Centralized Quotation Management System for Quantity Surveyors

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ABSTRACT

Quotation management is a core pre-contract responsibility of quantity surveyors; however, in current construction practice, it remains predominantly manual, fragmented across emails, paper records, and isolated spreadsheets. Such practices contribute to processing delays, inconsistent data, limited cost transparency, and a higher risk of errors during the pre-contract stage. Despite the growing availability of digital tools in the construction industry, quotation management in quantity surveying continues to lack affordable, structured systems tailored to the operational needs of small- and medium-scale practices. To address this gap, this study proposes a centralized quotation management system in Microsoft Excel, integrated with Visual Basic for Applications (VBA). A system development methodology was adopted, comprising workflow mapping, identification of process weaknesses, system design, and prototype implementation. The proposed system design consolidates supplier quotations, material specifications, unit rates, and basic project indicators within a single platform, incorporating limited automation and data verification features to reduce duplication and improve record traceability. While the system was not empirically tested through live project deployment or formal user evaluation, the prototype demonstrates the practical feasibility of using spreadsheet-based tools to improve the organization, consistency, and accessibility of quotation data. The findings suggest that, although not a substitute for fully integrated commercial software, a structured Excel-VBA solution can offer a low-cost, transitional digital approach for enhancing quotation management in resource-constrained quantity surveying environments.

Keywords: Quantity Surveying, Quotation Management, Cost Estimation, Microsoft Excel, Visual Basic for Applications (VBA), Construction Digital, Built Environment

INTRODUCTION

The construction sector is relevant to the development of the national economy, but one challenge is inefficiencies in cost management (Abdelalim et al., 2025). Quotation management is one area that has been severely impacted, and quantity surveyors mostly handle it during the pre-contract stage. These days, quotations are usually requested, received, compared, and selected via email, phone, and paper. This manual, disjointed system is ineffective, time-consuming, and very dependent on administrative work. Consequently, quantity surveyors experience increased workload, delays in decision-making, and a greater likelihood of errors and inconsistencies in evaluating quotations (Bascoul et al., 2020).

The management of quotations has become more complicated due to the increased number of suppliers, the widening scope of work, and price variations in construction materials. The process of handling multiple quotations manually complicates achieving reliable historical price records, transparency, and effective price comparison (Daoud et al., 2023). Moreover, the absence of a centralized digital system limits traceability and accountability during the quotation process. Such a lack of systematic control and audit trails also predisposes to unethical practices such as collusion and price manipulation, which may result in overstated project costs (Xiao et al., 2021; Hu et al., 2023).

Digital technologies, such as cloud-based storage, database systems, and spreadsheet automation tools, are by far the most prevalent. However, only a small number of digital quotation systems incorporate all of these technologies into their overall quotation management process. Bascoul et al. (2020) demonstrated that tools such as Microsoft Excel with Visual Basic for Applications (VBA) can automate and improve accuracy and efficiency

in construction cost analysis. Aspects of cloud-based platforms have been shown to enable better access to documentation and collaboration among project stakeholders (Abedi et al., 2014). Existing research examines each of these tools in isolation and does not provide a unified system within the practical work flows of quantity surveyors at the quotation stage.

Even though the available literature suggests computational remedies for managing construction costs and quotations, these primarily focus on sophisticated technologies such as BIM-based solutions and enterprise systems, which are not the solution to the real-life challenges faced by quantity surveying (QS) companies. These papers do not focus on the daily quotation management issues during the pre-contract phase, such as fragmented quotation history, manual evaluation of multiple suppliers, the lack of a centralized price history database, and poor document tracking. Consequently, there are a few concerns about the applicability of these digital solutions in small- and medium-sized QS consultancies.

In practice, QS firms continue to use manual Excel sheets, emails, and paper-based communications because they are cheap, well-known, and require minimal technical skills. In contrast, commercial digital systems are expensive, complex, and require specialized IT services. This scenario underscores the need for a centralized, low-cost quotation management system specifically designed to support QS workflows. With such a system, the gap between manual operations and intricate commercial software would be bridged, as centralized data storage, quotation comparison, and trustworthy historical price tracking could be realized during the pre-contract estimating process.

The current paper concludes that the current quotation management practices in the construction industry, especially at the pre-contract stage, are still ineffective as they continue to use fragmented and manual tools, including the use of the spreadsheet Excel, emails and paper-based documentation, which raises the workload of the quantity surveyors, slows down the decision-making process and enhances the risk of errors and inconsistency. These difficulties are also compounded by rising project complexity, more suppliers, more frequent price variations, and the lack of a central system that can reduce transparency, traceability, and the effective use of historical price information. The study addresses these problems by presenting the need for a low-cost, centralized quotation management system that is practical enough to support current QS processes and by leveraging tools such as Excel and VBA to facilitate automation, systematic quotation comparison, and consistent price tracking. Therefore, this paper aims to analyze the weaknesses of current quotation management practices and to develop a centralized quotation management system that improves efficiency, accuracy, and reliability during the pre-contract stage.

Problems Statement

In Malaysia, quotation management practices in quantity surveying (QS) companies are fragmented due to a lack of a structured, centralized system. Information on quotations is often scattered across emails, WhatsApp messages, paper files, and separate Excel spreadsheets, leading to poor coordination and inefficient information flow in organizations. This disintegration fosters record duplication, administrative inefficiencies, and inconsistent cost information, and it greatly burdens the workload of quantity surveyors and diminishes the accuracy of quotation appraisal in the pre-contract phase (Nasrun et al., 2014).

The issue is also complicated by the fact that construction material prices have changed significantly many times over the years, and the variety of building components is growing, requiring proper, current historical cost records. Nonetheless, quantitative surveyors are unable to maintain unified, reliable price databases due to manual, fragmented record-keeping. Consequently, quotation comparisons are often based on incomplete or outdated information, increasing the likelihood of pricing errors and cost-estimation mismatches (Memon et al., 2013).

Moreover, there is no structured digital system, so there is no traceability or proper audit trail in quotation management. Poor documentation management leads to a lack of transparency and accountability, making it hard to justify cost decisions and increasing the possibility of conflicts and mistrust among project stakeholders (Hamzah, 2012). Although there are current digitalization efforts in the Malaysian construction sector, actionable and affordable digital solutions that fit within QS quotation processes are still few, thus limiting the ability to make effective decisions and reducing the overall effectiveness of cost management processes.

Review Of The Current Approach

In contemporary construction, college students such as us often find it easier to confuse the supplier's standard evaluation tools with the quotation processes the Quantity Surveyor (QS) executes (Deepika et al., 2020). Much of the literature shows that Fuzzy Delphi, Fuzzy AHP, and Fuzzy TOPSIS are decision-making frameworks adopted by some companies to select suppliers based on factors such as price, quality, delivery period, and technical expertise (Deepika et al., 2023). These models are designed to make supplier selection more rational and objective. However, in most instances, they are not consistently applied outside the job site. According to some researchers, they help reduce bias, while others claim that QS and project teams rarely use them because they are too complex and not associated with any quotation work.

As Duarte and Sousa (2020) indicate, the actual go-to technique on the field is pre-qualification, i.e., asking for quotes. The old-fashioned approach involves completing a basic form, verifying the financial statements, and examining the contractor's previous projects. The reason behind its success is that it aligns with the routine activities of the QS, like trying to quickly determine whether a tenderer will actually be able to do the job. Nevertheless, it is primarily a method for screening eligibility and does not necessarily make the QS aware of whether the prices are legitimate.

The second trend we observe is a preference for maintaining long-term supplier relationships rather than searching for new suppliers per project (Bemelmans et al., 2012). In a one-off quoting system, having the same subcontractors enables QS to avoid price errors and save time in negotiations. However, Da Alves et al. (2017) found that long-term relationships do not necessarily improve outcomes. Contractors in their study also conducted internal quality and performance checks, but discontinued feedback to suppliers. Consequently, suppliers did not even know that they were committing errors. In the case of QS, it may mean that either new or existing suppliers may continue to submit the same pricing mistakes, omissions, or incorrect units to the tender, causing a recurring nightmare in subsequent tenders.

Weaknesses of Using a Traditional Method of Finding Quotation.

Common traditional quotation methods, despite their widespread use, also have several weaknesses from a QS perspective. The gap between QS theory and practice is one of the principal weaknesses. According to Deepika et al. (2023), more sophisticated mathematical models can improve supplier selection. Nevertheless, Duarte and Sousa (2020) claim that such models are overly complicated and time-consuming for most QS. QS is frequently required to make hasty decisions in actual projects. Thus, quick, plain information tends to be more critical than complex calculations, particularly on fast-track projects. This makes such models of little use in actual quotations.

The other significant weakness is the low quality of the tender documents used for pricing. As Whang et al. (2022) state, inaccurate quotations are often due to unclear or incomplete tender documents. From a QS perspective, this impacts cost planning and budget control, as subcontractors may miss items, underestimate quantities, or even introduce very high contingency costs. According to Laryea and Lubbock (2014), subcontractors usually have very little time to make their quotations. Consequently, QS can be presented with rushed, unreliable prices. This issue is especially acute because every construction project is unique, making it hard to standardize the quotation format and the method of checking (Almaian et al., 2015).

Traditional quotation practices also have ethical weaknesses. The literature demonstrates that collusion and bid rigging still occur, particularly in the absence of effective surveillance and low transparency (Shan et al. 2017; Youssef et al. 2023). In the case of QS, this goes against the essence of gathering various quotations, which is to achieve fair and competitive prices. The absence of proper checking systems can cause QS to make cost decisions based on inflated or manipulated prices, without knowing, thereby inflating project costs and reducing clients' confidence.

Technological Solution And Available Tools

The new approach to the traditional systems employed in the highly strategic field of quantity surveying would therefore involve implementing the most modern procurement technology, including automated Visual Basic Applications, cloud storage, and data servers. The advantages of the system include not only the ability to

improve process speed but also the potential to address a range of problems associated with traditional procurement processes. For example, the system would eliminate the likelihood of mistakes arising from traditional tender calculation procedures. The rationale for introducing the system is its capacity to organize a substantial amount of information used to refine estimation processes in quantity surveying.

Calculation and data management solutions are among the pillars on which the paradigm of quantity surveying is built, and they help develop an objective method for supplier management. The delivery of these solutions also helps avoid the subjectivity that influences the contractor selection process. One of the most important roles of quantity surveyors is effective data management on servers, given the impact this has on data security and information management. This technology is integral to the profession, given its significance for a more objective approach to post-contract management and subsequent construction disputes.

Microsoft Excel and VBA

Visual Basic of Applications (VBA) squarely eliminates the management choke points and vulnerability to human error present in manual quotation processes. Unlike traditional spreadsheet applications, VBA scripts help automate the distribution of enquiry packs, thereby eliminating the inefficiency of manually delivering email messages to numerous suppliers (Akinshipe et al., 2021). Besides, VBA minimizes the risk of faulty calculations during the analysis stage, as the software automatically sociologically breaks down supplier datasets for the lowest bidders and uncovers abnormalities, replacing the less efficient, more error-prone manual comparison (Ershov et al., 2012). However, despite VBA's ability to process and automate, it is not designed to support the volumes of graphical documentation that are often necessary in the tendering process; thus, the use of auxiliary storage systems (Keng & Ching, 2011).

Cloud Storage

Cloud computing databases, such as Microsoft Azure and Amazon Web Services, reduce logistical issues in distributing large tender documents, including technical drawings and specifications. These solutions also overcome the accessibility constraints of local storage by creating a centralized repository, enabling suppliers to access large files and deliver quotations remotely regardless of geographic location (Daher and Hajjdiab, 2018). This infrastructure addresses fragmented communication channels and enhances collaboration (Mohd et al., 2024). It must be noted, however, that cloud storage improves data exchange and access to the required content but does not embed the computational logic to analyze the price-related information in the presented documents (Bocchi et al., 2014).

Data Servers

The infrastructure required to manage the Master Vendor Lists and the historic pricing Database includes data servers. Compared to cloud-based solutions used to exchange files actively, secure servers are used to store confidential business information and verified supplier details, thereby preventing proprietary information from being compromised through entry points (Srinivasan and Krishnan, 2013). This centralized paradigm helps organizations sort suppliers by performance and capability (Sarkar et al., 2018), yet implementing such a strict infrastructure is generally more capital-intensive than a flexible cloud infrastructure (Rao and Reddy, 2016).

Table 1: Comparison of Tools

Technology Used	Strengths	Weaknesses
VBA (Excel)	**Automated Processing:** capable of auto-generating enquiry emails and mathematically comparing line-item prices. **Accessibility:** Utilizes a familiar interface with low barriers to entry for basic tasks.	**Transfer Limitations:** Relies on email for file transfers, creating version-control issues. **Stability Issues:** Performance degrades or crashes when processing excessive data volumes.

Cloud Storage	**Logistical Capacity:** Hosts voluminous drawing files and specifications that email cannot handle. **External Collaboration:** Facilitates suppliers in any location to post their quotes in a central location.	**Lack of Intelligence:** Pure data storage; without comparing, reading or analyzing data on prices held in files. **Security Risks:** Cloud links may pose security risks, as they can easily lead to information leakage when not implemented properly.
Data Servers	**Data Integrity:** Trustworthy means of securing Master Vendor Lists and past pricing information. **Audit Compliance:** Requires proper logging and security of proprietary information.	**Very Complex:** It is extremely inflexible and extremely expensive to enable simple, fast communication, such as sending enquiries. **Limited Access:** It normally does not allow outside vendors easy access to the system.

Table 1 compares the technologies and their operating capabilities, along with their limitations. Cloud storage technology excels at the logistical Processing of files, whereas data servers offer advanced capabilities that work best for data protection. Nonetheless, both of these technologies lack any fundamental aptitude for cost analysis performance. Therefore, Processing using Microsoft Excel and Visual Basic for Applications (VBA) has been determined to be the best approach, despite the inherent constraints of data processing and file transfer. The discovered technology is suitable because VBA's inherent capacity to perform the logical computations required to evaluate quotations, automatically allocate all inquiries, and make judgments on all incoming quotations.

Enhancement of Data-Driven Decision-Making

The Data-Driven Decision-Making approach can be used in quotation analysis to assess whether the quotation differs from the classical aggregated cost method and, instead, use supplier evaluation based on evaluation steps such as value for money rather than the general cost. The strategy also leaves behind the old-fashioned tradition of awarding contracts to the lowest bidder and would most likely take into account nonstandard prices during the process. With fact-based, objective standards trumping traditional standards, the role of the quantity surveyor in quotation analysis shifts to objective quotation evaluation to identify a supplier whose costs and other technical details meet project standards (Maheshkar et al., 2024; Thiess and Müller, 2018). The cost-structure analysis technique also improves negotiation tractability and effectiveness (Ojha et al., 2024; Jeyaprabha et al., 2025).

Microsoft Excel with VBA is used in this research as a useful tool for analysis. The advantage of using VBA scripts is that they can automate data normalization, enabling the surveyor to perform "what if" analyses, such as assessing how changes in material prices affect the tender sum (Dehghanimohammadabadi, 2022).

Additionally, it is possible to create dashboard analyses that visually represent price variations and outliers across different tenders using VBA. This capability to provide data visualization enables raw tender data to be effectively analyzed, providing a sound justification for the quantity surveyor to recommend the supplier offering the most economic supply (Bir et al., 2024; Chatvichienchai, 2023).

Overall, existing studies have primarily focused on advanced procurement decision models, cloud-based storage systems, or enterprise-level cost management platforms. While these approaches demonstrate technological potential, they often require complex infrastructure, specialized expertise, and high implementation costs, limiting their applicability for small- and medium-scale quantity surveying consultancies. Moreover, current research tends to address individual components of quotation management, such as supplier evaluation or data storage, rather than providing an integrated, workflow-oriented quotation management solution tailored to quantity surveyors' daily operational practices. Therefore, there remains a practical research gap in developing a low-cost, centralized quotation management system that integrates quotation recording, comparison, and historical price tracking within a single operational platform, which this study aims to address.

Current Process Of The Existing Method

In the current process for a quantity surveyor to receive a quotation for Bill of Quantities (BQ) cost estimation, it starts with identifying all items in the draft BQ that need updated market rates by the QS. These items usually

include materials, specialist components and products with unstable market prices. The QS then prepares detailed descriptions for each item, including specifications, quantities, required standards, and brand requirements.

The QS then identifies suitable suppliers or subcontractors using the existing suppliers list, contacts from previous projects, recommendations or online searches. A Request for Quotation (RFQ) is prepared and sent manually via email, phone, WhatsApp, or formal letter. If a supplier does not respond by the deadline, the QS must repeatedly follow up through reminders, which is time-consuming.
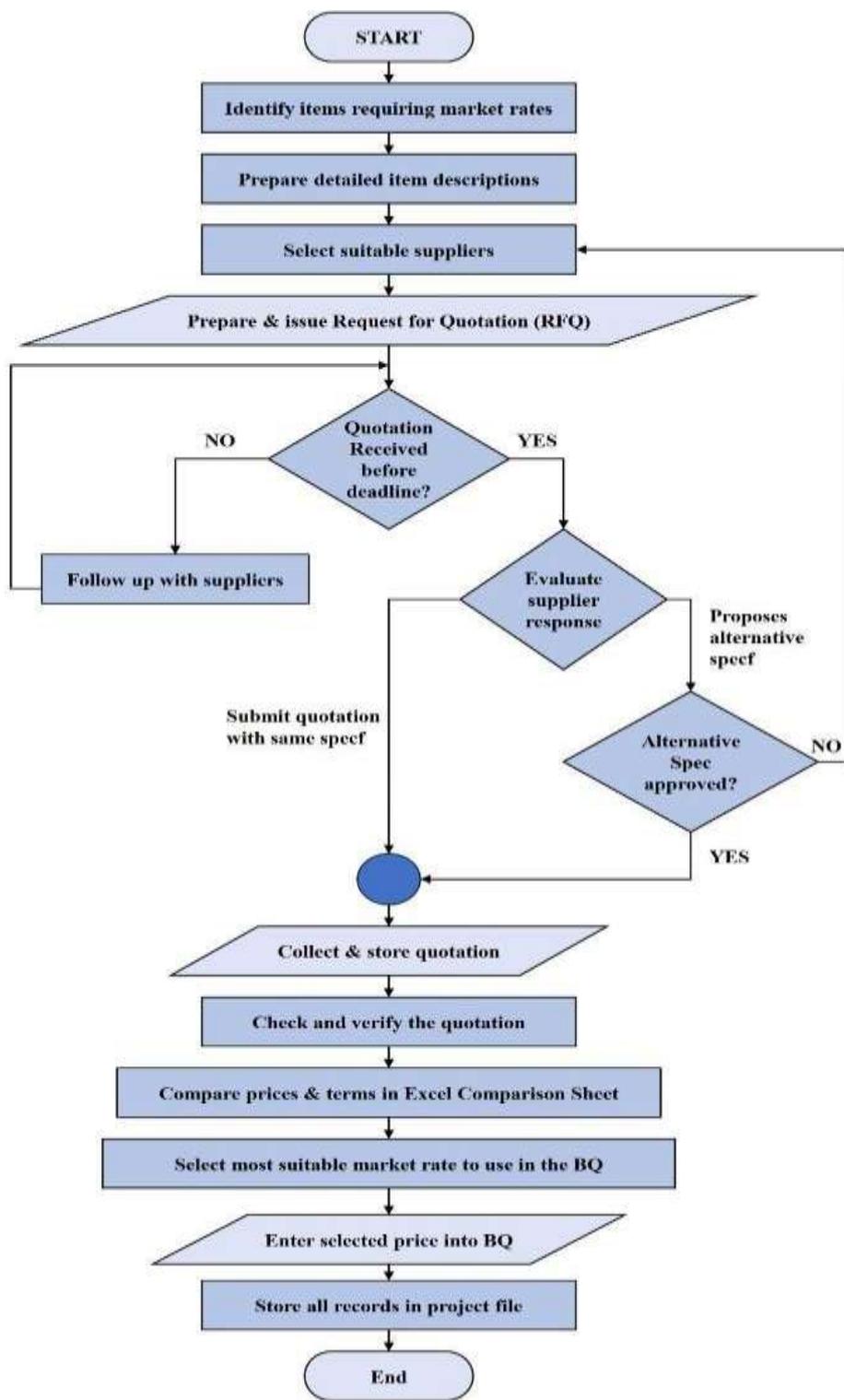

Figure 5.1 Flow Chart of Current Process

Several different situations may occur when suppliers respond. Some suppliers submit quotations, while others refuse due to a lack of stock, an unsuitable scope, or unstable prices. In some cases, suppliers propose alternative specifications that cannot be used without approval. When quotations are rejected or deemed unsuitable, the QS must identify new suppliers, resend RFQs, and repeat the follow-up process, leading to duplication and delays.

After receiving quotations, the QS collects and stores them. Quotations could be in PDF, Excel, WhatsApp messages or printed copies. All quotations are checked and verified for prices, specifications, quantities, delivery terms, validity periods, and exclusions. Suppliers are contacted if clarification is needed. All prices will be compared manually in Excel before the QS selects a suitable market rate to enter into the BQ. All RFQs, quotations, and comparison records are stored in the project file. Therefore, the process is highly manual, time-consuming, and repetitive, with a high reliance on follow-ups and document management, which increases the risk of delays and data inconsistency.

Proposed New Process For Quotation Management System

The proposed quotation management system is a prototype designed to centralize and manage supplier quotations for quantity surveying (QS) work. It is built in Microsoft Excel using VBA to provide a more efficient, organized quotation management process. Users access the system via a secure VBA login form, where authentication determines whether the user is an Editor or a Viewer. This access control safeguards data and ensures only authorized users can make changes.

Editors have full control over the quotation database. They can add new material types and create quotation records received from suppliers using a structured input form. Important details, such as the material type, supplier information, project reference, item description, unit rate, total price, date of quote, and supporting documents, must be entered before saving. This reduces missing data, improves consistency and minimizes input errors. Quotations can also be changed by the editor in the event of price changes, and all changes must be recorded to maintain a clear history of revisions. When it has been verified that the quotations are outdated or incorrect, they can be deleted to ensure the database is reliable and up to date.
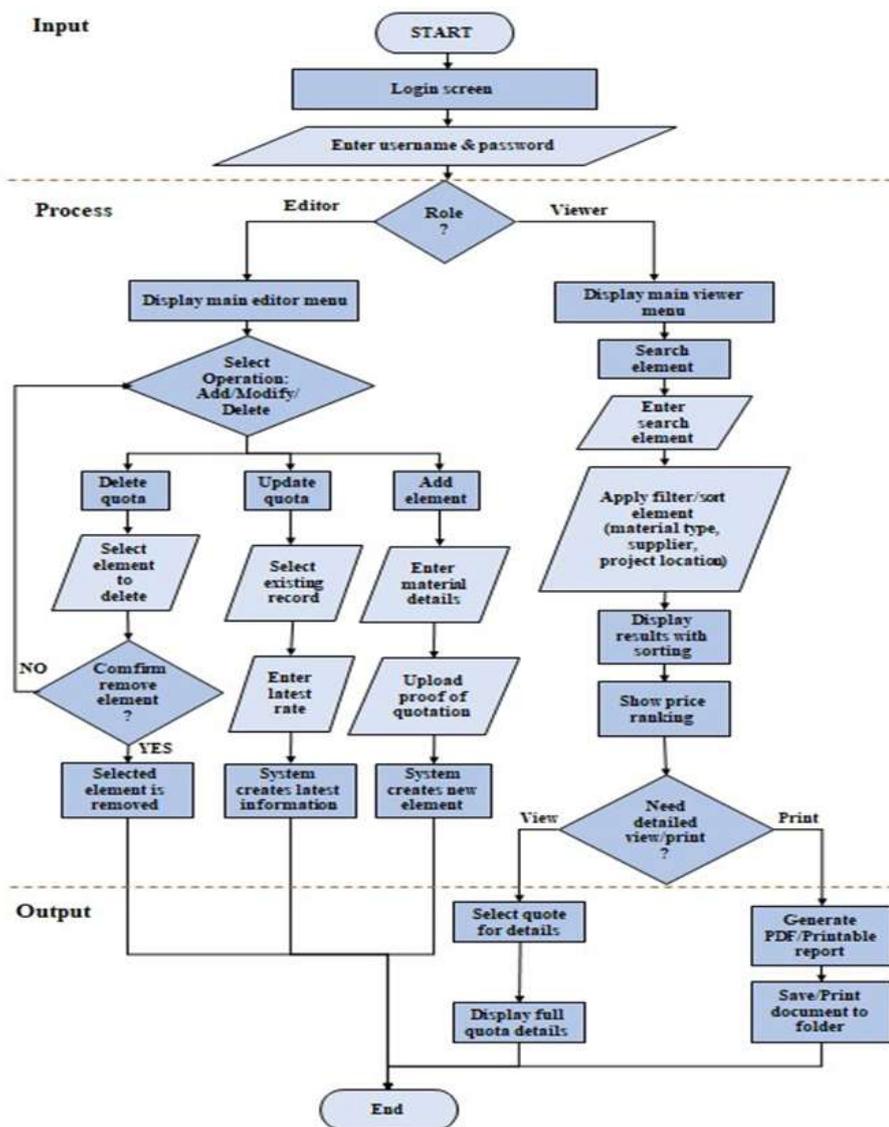

Figure 5.2 Flow Chart of New Process

Viewers primarily use the system to source costs and make decisions. They have read-only access but are given search, filter, and sort functions to quickly find quotations by material type, supplier, project, date, or rate. This eliminates the need to search through emails, WhatsApp messages or multiple spreadsheets. When a quotation is selected, all details and supporting documents are displayed in a clear, standardized format. The system also automatically calculates and displays the highest, lowest, and mean rates for each material type, which helps QS understand market price ranges and select suitable rates for BQ preparation. To assist with documentation and record-keeping, the system can generate printable or PDF quotation reports.

As a result, this prototype demonstrates that a centralized, semi-automated quotation management system could help reduce repetitive manual work, reduce the risk of errors, and enable faster cost comparisons. The system enhances a more efficient, professional QS workflow by improving data organization and accessibility.

System Architecture And Development Stages

The development of the proposed quotation management system followed a structured system development process. Firstly, workflow analysis was conducted to identify inefficiencies in the existing quotation management practices. Subsequently, system requirements were defined, and functional specifications were developed to ensure the system addressed the identified operational needs. This was followed by the development of a prototype in Microsoft Excel, integrated with Visual Basic for Applications (VBA), enabling automated quotation recording, comparison, and retrieval. Finally, functional testing was performed using simulated quotation datasets to verify the accuracy, reliability, and operational performance of the developed system.

The system architecture consists of three primary components. The first component is the user interface layer, which includes VBA-based input and retrieval forms designed to facilitate structured data entry and efficient information access. The second component is a centralized quotation database organized in relational Excel worksheets to support the systematic storage of historical pricing records. The third component comprises automated processing modules responsible for quotation validation, rate comparison, and report generation. Together, these components enable controlled data entry, centralized storage, and automated quotation analysis within a single operational environment.

Comparison Between The Current Process And The New Process

The comparison between the current quotation management process and the new process demonstrates how the proposed system addresses the research objectives of reducing manual workload, improving data accuracy and enhancing efficiency in QS cost estimation. Under the current process, supplier quotations are requested, received, and stored across multiple platforms, including email, WhatsApp, and individual spreadsheets. This fragmented workflow requires repeated follow-ups, manual data entry, and separate price comparisons, which increase the time required and the risk of errors. There is also inefficiency in retrieving information, as QS would have to go through various folders or communication records to find the relevant quotation.

In contrast, the proposed prototype system centralizes all quotation data in a single database. Quotations are recorded in a standardized input format with built-in data validation, directly supporting the research objective of improving data accuracy and consistency. Automated calculations of the highest, lowest, and mean rates further reduce manual comparison work and support faster, more informed decision-making during BQ preparation.

The current process also involves repeated handling of outdated or duplicated quotations, which affects the reliability of the market rates used. This problem is addressed by the proposed system, which supports controlled updates, maintains revision histories, and removes old records after verification. This is consistent with the study's objective of improving the reliability and traceability of cost information.

As a result, the existing procedure is mostly manual and relies on distributed sources of information, whereas the proposed system demonstrates that a formalised, centralised workflow can simplify QS practices. The comparison clearly shows that the new process is directly aligned with the research objective of reducing inefficiencies, improving accuracy, and providing a more systematic approach to handling quotations.

Benefits of the Proposed System

This system focuses on optimizing the efficiency of quantity surveying consultancies by reducing the time spent on repetitive processes. The process includes adjusting quotation document formats, re-entering unit prices, and processing email quotation submissions from various contractors and suppliers. With this system, these processes can be automated, allowing quantity surveyors to spend more time on other tasks such as cost analysis, bid evaluation, and financial decision-making, while reducing time spent on routine data processing.

Besides that, one advantage of this system is that it can provide centralized data management. All quotations received from contractors and suppliers are stored in a unified database, unlike the traditional method, which stores them in a folder. In reality, this helps surveyors be more efficient in retrieving historical unit price data during the early cost planning phase or when preparing cost estimates for similar projects. Centralized data storage is essential for feasibility studies and value engineering phases, as it supports rate comparisons and benchmarking analyses.

Furthermore, the system supports transparency and accountability in pricing management. This is because quantity surveyors can trace price changes, including rate updates and supplier modifications, through audit trails and also revise rate history. This feature is very useful in real-world practice during bid clarification meetings to justify pricing decisions. It also helps meet the requirements of professional documentation standards in quantity surveying practice, including improved record management (Royal Institution of Chartered Surveyors [RICS], 2017).

The system also improves communication and collaboration among the firm's facilities. By accessing the system, quantity surveyors can obtain the latest pricing information, compared to the traditional method, which requires follow-up emails or waiting for delayed responses from contractors and suppliers. For instance, all quantity surveyors in the firm can refer to the same up-to-date rates while preparing bills of quantities (BQs). It can reduce data inconsistency and also coordination issues.

Limitations Of The Proposed System

There are a few limitations to this system. One limitation is that employees need basic Excel and VBA skills. In real-world practice, quantity surveyors are generally unfamiliar with spreadsheet-based automation tools. There will be issues such as data entry errors, formula errors, or improper system operation if training is insufficient. Consequently, it will affect the reliability of the cost data used to prepare bills of quantities. This limitation highlights employees' knowledge of spreadsheet-based automation tools.

Moreover, the system has not been tested in quantity surveyor consultant firms. The performance is mostly based on sample data rather than real-world practice. The system also does not have a formal user to evaluate. Consequently, the system's advantages, such as ease of use, efficiency improvements, and practical application challenges, are not systematically evaluated. So, the system's limitations validate its suitability for real-world practice.

Nevertheless, key security and scalability issues are also limitations for the system. In the spreadsheet environment, the password protection is relatively low. The employees may share the password with others. It will increase the risk of unauthorized access and data tampering. Additionally, the data are stored in a file-based environment, which poses a risk of accidental overwriting or corruption. As the number of projects and quotation records increases, the system may struggle to handle large datasets efficiently. It is important to establish robust file management processes, access control mechanisms, and regular backup procedures to maintain data integrity and long-term reliability.

CONCLUSION

At its core, this research demonstrates that digital enhancement in Quantity Surveying does not necessarily require expensive or complex software. Rather, it needs a smarter, more methodical application of tools already used by QS professionals daily. This research addresses a real, typical issue in practice by systematically using Microsoft Excel and VBA to manage quotations scattered across emails, paper records, and individual spreadsheets, thereby simplifying the process and making it more effective.

This method has clear and practical advantages for the everyday practice of a QS. Keeping all the quotation details in a single point enhances the system's uniformity and reliability. Therefore, QS professionals will be more assured in explaining their pricing decisions by becoming more confident in justifying them during an audit, negotiation, or dispute, rather than spending a lot of time searching for records.

More to the point, the study helps bridge the gap between academic theory and actual practice. Most prior studies have focused on advanced systems that are extremely difficult to implement in typical projects, whereas this study is more realistic. It understands the time constraints and the shortage of skills available to QS professionals and provides a solution that integrates into their workflow. The paper will show that not every meaningful innovation in Quantity Surveying involves introducing new technology; rather, the key is to use the existing tools more wisely and effectively.

Future research should focus on conducting a pilot implementation of the proposed quotation management system within quantity surveying consultancy firms to evaluate its operational performance in the real world. Empirical validation using performance indicators such as reduced processing time, improved data accuracy, and increased user satisfaction would provide stronger evidence of the system's effectiveness and support further refinement for industry-scale adoption.

REFERENCES

1. Abbas, J. (2020). Impact of total quality management on corporate sustainability through the mediating effect of knowledge management. Journal of Cleaner Production, 244. https://doi.org/10.1016/j.jclepro.2019.118806
2. Abdelalim, A. M., Salem, M., Salem, M., Al-Adwani, M., & Tantawy, M. (2025). An Analysis of Factors Contributing to Cost Overruns in the Global Construction Industry. Buildings, 15(1). https://doi.org/10.3390/buildings15010018
3. Abedi, M., Rawai, N. M., Fathi, M. S., & Mirasa, A. K. (2014). Cloud computing as a construction collaboration tool for precast supply chain management. Jurnal Teknologi, 70(7), 1–7. https://doi.org/10.11113/jt.v70.3569
4. Akinshipe, O., Aigbavboa, C., Oke, A., & Sekati, M. (2021). Transforming Quantity Surveying Firms in South Africa Through Digitalisation. Lecture Notes in Networks and Systems. https://www-scopuscom.ezproxy.utm.my/pages/publications/85112286547?origin=scopusAI
5. AlMaian, R. Y., Needy, K. L., Walsh, K. D., & Da C L Alves, T. (2015). Supplier quality management inside and outside the construction industry. Engineering Management Journal, 27(1), 11–22. https://doi.org/10.1080/10429247.2015.11432032
6. Bascoul, A. M., Tommelein, I. D., & Douthett, D. (2020). Visual Management of Daily Construction Site Space Use. Frontiers in Built Environment, 6. https://doi.org/10.3389/fbuil.2020.00139
7. Bemelmans, J., Voordijk, H., & Vos, B. (2012). Supplier-contractor collaboration in the construction industry. Engineering Construction & Architectural Management, 19(4), 342–368. https://doi.org/10.1108/09699981211237085
8. Bir, V., Kumar, T., Tanwar, P., & Kumar, P. (2024). Developing an advanced tool for transforming spreadsheet data into interactive dashboards with predictive insights. 2024 2nd International Conference on Advances in Computation, Communication and Information Technology (ICAICCIT). https://wwwscopus-com.ezproxy.utm.my/pages/publications/105001281836?origin=scopusAI
9. Bocchi, E., Mellia, M., & Sarni, S. (2014). Cloud storage service benchmarking: Methodologies and experimentations. 2014 IEEE 3rd International Conference on Cloud Networking (CloudNet). https://www-scopus-com.ezproxy.utm.my/pages/publications/84925859035?origin=scopusAI
10. Chatvichienchai, S. I. (2023). Empowering database manipulation skills: A holistic approach integrating user-friendly database tools and spreadsheet software. Proceedings - 2023 5th International Workshop on Artificial Intelligence and Education (WAIE). https://www-scopuscom.ezproxy.utm.my/pages/publications/85191721270?origin=scopusAI
11. Da C L Alves, T., Desai, P., Needy, K. L., Hegwood, A., & Musick, S. (2017). Impact of supplier evaluation on product quality. Annual Conference of the International Group for Lean Construction, 11–18. https://doi.org/10.24928/2017/0268

12. Daher, Z., & Hajjdiab, H. (2018). Cloud storage comparative analysis Amazon Simple Storage vs. Microsoft Azure Blob Storage. International Journal of Machine Learning and Computing. https://www-scopus-com.ezproxy.utm.my/pages/publications/85042547105?origin=scopusAI

13. Daoud, A. O., El Hefnawy, M., & Wefki, H. (2023). Investigation of critical factors affecting cost overruns and delays in Egyptian megaconstruction projects. Alexandria Engineering Journal, 83, 326–334. https://doi.org/10.1016/j.aej.2023.10.052

14. Dehghanimohammadabadi, M. (2022). Data-driven simulation-optimization (DSO): An efficient approach to optimize simulation models with databases. Communications in Computer and Information Science. https://www-scopus-com.ezproxy.utm.my/pages/publications/85145251219?origin=scopusAI

15. Duarte, B. M., & Sousa, S. D. (2020). Supplier pre-qualification method for the Portuguese construction industry. Procedia Manufacturing, 51, 1703–1708. https://doi.org/10.1016/j.promfg.2020.10.237

16. Ershov, M., Avramenko, Y., Häkkinen, J., & Beloglazov, I. (2012). Quotation Tool for Process Equipment. Computer Aided Chemical Engineering. https://www-scopuscom.ezproxy.utm.my/pages/publications/84862862372?origin=scopusAI

17. Hamzah, N., Khoiry, M. A., Arshad, I., Tawil, N. M., & Ani, A. I. C. (2012). Causes of construction delay - Theoretical framework. Procedia Engineering, 20, 490-495.

18. Hu, G., Liu, Y., Liu, K., & Yang, X. (2023). Research on Data-Driven Dynamic Decision-Making Mechanism of Mega Infrastructure Project Construction. Sustainability (Switzerland), 15(12). https://doi.org/10.3390/su15129219

19. Jeyaprabha, B., Kumar, S. R. R., Bolla, R. L., & Arora, K. (2025). Data-driven decision making in management: Leveraging big data analytics for strategic planning. 1st International Conference on Advances in Computer Science, Electrical, Electronics, and Communication Technologies (CE2CT). https://www-scopus-com.ezproxy.utm.my/pages/publications/105002700729?origin=scopusAI

20. Keng, T. C., & Ching, Y. K. (2011). A study on the use of measurement software in the preparation of bills of quantities among Malaysian quantity surveying firms. International Conference on ICT and Knowledge Engineering. https://www-scopus-com.ezproxy.utm.my/pages/publications/84858788960?origin=scopusAI

21. Laryea, S., & Lubbock, A. (2013). Tender pricing environment of subcontractors in the United Kingdom. Journal of Construction Engineering and Management, 140(1). https://doi.org/10.1061/(asce)co.1943-7862.0000749

22. Maheshkar, C., Poulose, J., & Sharma, V. (2024). Data-driven decision making in the VUCA context: Harnessing data for informed decisions. Data-Driven Decision Making. https://www-scopuscom.ezproxy.utm.my/pages/publications/85216028617?origin=scopusAI

23. Memon, A. H., Asmi, A., Azis, A., Rahman, I. A., Tarmizi, A., & Karim, A. (2013). Controlling Cost Overrun Factors in Construction Projects in Malaysia. Research Journal of Applied Sciences, Engineering and Technology, 5(8), 2621–2629.

24. Mohd, N. I., Md Yusoff, N. N. S., Tajul Ariffin, H. L., & Fauzi, A. F. A. A. (2024). Cloud computing adoption at quantity surveying firms: Are We Ready? Insights on Resiliency and Urban Development. https://www-scopus-com.ezproxy.utm.my/pages/publications/85201338493?origin=scopusAI

25. Nasrun, M., Nawi, M., Baluch, N., & Bahauddin, A. Y. (2014.). Impact of Fragmentation Issue in Construction Industry: An Overview. https://doi.org/10.1051/C

26. Ojha, V. K., Goyal, S., & Chand, M. (2024). Data-driven decision making in advanced manufacturing systems: Modeling and analysis of critical success factors. Journal of Decision Systems. https://wwwscopus-com.ezproxy.utm.my/pages/publications/85173737550?origin=scopusAI

27. Rao, L. S., & Reddy, I. R. (2016). Study and comparison of non-traditional cloud storage services for high load text data. Smart Innovation, Systems and Technologies. https://www-scopuscom.ezproxy.utm.my/pages/publications/84969188091?origin=scopusAI

28. Safavi, A., Bigham, B. S., & Mazyar Zahedi-Seresht. (2025). Supplier Selection Utilizing AHP and TOPSIS in a Fuzzy Environment Based on KPIs. Contemporary Mathematics, 574–593. https://doi.org/10.37256/cm.6120256152

29. Sarkar, S. J., Kundu, P. K., & Sarkar, G. (2018). Realization of a cloud server based power system operational data management system. ICECE 2018 - 10th International Conference on Electrical and Computer Engineering. https://www-scopus-com.ezproxy.utm.my/pages/publications/85062846707?origin=scopusAI

30. Shan, M., Chan, A. P. C., Le, Y., Hu, Y., & Xia, B. (2016). Understanding collusive practices in Chinese construction projects. Journal of Professional Issues in Engineering Education and Practice, 143(3). https://doi.org/10.1061/(asce)ei.1943-5541.0000314

31. Srinivasan, S., & Krishnan, R. B. (2013). Data property analyzer for information storage in cloud. Proceedings of the 2013 International Conference on Pattern Recognition, Informatics and Mobile Engineering (PRIME). https://www-scopus-com.ezproxy.utm.my/pages/publications/84876755933?origin=scopusAI

32. Thiess, T., & Müller, O. (2018). Towards design principles for data-driven decision making - An action design research project in the maritime industry. 26th European Conference on Information Systems (ECIS). https://www-scopus-com.ezproxy.utm.my/pages/publications/85061307906?origin=scopusAI

33. Whang, S., Donyavi, S., Flanagan, R., & Kim, S. (2022). Balanced approach for tendering practice at the pre-contract stage: The UK practitioner's perspective. Journal of Civil Engineering and Management, 28(5), 338–348. https://doi.org/10.3846/jcem.2022.16580

34. Xiao, L., Ye, K., Zhou, J., Ye, X., & Tekka, R. S. (2021). A social network-based examination on bid riggers' relationships in the construction industry: A case study of China. Buildings, 11(8). https://doi.org/10.3390/buildings11080363

35. Youssef, M. A., Ibrahim, A. H., & Bakry, R. A. (2023). Technical audit and unethical practices in the construction industry. Civil Engineering Journal, 9, 173–191. https://doi.org/10.28991/cej-sp2023-09014