

QUANTITY SURVEYOR'S PERSPECTIVE ON DOCUMENT MANAGEMENT IN CONSTRUCTION PROJECTS: AN EXPLORATORY STUDY IN SRI LANKA

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ABSTRACT

Electronic Document Management Systems (EDMS) have become increasingly popular in recent years as construction organisations seek to improve document management efficiency, productivity, and security. However, the Quantity Surveyor (QS), a key stakeholder responsible for construction documentation management, has less adapted to it in the Sri Lankan context. Accordingly, this study used twelve expert interviews to identify the status of documentation management in the Sri Lankan construction industry from a QS perspective. Manual content analysis was used to analyse the findings. Despite the disadvantages, the conventional DMS approach is still prevalent in the Sri Lankan context. Despite the Qs having a basic understanding of the EDMS approach and being willing to transit to EDMS, they are less familiar with EDMS software. In addition, project size, limited availability of technical facilities, and the reluctance of government and professionals cause to continue this adaptation are still a barrier. The findings of this research can be based on future studies on different stakeholder perspectives. Since conventional DMS is proved to be a less efficient solution for the document management of construction projects and EDMS is also difficult to be initiated, these findings can be benchmarked by policymakers to address the identified causes of the issue.

Keywords: *Barriers; Document; Electronic Document Management System (EDMS); Quantity Surveyors (QS); Sri Lanka.*

1. INTRODUCTION

Effective and efficient management of documents is essential to ensure the successful completion of a construction project (Ahmad et al., 2019). Specifically, as Gerardi (2022) stated, document management in construction refers to organising, regulating, storing, sharing, and editing drawings, specifications, estimates and other construction-related documents. Specifically, the construction industry uses many documentation techniques and profusely adapts conventional document management for their projects (Ahmad et al., 2015). This conventional approach of record keeping refers to a conventional

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document management system (DMS) where records are kept in hand-written or printed hard copies with or without soft copies. However, this conventional approach of DMS exhibits several disadvantages, including less flexibility in inserting comments and revisions, difficulty searching for the correct document, high maintenance costs and time wastage (Jane, 2020). Consequently, limitations of the conventional DMS intensify the importance of an electronic document management system (EDMS) to construction projects, which can be identified as an approach with high operational efficiency and effectiveness (Abdulkadhim et al., 2015).

As revealed in the recent study of Chandramohan et al. (2020) documentation is the most important competency for a quantity surveyor (QS). Despite QSs play a significant role in managing construction project documents, they hesitate to adopt this technology for several reasons, such as lack of awareness, resistance to change, and limited technological infrastructure (Haupt & Naidoo, 2016). Sri Lanka is a developing country with a high tendency of reluctance to technology, especially in quantity surveying (Edirisinghe & Bandara, 2022). Henceforth, Sri Lankan QSs are biased to practice traditional documentation methods in their projects, which is less advantageous in the present context as the global construction industry and professionals are eagerly embracing new technologies. Accordingly, this study aims to investigate the perspectives of QSs, who play a significant role in managing construction project documents, regarding the DMSs used in the Sri Lankan context. Following the aim, the main DMSs used in Sri Lanka, their limitations, awareness about EDMSs and their tools by Sri Lankan QSs, and barriers to the adaptation of EDMSs have been presented in this paper.

2. LITERATURE REVIEW

2.1 TRENDS IN DOCUMENT MANAGEMENT IN CONSTRUCTION INDUSTRY

Most professionals have personal computers today, and the Internet's "information superhighway" provides the essential infrastructure for effective computer-assisted document management. A considerably advanced approach is that documents are digitally generated and conveyed as email attachments. This approach facilitates a rapid transfer of documents (Björk, 2003). Further, Samuelson and Bjork (2013) reported the findings of an IT barometer study performed in 2000, 2007, and 2022, suggesting that EDMS usage in construction companies is rising year after year. Similarly, this concept has been strengthened in a recent study by Oral and Aydinli (2017). In the last few years, the use of EDMS has been the fastest-growing IT application in construction (Fernando et al., 2019; Hjelt & Björk, 2006). Moreover, the findings of the Fernando et al. (2019) expressed that the current scenario in the construction sector is that papers are managed using a combination of different generating processes like manual and electronic. Overall, Figure 1 describes the evolution of construction document management methods.

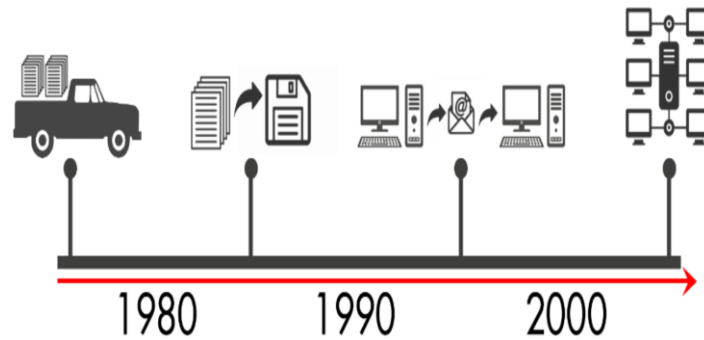


Figure 1: The evolution of construction document management methods over the last decades
Source: (Jordan et al., 2022; Sprague, 1995)

According to Figure 1, sharing of documents has evolved with time, and in the earliest stages, documents themselves have to be transported from place to place. After, documents were stored in a portable data transfer media and exchanged. The next stage was considered sharing documents through computers using an electronic transferring medium (Jordan et al., 2022), and finally, the computers were connected within and across organisations to transfer the documents (Samuelson & Bjork, 2013). This opens the potential for application of the digital technologies like BIM and blockchain to construction documentation (Mandicak et al., 2022). Overall, in the present context, the construction industry utilises four main documentation trends, hardcopies, a combination of hardcopies and softcopies, softcopies, and electronic documents. The first three approaches can be referred to as conventional DMS; the last approach is the emerging trend in the construction industry, referred to as EDMS.

2.2 CONVENTIONAL DOCUMENT MANAGEMENT SYSTEMS

A conventional document management system (DMS) is a system that manages documents in a physical or paper-based format or saves all the documents in one location and is difficult to retrieve and use on an urgent occasion (Jane, 2020). Further, McHugh (2021) explains conventional DMS as a practice of keeping paper-based records, which are stored physically as hardcopies and maintained. It is a common record-keeping procedure used in present business organisations (McHugh, 2021), which has the benefits of easy handling and less technical knowledge requirements. However, it processed a variety of drawbacks, including security issues, a requirement for high storage space, the difficulty of editing, collaboration and transportation and can be easily damaged (Melo, 2019). The findings of this study present the barriers to using conventional DMS for QSs for construction document management.

2.3 ELECTRONIC DOCUMENT MANAGEMENT SYSTEMS

EDMS tend to treat the documents they shuffle around as black boxes, just like the post office has little interest in what is inside the envelopes they keep shuffling around as long as the mail gets to the recipient in time (Björk, 2003). Furthermore, according to Accruent (2023), most EDMSs let users alter and administer the system and various physical filings methods, such as storage location, security, access control, and version or revision control, are often included.

Dokić et al. (2012) define EDMS as a process of selecting the evidentiary documents relating to the institution's actions from all of the documents the institution prepares

throughout its daily operations and managing them from production to final destruction while protecting their format and characteristics.

2.3.1 Electronic Documentation Process

According to Oral and Aydinli (2017), every document utilised in the company has a life cycle. This life cycle includes operations that begin with the document's creation and finish with its destruction. The above view strengthens the findings of Johnston and Bowen (2005) and Yusof and Chell (2000). Figure 2 exhibits the critical processes in the life cycle of an electronic document, which the stakeholders' access through an EDMS.

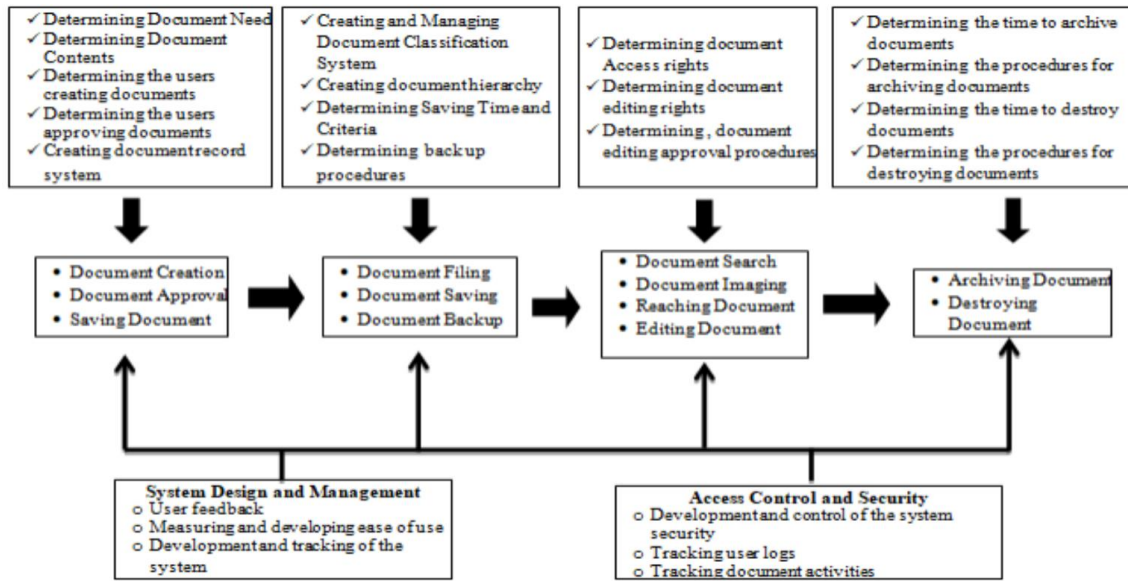


Figure 2: Key processes in the life cycle of an electronic document
Source: (Oral & Aydinli, 2017)

Accordingly, EDMS can manage the documents in these vital life stages by quickly upgrading revisions.

2.3.2 Electronic Document Management Software Used in the Construction Industry

There are several software brands available now for electronic document management. Software-suggest (2023) provides a list of well-known document management tools. Aconex, FileHold, Efilecabinet, dMACQ DMS, Skysite, and Procure are some brand names used globally. The majority of firms in the world currently uses those systems.

2.3.3 Impacts of Electronic Document Management Systems (EDMS) on the Construction Industry

According to Mandicak et al. (2022), EDMS provides a comprehensive, effective system to electronically collect, manage, and secure critical data in a flexible yet regulated manner, allowing to keep everything in one place, waste less time and save money while work from anywhere, simplify compliance, and guarantee security by eliminating lost or misfiled construction documents. Furthermore, they highlighted that automating superfluous procedures, controlling access and tracking building documents, saving money and space, fast-tracking the completion of construction papers, performance maximisation, expanding the building company, processing bidding paperwork, building financing, and more can be easily achieved through the implementation of EDMS.

Moreover, an EDMS simplifies users' jobs and provides the organisation with security, data dependability, and work process management (Forcada, 2005; Mandicak et al., 2022). These characteristics ultimately reduce time, facilitate work, secure investment in document creation, enforce quality standards, allow an audit trail, and assure accountability. Moreover, the initialisation of EDMS in construction projects expands advanced opportunities and effective technologies in future including BIM and blockchain (Kiu et al., 2022).

However, Fernando et al. (2019) stated that in developing nations such as Sri Lanka, no significant efforts have been made to implement electronic document management technologies, nor attempts have been made to comprehend documentation needs appropriately.

3. RESEARCH METHODOLOGY

This study followed a qualitative research approach with a survey strategy and utilised expert interviews as the data collection technique. This approach was led by the researcher's requirement to collect broad and subjective data about attitudes, views and behaviours through the participants, where Kothari (2004) identified the qualitative approach as appropriate. Accordingly, to identify the insights of the QS experts of the construction industry regarding the current DMSs used in construction projects, their limitations, suitability, awareness, and limitations of EDMS and its tools, 12 semi-structured expert interviews were conducted with Qs in the construction industry, with the knowledge and experience on different DMSs. Here, the professional Qs in the construction industry was selected as the population, and the experts were identified using judgemental sampling, where the experts have knowledge and experiences on different DMSs, making them suitable to be participated as an expert. This sampling technique has been recognised for studies where the researcher defines the purpose and involves their knowledge in the determination of participants (Andrade, 2021). Table 1 provides the details of the respondents who participated in the study.

Table 1: Respondent Profile

Expert Code	Designation	Industry experience
R1	Senior Quantity Surveyor	08 years
R2	Quantity Surveyor	05 years
R3	Quantity Surveyor	03 years
R4	Quantity Surveyor	04 years
R5	Senior Quantity Surveyor	11 years
R6	Quantity Surveyor	06 years
R7	Consultant Quantity Surveyor	04 years
R8	Senior Quantity Surveyor	22 years
R9	Senior Quantity Surveyor	09 years
R10	Senior Quantity Surveyor	06 years
R11	Senior Quantity Surveyor	07 years
R12	Senior Quantity Surveyor	10 years

4. DATA ANALYSIS AND DISCUSSION

4.1 DOCUMENT MANAGEMENT SYSTEMS USED IN SRI LANKAN FIRMS

Experts validate the less use of EDMS in Sri Lanka, and five (05) respondents (out of 12) confirm their current experience with EDMS but in partial. Specifically, R2 emphasised that *"firms will find it challenging to adopt EDMS for QS-related activities entirely"*. This view has been emphasised by R1, explaining the mixed use of conventional and electronic DMS in their firms and claiming that *"ERP and Aconex systems are employed, and ERP handles pre-contract process documenting while Aconex addresses post-contract phase documenting but, in some instances, conventional document management systems are also employed in the company"*. Moreover, R10 and R11 similarly explained the mixed use of DMS in their organisations. According to their views, conventional DMS are highly weighted (with more than 50% of use), and EDMS are less commonly used, primarily in the pre-contract stages.

Seven (07) experts ascertained their entire experience with conventional DMS, and R6 highlighted that *"all papers are filed as hard copies, with multiple copies generated for the Employer, Engineer, and Contractor reference copies. Soft copies are also stored as working documents, and a scanned signed copy serves as the final draft"*. Furthermore, R7 mentioned the use of electronic devices in the generation and exchange of documents; however not entirely electronic because *"all letters are sent with signed physical copies, as well as a scanned copy of the signed letter and attachments delivered through email. Working copies of letters are also maintained, organised by the person to which the letter is sent and the reference number "*.

According to the information above, QSs have basic knowledge about EDMS and are also curious about adapting EDMS. However, it portrays minimal use in Sri Lankan firms as a hybrid approach and conventional DMS. Furthermore, firms that use EDMS are designated explicitly as international firms or any local firm that has a link with a foreign firm highlighting that Sri Lankan firms are still reluctant to adopt EDMS for the cost management of megaprojects.

4.2 LIMITATIONS OF CONVENTIONAL DOCUMENT MANAGEMENT SYSTEMS

Despite being the abundant DMS in Sri Lanka, conventional DMS instigates a variety of difficulties and limitations for the users. The experts illustrate the limitations of conventional DMS, as shown in Table 2.

Table 2: Limitations of conventional DMS

Limitation	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12
Delivery Speed is slow	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
A tremendous amount of waste is created		✓			✓	✓				✓	✓	
It needs more storage space	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
The documents' durability is poor	✓				✓		✓					✓
The procedure of delivery has become more challenging			✓			✓				✓		

Limitation	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12
Finding paperwork in an emergency is difficult	✓	✓			✓		✓				✓	✓
It is tough to locate old records		✓		✓				✓	✓			
When sending documents, agents provide private data to external parties			✓				✓	✓				
During a lockdown in a pandemic crisis, there is no access to papers	✓					✓				✓		
If there are a large number of users, need to print a large number of hard copies		✓							✓		✓	

Given the preceding opinions of each expert, it is evident that most of them have raised similar issues about the conventional document management system. As a result of the concerns mentioned above, it is clear that everyone agrees that the most prevalent difficulty with conventional DMS is the necessity of high storage and poor delivery speed. Similarly, R6 stated, "*the most significant difficulty with the conventional document method is storage and time.*" Apart from the two primary concerns described above, most experts cited issues such as increased waste generation, complex delivery procedures, difficulty finding papers in an emergency, and poor durability as other critical issues with the conventional document management system. "*If there are a significant number of users,*" R5 stated, "*we must print many hard copies.*" The time spent collecting and submitting hardcopy papers was unnecessary, and it was also demonstrated that the conventional document management procedure is far more complicated.

According to the information mentioned earlier, conventional DMSs use in Sri Lanka has several challenges, which are impacted by the firm's status. Due to the aforementioned issues faced by conventional systems firms, it has become a driving force to switch from conventional document management to electronic document management systems (EDMS). Overall, limitations of conventional DMS have strengthened the focus of Sri Lankan construction firms to utilise EDMS.

4.3 SUITABILITY OF ELECTRONIC DOCUMENT MANAGEMENT SYSTEM TO SRI LANKAN CONSTRUCTION INDUSTRY

All the respondents positively accepted EDMS to the construction sector in Sri Lanka and explained its benefits and challenges. When evaluating the opinions of interviewees on EDMS, R1, R10, and R11 stated that EDMS is a superior option for document management as maintaining and managing documents using EDMS is effective and efficient. In addition, R3 stated, "*It is a superior solution for large-scale projects.*" Furthermore, R2 emphasised the suitability of EDMS with a current example and highlighted that EDMS is more advantageous in pandemic situations, particularly for megaprojects to carry out work in a "work from home" approach, since time management is critical in megaprojects owing to their high time consumption. On the other hand, R6 noted, "*For small-size projects, it could be a pricey option*", while R9 and R12 expressed similar sentiments about its applicability for small-scale projects.

Nonetheless, this suitability is subjected to some limitations. Specifically, R4 claimed that "*Benefits should be considered and a cost analysis should be conducted to assess the viability, prior to implementing EDMS,*" whilst R6, R9, and R12 indicated that EDMS is not a simple mechanism. It requires an adequate technical understanding to get the best results accordingly. Furthermore, the experts representing government organisations R6, R8, R9, and R12 stated that the Sri Lankan government sector is still not ready to embrace EDMS in their construction firms.

4.4 AWARENESS OF ELECTRONIC DOCUMENT MANAGEMENT SYSTEMS IN SRI LANKA

As per the data gathered through expert interviews, experts that have already used EDMS in their firms have a greater level of understanding, which is to be expected. However, the significant takeaway from the given information is that the experts with conventional document management systems in their firms are also aware of the EDMS to a decent degree. Accordingly, all the experts have an acquaintance with the meaning, purpose, and concepts of EDMS. Hence, the results provoke low utilisation despite the considerable knowledge and awareness of EDMS in the Sri Lankan context.

4.5 AWARENESS OF EXISTING ELECTRONIC DOCUMENT MANAGEMENT SYSTEM SOFTWARE IN THE SRI LANKAN CONSTRUCTION INDUSTRY

Although most respondents are aware of the concept of an EDMS, they are less familiar with the electronic document management tools that most organisations now utilise. "*In Sri Lankan firms that have already switched to EDMS, Aconex is the frequently utilised Electronic Document Management System,*" R1 stated. The concept conveyed by the R1 was supported, according to the interpretation of the R2, R3, R10, and R11, since they had the same motive about the existing EDMS in the local context. Furthermore, R1, R2, R3, R5, R7, and R8 stated that ERP is an EDMS utilised in the local context, but R4, R6, R9, and R12 had no idea about the current electronic document management tools in the local context despite being familiar with the concept of EDMS. Nonetheless, the experts' awareness of EDM tools used globally was far lower since they only knew of Aconex. As a result, their comprehension of EDM tools in a global context was inadequate, even though a few other tools are utilised in a global setting, as evidenced by the literature findings in Subsection 2.3.1.

4.6 BARRIERS TO THE USE OF ELECTRONIC DOCUMENT MANAGEMENT SYSTEMS IN THE SRI LANKAN CONSTRUCTION INDUSTRY

Even with the fact that the construction industry is willing to incorporate EDMS, a variety of barriers hinder the use of EDMS. First, the system's complexity, which is not supported by the available facilities of the construction industry, can be identified. This opinion has been confirmed by R3 and R11 and indicated that the project's magnitude is one of the main concerns which hinders the use of EDMS. Further, small projects are having a problem when comparing their project costs to the EDMS as it requires a high initial cost and ongoing maintenance cost. Accordingly, the size of the project acts as a barrier to initiating EDMS in the Sri Lankan construction industry, consequent to the difficulty of managing finance.

Further, R6 and R9 emphasised that the Sri Lankan government did not participate in or do a study on EDMS to modernise its systems. Also, according to E12, "*most of the*

employees lack the proper technical knowledge and apprehension about implementing new systems". This knowledge deficiency is a severe concern that limits the use of EDMS in the Sri Lankan construction industry, which is further validated by E8, which states that some professionals are hesitant to rely entirely on electronic documents as they are unfamiliar with them. Overall, based on the information acquired from the interviews and the literature, it is evident that EDMS is the new worldwide trend in construction documentation. However, as stated in the preceding section, the Sri Lankan construction sector is experiencing difficulties adopting EDMS.

5. DISCUSSION

The empirical findings of this study convey the limitations of conventional methods for document management, which illustrates similar views to the findings of Jane (2020) and Melo (2019). However, damages that occurred during the transportation, which was identified as an issue by (Melo, 2019), were not revealed as an issue in Sri Lankan context. Nonetheless, the QSs' level of awareness of electronic document management tools in a global context was far lower since they only knew of Aconex. It contradicts the view of Software-suggest (2023), which highlights the great use of EDMS in the global context. Further, Sri Lankan QS considers time-saving and multiple editing as the pros of EDMS and recognised technology and cost as the significant cons. Henceforth, despite Accruent's (2023) findings, Sri Lankan QSs must be more aware of EDMS's benefits. As a result, comprehension of Sri Lankan QSs regarding the electronic document management tools used in a global context was inadequate.

Moreover, findings of the empirical study emerge the benefit of EDMS in work-from-home concepts and crises. Concerning the application of EDMS to the Sri Lankan construction industry, this study contradicts the findings of Fernando et al. (2019) and mentions that Sri Lankan industry efforts to adopt EDMS, especially for mega construction projects and however, the efforts of expanding are in vain consequent to the identified barriers. Barriers to adopting the EDMS in Sri Lanka from the QSs perspective disclose similar findings to the study of Haupt and Naidoo (2016). In addition, less support from the government, project size and less familiarity with electronic documentation have been revealed as current barriers for Sri Lankan QSs.

6. CONCLUSIONS

Sri Lanka prominently practises conventional documentation, basically hardcopies and/or softcopies stored in a computer folder. Even though storing data in softcopies has taken attention, professionals rarely agree to maintain only softcopy documents. This documentation process highly impacts the successful completion of construction projects and creates various time, cost, quality, and storage issues. Following this, Sri Lankan QSs are ready to welcome EDMS positively but not ready to practically implement it in their projects, consequent to various barriers within and beyond their control. Accordingly, the current barriers are the complexity of EDMS technology, unavailability of adequate training facilities, compatibility issues, absence of a standardised procedure, attitudes and perceptions. Moreover, the QSs generally understand the EDMS concept but are less familiar with the tools.

Various circumstances limit the use of EDMS in construction projects, including project size, hesitation of government and professionals, and incompatibility with the current

practices of construction projects. To sum up, conventional DMS is proved to be a less efficient solution for the document management of construction projects, and EDMS is also difficult to be initiated. Accordingly, future studies can focus on the different stakeholders who are less responsible for less incorporation of EDMS to identify feasible solutions to normalise it in construction projects.

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