BARRIERS IN BLOCKCHAIN TECHNOLOGY ADOPTION FOR FACILITIES MANAGEMENT PROCUREMENT PROCESS IN SRI LANKA

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Procurement has become an essential facilities management business operation. With the increase of complexity and transparency issues in existing procurement processes, the adoption of an advanced digital technology is required. As a solution, this study investigates the existing barriers in adopting blockchain technology for facilities management procurement process in the Sri Lankan context and presents the potential solutions to overcome them. A qualitative approach was adopted for this study and blockchain technology experts in information technology field and research field were interviewed using semi-structured interviews until the data saturation was achieved. Findings revealed, main adoption barriers related to socio-cultural, legal, economical, technical, political and administrative categories. Resistance to change, absence of laws and regulations, financial incapability, absence of a customised solution for the use case and less autonomy are some of the identified barriers. Conduct training and awareness on blockchain technology, identify system requirements and the system design properly, and develop laws and regulations for blockchain technology adoption are some of the proposed solutions. The research concludes by guiding facilities management and information technology professionals to overcome the identified barriers.

Keywords: blockchain technology; facilities management; procurement; Sri Lanka

INTRODUCTION

According to Shi and Tay (2019), adoption of advanced technologies can result in efficient Facilities Management (FM) operations while increasing productivity and reducing costs. Authors further stated, Blockchain Technology (BCT) can have a significant impact on FM practices in operations and maintenance of buildings which enables real time data monitoring, analytical services, fault detection of equipment through the integration of artificial intelligence and especially transparent record keeping, reduction of manual errors and issues in data verification by the use of smart contracts. BCT is advantageous for FM under different perspectives such as data security, easy access, cost reduction and replacement of manual processes (Conley and Richards 2018). When considering the FM industry, procurement process is essential for managing service providers, obtaining the required building facilities, and continuing reliable and effective business operations (Pun, Choy and Lam 2018). Due to the rapid changes in the highly competitive market, procurement has become a

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complex and challenging process which needs to adopt innovative processes to be more effective (Hong and Kwon 2012). The requirement of transforming to an advanced digitalised procurement system is identified by the FM industry and BCT can be considered as a significant innovation for this purpose (Gunasekara, Sridarran and Rajaratnam 2021). According to Nicoletti (2017), by applying BCT throughout the procurement process, the security of the procurement process can be improved. However, Adama and Michel (2017) argued, it is required to investigate the challenges in the adoption of new technologies while evaluating their applicability for the FM industry.

In the Sri Lankan context, BCT has applied in the private bank sector, and it is expected that BCT will change the Sri Lankan banking sector (Perera 2018). However, BCT is still new to Sri Lanka, and thus the BCT adoption for FM procurement process is a major challenge and it is required to identify and solve the existing barriers before its implementation. Therefore, it is required to analyse this gap and this research aims to identify the related barriers and solutions to overcome them. Recently, researchers have identified common barriers on the applications of BCT, and some have researched on barriers specifically for supply chain management (SCM). This is the first research to analyse the gap in identifying barriers in BCT adoption which will be beneficial for FM industry for the future development of the procurement process. The research scope was limited to identifying barriers in the Sri Lankan context.

LITERATURE REVIEW

Role of Facilities Management in Procurement

Pun, Choy and Lam (2018) stated that procurement is a crucial and a complex process in FM for managing services and for interacting with different stakeholders to support the core business function of any organisation. Authors further mentioned, Facilities Managers have to consider the quality and cost of the procured services because of the prevailing dynamic and complex business processes in the organisations. However, FM procurement strategy should be properly planned to make a correct procurement decision on behalf of the organisation (Atkin and Brooks 2015). Authors further mentioned that this FM procurement strategy should adhere to the existing business processes to fulfil the corporate objectives through the procurement process. The procurement process is aimed at selecting the best bidder who provides the required service of clients within the specified time limit at an acceptable price while accepting the optimal commercial and legal terms (International Facility Management Association and Royal Institution of Chartered Surveyors 2018).

Issues in Current Facilities Management Procurement Process

According to Tavares (2018), procurement process is more complex because large number of transactions are involved, and it should be based on trust among the parties involved in the process. Currently existing transaction systems are designed to be centralised and a third party is monitoring and managing transaction instead of the parties who are involved in the transaction (Yli-Huumo *et al.,* 2016). Facilities Managers have found that existing systems are consisting of inefficient and time-consuming search interfaces, lack of unified interfaces for information exchange, and unable to process and store large amounts of data (Koch, Hansen and Jacobsen 2017). Application of BCT for pre tendering, tendering and post awarding phase of FM procurement process can solve the current issues in FM industry in terms of

transparency, security, efficiency, integration and third-party intervention for transactions (Gunasekara, Sridarran and Rajaratnam 2021).

Adoption of Blockchain Technology

In the past few years, BCT or distributed ledgers have become an important future technology (Barenji *et al.,* 2018). BCT was introduced by Satoshi Nakamoto, as the first Distributed Ledger Technology (DLT) which could be applied in cryptocurrency associated functions (Li, Greenwood and Kassem 2018). However, Yli-Huumo *et al.,* (2016) argued, BCT has a broader application beyond the cryptocurrencies, and it can be applied to any environment where transactions are carried out. The presence of a secured distributed database of blockchain, makes it a very attractive technology to solve the current financial as well as non-financial industrial problems (Crosby *et al.,* 2016). Distributed databases can assist various stakeholders in the organisation's procurement process when required and they can enable a procurement process which is reliable and uninterrupted (Nicoletti 2017). Smart contracts are currently the most revolutionary blockchain applications which automatically generate payments and transfer money or other assets when negotiations are fulfilled (Iansiti and Lakhani 2017). BCT developers have stated, currently most of the companies in the world are focussed on blockchain-related innovations, but only a few of these companies are working on actual BCT development due to poor knowledge and poor understanding of this technology (Mattila 2016). However, Hileman and Rauchs (2017) argued, although the use of blockchain may have a revolutionary advantage over other technologies, they are not a perfect solution in some cases, and they cannot magically solve every problem.

Though infrastructure is identified as a major challenge on the adoption of blockchain in SCM, organisational capabilities, such as internet, cloud services, integration with SCM, training and awareness are also important (Queiroz *et al.,* 2020). Authors further stated, effect of trust is another challenge for the adoption of BCT, and thus it is required to monitor and identify the behaviours that affect the trust in BCT by enabling the confidence in the information that is shared among the parties who are involved in operations of SCM. The adoption of blockchain for procurement must overcome obstacles such as, resistance to adapt new technologies, integration with legacy systems, adoption costs, and obtaining stakeholder support (Williams-Elegbe 2018). Nawi *et al.,* (2016) argued, although the organisations cannot control the external obstacles arising from industry, market, government and technological change, these obstacles can be minimised or even eliminated entirely through careful planning and research. However, Hackius and Petersen (2017) argued, organisations are reluctant to invest their resources to develop BCT based applications despite realising that blockchain may have a favourable impact on them. Accenture Operations (2017) stated, to take full advantage of new technologies, companies must review their policies and procedures and ensure that everyone understands their roles and responsibilities clearly relevant to the new procurement process.

RESEARCH METHODOLOGY

According to Kothari (2004), research approaches can be categorised as quantitative approach and the qualitative approach. Author further mentioned, in quantitative approach, data is generated in a quantitative form and data is subjected to quantitative analysis rigorously in a formal and rigid manner wherein qualitative approach is concerned in the assessing of attitudes, opinions and behaviours subjectively. Antwi and Hamza (2015) stated, quantitative approach is concerned in quantifying social

phenomena by collecting and analysing data while qualitative approach is focused in understanding social phenomena. This research is focused on presenting barriers and solutions to overcome those barriers when adopting BCT for FM procurement. Therefore, in order to do it successfully understanding the current phenomena is required by assessing of attitudes, opinions and behaviours subjectively. Therefore, qualitative approach was selected.

According to Yin (2018), case studies, surveys, experiments, archival analysis and histories are the main social science research strategies. Thus, barriers in adopting BCT for FM procurement and solutions to overcome them were identified using an expert survey.

When designing a high-quality research, establishing inclusion and exclusion criteria for research participants is a standard and necessary approach (Patino and Ferreira 2018). Inclusion criteria characteristics are predefined to identify subjects who will be included in a research study (Salkind 2010). In contrast, the exclusion criteria characteristics are defined as potential research participants meeting the inclusion criteria including additional features that may affect research success or increase the risk of adverse results (Patino and Ferreira 2018). Inclusion criteria considered in this research are, selection of normative experts from Sri Lanka in the Information Technology (IT) field who actively contribute to the development of blockchain-based solutions and who conduct research on blockchain adoption, and with at least seven-year experience in the field of expertise. Experts which do not meet the minimum outcomes were excluded.

All of the experts were given an introduction on how the FM procurement process is performed before the interviews. Profiles of experts are presented in Table 1.

Table 1: Profiles of Experts

Expert	Designation	Years of Experience	Field of Expertise
E1	Senior Software Engineer	8	IT field with experience on developing blockchain based solutions
E2	Lead Consultant -Technology	7	
E3	Senior Technical Lead	8	
E4	Technical Lead - Blockchain Development	10	
E5	Senior Software Engineer	7	IT field with experience on conducting research on blockchain adoption
E6	Director of Software Engineering	10	
E7	Senior Software Engineer	6	
E8	Head of Engineering	15	

Semi-structured interviews were selected as the data collection technique to investigate the barriers. Dawson (2002) stated, in qualitative social research, the most commonly used interviews are semi-structured interviews. In semi-structured interviews, interviewees can explain their thoughts freely and they can highlight their areas of special interest and expertise and able to question certain responses especially to reveal and resolve obvious contradictions (Horton, Macve and Struyven 2004). Eight semi-structured interviews each lasting 1.5 hours were conducted. These interviews were audio recorded and transcribed.

Commonly identified qualitative data analysis techniques are content analysis, thematic analysis, grounded theory, interpretative phenomenological analysis, and some other narrative analysis techniques (Robinson 2013). Content analysis and thematic analysis seem to have the same goal of analysing and examining the

narrative material by dividing the text into relatively small content units and submitting them to descriptive processing (Sparker 2005). By using content analysis, the data can be qualitatively analysed and the data can be quantified at the same time (Gbrich 2007). On the contrary, thematic analysis provides a purely qualitative, detailed and nuanced description of the data. (Braun and Clarke 2006). In this regard, qualitative researchers should be more familiar with thematic analysis as an independent and reliable qualitative analysis method. (Vaismoradi 2016). The thematic analysis process may be based on previous categories, or categories that become clear to the researcher only while the analysis is in progress and once the interview data is collected from the interviewee, these categories will become the "themes" that researchers use to analyse the collected data (Fox 2004). Therefore, thematic analysis was selected as the data analysis technique because five main themes were identified as the types of barriers in BCT adoption, and the data analysis was performed using NVivo software.

FINDINGS AND ANALYSIS

Barriers in Blockchain Technology Adoption for Facilities Management Procurement Process and Solutions to Overcome Them

According to the responses provided by the experts, barriers in adopting blockchain for FM procurement process can be categorised as socio-cultural, legal, economical, technical, political and administrative barriers as follows.

Socio - Cultural Barriers and Solutions to Overcome Them

E1 stated, resistance from industry is the main socio-cultural barrier in Sri Lankan FM industry and explained that people have still not understand the strength of BCT applications for the FM procurement use case. Further E1 stated, while foreign banks are currently using blockchain based cryptocurrencies for payments, Sri Lankan banks have a low level of trust on the execution of payments through this technology. E4 mentioned, in addition to attitude problems, lack of knowledge and skilled resources is another main issue for the blockchain implementation in Sri Lankan FM procurement process. E8 mentioned, it is difficult to integrate different suppliers and FM service provider organisations related to FM procurement process because they will be reluctant to feed data from their current databases or systems by considering a blockchain based system as an overhead. E5 stated, confidence must be there to disclose all the procurement-based information because normally data within the blockchain is public and it is more transparent, unlike a deposit done in a bank where normally information is stored in a private ledger. Further E5 mentioned, the mentality of organisational management should be fit to this type of situation and there is a lack of confidence in using blockchain which facilitates a transparent procurement process. E4 added, blockchain will be inconvenient for FM users, suppliers and other stakeholders because it is a new technology, and they are not used to it. According to most of the experts, there are barriers of how people can be brought into a blockchain based platform to do procurement activities. It is required to identify whether suppliers are ready to feed procurement related data and the basic idea on blockchain should be there. Thus, it is important to make people confident enough to use blockchain by conducting awareness and training programmes on blockchain implementation for FM procurement.

Legal Barriers and Solutions to Overcome Them

Most of the experts stated, it is important to identify whether the contracts are legally binding and what is the relevant law when using smart contracts between suppliers

and FM organisations in terms of payments and conditions of contracts. However, absence of laws and regulations regarding the blockchain adoption and usage is the main barrier because there are no smart contracts or blockchain based procurement laws in Sri Lanka to handle them. Furthermore, experts suggested, if the industry is adopting a new technology, relevant law has to be there. Thus, it is required to develop laws and regulations regarding the adoption and usage of BCT for FM procurement in the Sri Lankan context.

Economical Barriers and Solutions to Overcome Them

As per the opinions of experts, there can be economical barriers. Most of the experts stated, financial incapability is the major barrier in blockchain adoption and organisations are reluctant to convert their current e-procurement systems or to adopt a new system. E5 stated, there additionally may be costs to run servers according to the designed platform. E6 and E7 added, another major barrier as costs related to hosting/ transactions and initial migration cost. Thus, economical barriers can be affected in the BCT implementation. Experts suggested that in order to reduce the unnecessary costs, existing procurement system should be analysed, and it is essential to identify what types of requirements should be addressed and how blockchain platform can conflict with the existing e-procurement system. Thus, a complete analysis is required to identify them and then it can be decided whether to proceed with a conversion or a completely new development. Further E1 added, blockchain implementation is not easy, therefore cost and implementation weight should be considered and addressing of most important requirements of the procurement process is required according to this use case.

Technical Barriers and Solutions to Overcome Them

E1 explained, it is not required to use blockchain 100% for the FM procurement process, because if everything is done through blockchain it can reduce flexibility of the system. Further, it was mentioned that integration of existing e-procurement systems is difficult. Experts stated, when compared to a normal system, there can be a transaction delay in a blockchain based system. According to E3, for example if a database system is used, thousands of transactions can be run per second unlike in a blockchain where less than a hundred transactions per second can be run. E4 supported, time factor can be an issue. Thus, when blockchain is used for the procurement process, there can be delays in transactions. E7 stated, a blockchain based system requires high computational power, but as plenty of hardware is available it is not a big issue. E4 added, if a digital system is currently available, additional special system requirements are not required and the minimum hardware requirement is there. Thus, it was suggested to utilise the available hardware according to the requirement. However, E3 added, absence of a strong internet connection can interrupt the performance of the system. E2 explained, another technical barrier is the absence of a customised solution for the use case which can directly incorporate for FM procurement. Thus, you have to customise specifically for the use case. When customising, it is required to write the smart contracts with the minimum level of customisation, incorporate different consensus and modify the eligibility of a party or an organisation to get involved.

E7 stated, conversion of current EP system to a BCT based system should be done based on the current design of the system. E1 suggested to design the system properly according to the requirement of proper integration of parties involved in the procurement process. Experts stated, in the system analysis, it is important to identify the most important FM procurement requirements and it is required to use blockchain

at the optimum level without overusing it. According to the requirement it can be developed, but within the scope of the solution. E2 added, blockchain should be explored properly, because it has its own set of use cases and at the same time it should not be overused.

Political and Administrative Barriers and Solutions to Overcome Them
Experts stated, in Sri Lanka there is less autonomy and less support is available for the start-ups when adopting a new technology like blockchain for developing industries like FM. Further, E2 added, appropriate cultural changes should be there in FM industry to welcome new technologies as required. Thus, experts suggested, organisational procurement policies and procedures should be reviewed and necessary resources should be utilised to support the new blockchain projects for FM procurement. Further E8 added, new proposals regarding BCT adoption for FM procurement should be developed and it is required to recruit experts on BCT for those developments.

DISCUSSION

Data analysis and findings revealed that barriers in BCT adoption for FM procurement can be identified under socio-cultural, legal, economical, technical and political and administrative categories. Data analysis revealed, there are some socio-cultural barriers where FM industrial professionals lack the confidence in using blockchain and they are reluctant to participate in a blockchain based procurement system with the lack of knowledge and skilled resources. Though foreign banks are currently using cryptocurrencies on execution of payments, local banks have a low level of trust on them. Therefore, payment execution using cryptocurrencies is not possible at the moment. Further, the absence of laws and regulations regarding the blockchain adoption and usage for FM procurement was identified as the main legal barrier because for the execution of smart contracts and for them to be legally enforceable, there should be proper laws and regulations. Technical barriers were identified as absence of a customised solution for the use case, reduce flexibility by the over usage of BCT, absence of a strong internet connection, difficulties in integration of existing systems and parties involved in FM procurement process and delays in transactions compared to other systems. Further, this study identified some economical barriers related to adoption such as, financial incapability, additional cost to run servers, high costs related to hosting/ transactions and high initial migration cost. Findings revealed, political and administrative barriers as, less autonomy and availability of less support for start-ups.

Careful research, planning, designing, training, awareness and reviewing organisational procurement policies and procedures are required to solve the adoption barriers. Similarly, several solutions were identified by this study to overcome the above identified barriers. Mainly it was suggested to conduct training and awareness programmes on BCT because it is a new technology to Sri Lanka and most of the organisations are not aware of it. Further, when designing a BCT based procurement system it is required to analyse the most important requirements and to design the system according to those requirements without overusing the technology and within the scope. Proper integration of law and technology should be enabled by developing laws and regulations for BCT adoption and usage for FM procurement process.

CONCLUSION

Adoption of BCT to FM procurement process is a challenge in the Sri Lankan context because of prevailing barriers in the industry. In this study, key barriers were identified under five main categories as socio-cultural, legal, technical, financial, political and administrative barriers. This research contributes by identifying the existing barriers for the adoption of BCT to FM procurement process and identifying solutions to overcome them. It was evident that FM procurement process can be further developed with BCT adoption if the required attitude changes, financial capability, organisational contributions, legal background and technical knowledge and strength are available in the Sri Lankan context. However, as identified in this study, FM and IT industries can work together to achieve a significant output if these barriers can be solved in the future. Outcomes of this research are useful for the FM industry and IT industry by guiding them towards blockchain adoption for FM industry. Therefore, it is required to analyse these barriers before moving towards BCT technological transformation by considering the recommended solutions. As BCT is at a preliminary stage in Sri Lanka, some unavoidable limitations were encountered when conducting this study because of the lack of IT experts who are proficient in BCT in Sri Lankan context. This was overcome by recruitment of interviewees who have actively contributed in developing blockchain based solutions for some industrial applications and who have actively conducted research on blockchain adoption. Therefore, it was able to obtain sufficient information with the data saturation to achieve the research aim.

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