due to deficiencies in IT application in new techniques adopted for competitive advantage. These were suggested by Afzal and Shafiq (2021) that the impact of four-dimensional (4D) models can be used to anticipate safety hazards and the assignment and allocation of project resources and construction-related machinery to the work site, as well as for constructability reviews for achieving a competitive advantage in the construction industry.

Customers' Benefits of IT on the Construction Industry

In Table 4, quality design and collaborative working having 85% respectively were considered by the respondents as the most important benefits the customer derived through the use of IT in the construction industry. No doubt, once there is working collaboration among the construction operators, quality design is bound to be achieved because these would eliminate the faulty areas in the design and construction thereby giving the customer advantage of achieving satisfaction with the outcome of the work produced. These results were argued by Eliwa, Jelodar and Poshdar (2022) that it depends on the implementation methods.

Table 4. Customer-derived benefits in construction

S/N	Derived Benefits for Customers	Architects										Project Managers										Quantity Surveyors										Engineers										Total	%
		R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10		
1	Collaborative working (CW)	×	×	×	×	×	×	×	×	×	×	×	×	×		×	×	×		×	×	×	×	×	×	×		×		×		×	×	×	×	×	×	×		×	×	34	85
2	Integration and CW	×	×		×	×	×	×	×	×	×	×		×	×	×		×		×	×		×	×			×		×		×		×	×		×	×	×		×	×	28	70
3	Quality design	×	×	×	×	×	×	×	×	×	×		×	×	×	×	×	×		×	×	×	×	×		×	×	×	×		×	×	×	×	×		×	×	×			×	34	85
4	Health and safety	×	×	×		×		×			×		×	×		×	×						×			×	×	×		×					×		×						30	75
5	Identify talent on people skill	×	×	×		×		×		×	×			×		×	×	×		×	×			×		×	×	×		×		×		×		×		×				22	55
6	VRE awareness	×	×		×	×	×	×			×		×	×								×	×			×	×		×				×		×		×	×		×	×	×	20	50
7	Waste reduction	×	×	×		×	×	×		×	×	×	×	×		×	×		×	×	×	×	×		×		×	×	×	×	×	×	×	×		×	×	×	×	×		32	80
8	Lean and IT application		×		×	×	×	×			×		×	×							×		×			×	×		×	×						×	×		×		×		18	45

Furthermore, 80% of the respondents are equally convinced that customers tend to achieve benefits through waste reduction and these are obtained with a good quality design that is in line with the working relationship among the workers. These results confirm the findings of Potts and Ankrah (2013), Olanrewaju (2013) and Mandičák, Mésároš and Spišáková (2021). Other than that, 75% of the respondents also believed that health and safety can be achieved with design adequacy which goes along with the working collaboration in any construction industry.

The interviewees express that integration and collaborative working is critical for a customer in achieving benefits and these are considered 70%. This is further considered a "major influence" by Potts and Ankrah (2013), Olanrewaju (2013) and Afzal and Shafiq (2021). However, only 55% of respondents identify the talent for people skills in giving benefits to customers. The skills displayed by people based on their talent can only be appreciated if customers derived benefit from the knowledge acquired, hence much impact is felt in construction operation that offers customer satisfaction.

In a similar vein, only 50% of the respondent considered VRE awareness in the construction organisation. The result could be viewed as waste being experienced as well as design deficiencies, leading to poor health and safety practices. Hence, the result of the lack of VRE awareness level by most practitioners in the industry has made the challenge very clear in terms of agitation of customer dissatisfaction. Therefore, it is important to create awareness for the industry players on how to achieve value addition for customer benefits. The cumulated use of lean and IT applications became remorse in the industry, as these affect the global competitiveness in the industry, giving room to expatriates to take undue advantage of the local operators in the industry. Furthermore, only 45% considered lean and IT applications as important aspects in deriving benefits for customer satisfaction.

Customer Value-Added Perspectives in the Construction Industry

In Table 5, during the interview, 90% of the respondents were optimistic that over-design leads to delays in design approval, as well as the use of high technology that influences both design and construction operations. These results were argued from the studies conducted by Eliwa, Jelodar and Poshdar (2022) which identified the implementation methods as a major variable in achieving VRE results in ICT applications. Therefore, employing appropriate workers with requisite educational skills and training and early dissemination of information and design adequacy reduces pressure on both materials and labour scarcity which gives customer value addition. However, 85% of respondents stated that constructability design produced by the design team for the client also offered customer value addition on construction. Also, 80% of the respondents reiterate that the use of appropriate available equipment that reduces delays in transportation also added value to the customer which is achieved through price reduction on construction while 75% equally believed that appropriate risk-efficient measures that may result, due to inadequate health and safety practices are considered important factors that add value to customers. These results were argued by Afzal and Shafiq (2021) that the impact of 4D models can be used to anticipate safety hazards and the assignment and allocation of project resources and construction-related machinery to the work site, as well as for constructability reviews for achieving a competitive advantage in the construction industry.

Table 5. Value-added perspectives in the construction industry

S/N	Value Adding Perspective	Architects										Project Managers										Quantity Surveyors										Engineers										Total	%
		R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10		
1	Clarity in design with complete drawings/ details, leading to repetitive revisions and changes reduces the rate of changes to the design		×					×			×		×	×				×		×		×		×	×	×	×		×					×	×	×	×	×		×	×	20	50
2	Improving the control of material specifications to reduce error	×	×	×	×	×		×		×	×		×	×		×	×	×	×	×	×			×			×	×	×							×		×			×	×	24	60
3	Unnecessary design revision that improves design cost effectiveness	×	×	×	×		×	×			×			×	×	×	×	×		×				×			×				×		×	×		×	×	×	×	×	×	24	60
4	Over design, leading to delay in design approval	×	×	×	×	×	×	×		×	×	×	×	×	×	×	×	×	×	×	×	×		×		×	×	×	×	×	×	×	×		×	×	×	×	×	×	×	36	90
5	Appropriate risk efficient measure that may result, due to inadequate Health and Safety (H & S) practices	×	×	×	×		×	×		×	×	×	×	×	×	×	×	×		×		×	×	×	×		×			×	×	×	×	×	×	×			×		×	30	75

(Continued on next page)

Table 5. *Continued*

S/N	Value Adding Perspective	Architects										Project Managers										Quantity Surveyors										Engineers										Total	%
		R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10		
6	Increasing the moral encourages cooperation among the workers thereby creating the team spirit among the workers that improves productivity	×	×	×		×	×	×		×	×		×	×		×	×	×		×	×	×	×	×		×	×	×	×		×					×		×	×			26	65
7	Proper management practices to reduce waste	×	×	×	×		×	×	×	×	×	×		×	×	×	×	×		×	×		×	×			×	×	×		×					×		×	×	×	×	28	70
8	E×amine cost efficient procurement arrangements for the realistic project e×ecution plan	×	×	×		×	×	×		×	×			×			×	×		×		×	×	×		×	×		×				×	×		×		×	×		×	24	60
9	Use of high technology that influences both design and construction operations	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×		×			×		36	90
10	Use of appropriate available equipment that reduce delay in transportation	×	×		×	×	×	×		×	×	×	×	×	×	×	×	×		×	×	×	×		×	×	×	×	×	×	×	×	×	×	×	×		×	×			32	80

(*Continued on next page*)

Table 5. *Continued*

S/N	Value Adding Perspective	Architects										Project Managers										Quantity Surveyors										Engineers										Total	%
		R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10		
11	Influence of government policies through right decision-making abilities on bureaucracy by good leadership				×			×			×		×					×		×	×			×			×						×		×	×	×	×	×	×		16	40
12	Proper planning of site layout for construction, reduces more off- site activities		×		×		×	×		×	×			×		×	×	×		×	×		×	×			×	×	×				×	×				×	×			22	55
13	Employing appropriate workers with requisite educational skills and training	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×			×	×			36	90
14	Better use of mechanization which enable the elimination of unspecified poor material interface for quick response to Requests For Information (RFI)		×			×	×	×			×		×					×		×		×					×	×		×			×	×	×	×			×	×	×		18	45

(*Continued on next page*)

Table 5. *Continued*

S/N	Value Adding Perspective	Architects										Project Managers										Quantity Surveyors										Engineers										Total	%
		R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10		
15	Appropriate use of construction methodology that reduces contradiction in design documents	×	×	×		×		×		×	×			×		×	×	×		×			×			×	×		×							×	×	×	×	×		22	55
16	Early dissemination of information and design adequacy reduces pressure on both materials and labour scarcity	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×		×	×	×	×	×	×	×	×	×	×	×		×		×	×	×	×		×	×	×	36	90
17	Adequate control and inspection of document system to prevent over/ under ordering of materials	×	×	×	×		×	×			×			×		×	×			×	×	×	×				×			×		×					×	×				18	45
18	Constructability design produce by the design team for the client	×	×	×	×	×	×	×		×	×	×	×	×	×	×	×	×			×	×	×	×	×	×	×	×	×	×		×	×	×	×	×	×	×		×		34	85

Moreover, 70% of respondents observed that proper management practices to reduce waste are considered to be a value-added perspective to the customer with less effect since cost overrun is being curtailed with waste management. Moderately considered important by the respondents is increasing the morale that encourages cooperation among the workers thereby creating the team spirit among the workers that improve productivity by 65%. While improving the control of material specifications to reduce error, unnecessary design revision that improves design cost-effectiveness and examines cost-efficient procurement arrangements for the realistic project execution plan were viewed by the respondents to be 60%, respectively.

Furthermore, 55% of interviewees stress that proper planning of site layout for construction, reduces more off-site activities and appropriate use of construction methodology that reduces contradiction in design documents are viewed by the professionals in the industry as unimportant factors. Whereas 50% of respondents believed that clarity in design with complete drawings/details, leading to repetitive revisions and changes reduces the rate of changes to the design added value perspective to customer satisfaction in a construction project. It is however believed by 45% of the respondents that better use of mechanisation which enables the elimination of unspecified poor material interface for quick response to requests for information (RFI) and adequate control and inspection of document system to prevent over/under ordering of materials has less influence on value-added perspective to customer satisfaction. Only 40% of respondents believe that the influence of government policies through the right decision-making abilities on bureaucracy by good leadership adds value to customers. These results corroborate the findings of (Abdellatif, Farhan and Shehata, 2018; Chen, 2019 and Foster, 2017).

CONCLUSION AND RECOMMENDATIONS

The objective of the research is to create an enabling environment for the Nigerian construction industry in meeting the customer's needs by providing value for their products. Achieving customer satisfaction through VRE is envisaged to be a breakthrough solution that would overcome the challenges of dissatisfaction with the customer's needs. However, the major catalyst for this driver is the application of IT that enhances the process of design and collaborative working among the VRE practitioners. The application of IT helps the customer to derive the benefit of waste reduction by achieving value-added perspectives using high technology that influences both design and construction operations.

VRE has become a useful weapon for any construction industry that is seeking improvement in its current organisational performance and intends to achieve customer value satisfaction in its operating industry and its environment. Process re-engineering remains an effective tool for the industry striving to operate in the competitive world; industries are required to re-engineer their value processes to achieve breakthrough performance and long-term strategy for customer relations. Industries often fail to achieve re-engineering objectives because they trivialise the concept. Re-engineering requires creative thinking. It requires a new perspective on the part of the implementer of the technique with even a new philosophy. Hence, these can only be achieved through the application of IT on VRE implementation in any construction industry trying to redesign its value processes in meeting customer satisfaction.

The development of IT and its decreasing costs creates prospects for the changing need by improving the way the construction industry conduct its activities. It is the most effective enabling technology for VRE to operate. IT application in VRE implementation plays an integral role in achieving this success of re-engineering. It is an enabler of re-engineering.

Given these, tis study, therefore, recommends that for the construction industry to meet the sustainable competitive advantage, enabling roles should be created in achieving it. Another recommendation is that to achieve a competitive advantage in the industry the application of IT must be given the utmost priority. Finally, managers or leaders who influence policies on decision-making abilities should be mindful of the bureaucracy in the industry, as only good leadership succeed in this aspect.

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