JOURNAL OF DIGITAL SYSTEM DEVELOPMENT

https://e-journal.uum.edu.my/index.php/jdsd

How to cite this article:
Yee, A.S. & Daud, A.Y. (2023). Tender And Asset Management System for Office Equipment. *Journal of Digital System Developments, 1*, 96-111. https://doi.org/10.32890/jdsd2023.1.8

TENDER AND ASSET MANAGEMENT SYSTEM FOR OFFICE EQUIPMENT

[1]Ang Shie Yee & [2]Ali Yusny Daud
[1,2] School of Computing, Universiti Utara Malaysia, Malaysia

[2]Corresponding author: aliyusny@uum.edu.my

Received: 17/9/2023 Revised: 21/9/2023 Accepted: 1/10/2023 Published: 31/10/2023

ABSTRACT

The Tender and Asset Management System for Office Equipment is a mobile application designed to streamline asset management processes within organisations, from tendering to asset management for office equipment. This paper presents an overview of the prototype's functionalities and features and evaluates its usability and effectiveness. The project's objectives were to enhance efficiency, design a user-friendly interface, and reduce labour-intensive tasks. To realise the project, five phases of methodology were conducted. The phases include project planning, requirement gathering, project design, project development and project evaluation. The evaluation involved a questionnaire to gather participant feedback, providing insights into usability strengths and areas for improvement. This paper concludes with recommendations to enhance the system's usability and support organisations in achieving efficient tender and asset management processes.

Keywords: Tender, asset management, mobile application, asset lifecycle management.

INTRODUCTION

Nowadays, tender systems and asset management systems usually are two separate systems. These systems can be a challenging process for construction businesses that interact with third parties. This may result in a lack of control over projects and relationships while managing many contracts and proposals simultaneously without the right tools. The critical reason to integrate is to control asset lifecycle management better. Integration efforts could delve into extending asset management practices throughout

the entire lifecycle of an asset, from the initial procurement phase through disposal or retirement. This might involve tracking costs, performance, and maintenance history across the asset's lifespan.

Organisations face Common problems and issues when they do not integrate their asset management with bidding systems, including data silos. Without integration, asset management and procurement data often exist in separate silos, making it challenging to access and analyse critical information across the organisation. Moreover, asset managers may have limited visibility into the procurement process, making it difficult to effectively plan for asset lifecycles and maintenance. Other than that, the lack of integration often requires manual data entry. This might lead to data errors, inconsistencies, and time-consuming administrative tasks. Therefore, many organisations have started using tender and asset management tools to help them handle multiple contracts and proposals simultaneously. Due to the demand from many organisations, a tender and asset management system is being developed as a software application to assist organisations in solving their problems.

The tender and asset management system is designed to help organisations manage the tenders for projects or assets (Kenton, 2022). The term "tender" refers to an invitation to bid for projects or assets, while the term "bid" refers to an offer made by an individual or corporation to purchase an asset (Chen, 2021). The term "e-tendering" refers to the entire tendering process conducted entirely online, from the publication of advertisements to the announcement of the winner (Goswami et al., 2020). Additionally, every organisation needs to track its assets to understand their status, such as how many assets are still available, to ensure a smooth operation of education for these organisations. Regarding physical assets, estimating remaining assets is essential to management strategies and policies (Mirzaei et al., 2020). The features of this Tender and Asset Management System include options to add, delete, search, view, edit, and update the tender and asset processes.

Many organisations have faced many problems that affect their efficiency in achieving their goals. Firstly, one of the common issues organisations faces is low productivity, primarily attributed to manual paper-based tender processes (Lux et al., 2019). The buyers usually must handle many contracts and proposals at once, and they need to apply different kinds of information or documents developed by various suppliers. Consequently, these manual processes can be time-consuming and complicated, often taking three months or longer. Thus, the slow process causes the organisation's productivity to be delayed, and organisations cannot run well and have high productivity. Therefore, the organisation needs help to maximise its profits.

Poor management can result in losing a company's resources and failure to win and complete contracts (Lyandau & Umnova, 2021). Additionally, some organisations must use updated versions of Tender and Asset Management Systems to run their tender and asset management processes. This results in a lack of access to the latest information updates and notifications not being received on time. Simon (2020) emphasised that a lack of capabilities can result in an unnecessary cost increase and lengthening of the tendering phase. Therefore, in the future, organisations will need to address these issues and opt for modern, efficient, and cost-effective Tender and Asset Management Systems to improve their productivity and achieve their goals more effectively. In this project, we focus on making tendering and asset management prototypes for office equipment. Integration offers advantages tailored to the needs of managing office assets. The key benefits of integration are as follows. 1) Integration streamlines the procurement process for office equipment. When the tender is awarded, relevant data can seamlessly flow into the asset management system, reducing the need for manual data entry and ensuring that new equipment is promptly added to the inventory. Integration improves the accuracy of asset data. It ensures that the office equipment inventory remains up to date, reducing the risk of overstocking, under-utilisation or loss of assets. Integrated systems provide a holistic view of costs associated with office equipment, including procurement, maintenance, and disposal. This comprehensive cost visibility enables

organisations to identify cost-saving opportunities and allocate budgets more effectively. Organisations can track and analyse how office equipment is being used. This data helps optimise asset utilisation, making redistributing assets as needed and avoiding unnecessary purchases easier. Integration ensures that office equipment is appropriately tracked throughout its lifecycle, including retirement, disposal, and action to replace it. This can lead to more efficient asset retirement processes and compliance and environmental standards adherence.

The remainder of the text is structured as follows: The next section looks at the background. The following section outlines the project's methodology. The fourth section presents the suggested prototype for managing assets and soliciting bids. Evaluation and numerical results are presented and discussed in section four, and the final section includes conclusions and suggestions for additional research.

BACKGROUND

Asset management is a current concern and one of the most debated topics because it must integrate the goals of activities such as maintenance, processes, systems, resource management, and so on, as well as health, safety, and the environment (Pais et al., 2020). Physical asset life cycle extension, adequate tendering, maintenance, reuse, renovation, and recycling are strategic variables in its management. According to Van der Lei et al. (2012), methods to improve the asset life cycle have been developed to overcome challenges in various asset management. Improved operation and maintenance result in lower replacement costs and maybe a foundation for better design. Following this advancement, methods and tools for engineering asset management have increased in the design, operation, and maintenance phases. Asset management emphasises the importance of considering the entire asset life cycle. This is a novel development because the design, operation, and maintenance phases were previously managed separately.

Asset management is defined by Pais et al. (2020) as a set of activities that include 1) determining what assets are required, 2) determining funding requirements, 3) acquiring assets, 4) providing logistic and maintenance support systems for assets, and 5) disposing or renewing assets. According to this definition, asset management encompasses a broader and distinct set of activities than "maintenance," primarily concerned with keeping existing equipment operational.

Asset Management is an umbrella term for combining many existing good practices and filling some remaining gaps. It ensures that the component activities operate harmoniously and that what we do is aligned with clear business goals. It necessitates sophisticated technical solutions, but the most important factor is human understanding, motivation, trust, and collaboration to achieve the best-combined outcome rather than local and short-term self-interest. Asset Management is an umbrella term for bringing many existing good practices together and filling some of the remaining gaps. It links what we do to specific business goals and ensures the component activities work together. It necessitates sophisticated technical solutions, but the most critical component is human-shared understanding, motivation, trust, and collaboration to achieve the best combined outcome rather than local and short-term self-interest.

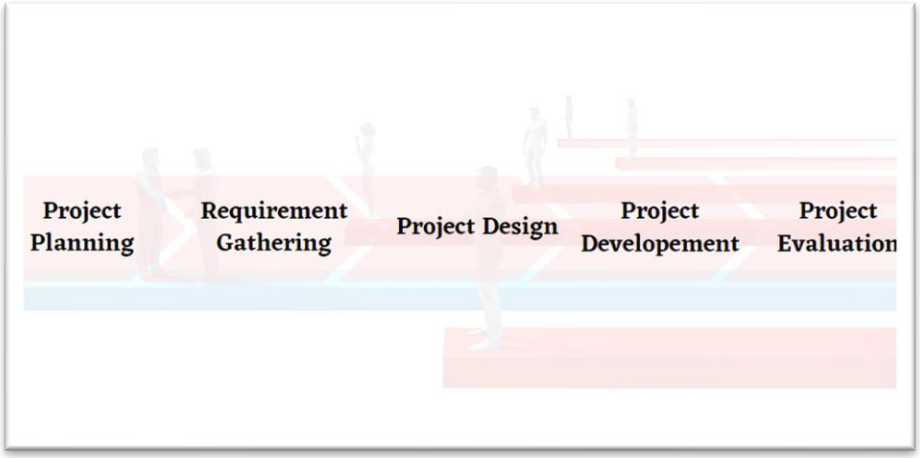
Vanier (2001) emphasises and assesses decision-support tools for municipal infrastructure planning. Poor quality data compromises decision-making. Insufficient data decreases employee job satisfaction and increases the mistrust internal organisations may have in another; it is clear that departments in the organisations have needs overlap, but if each department keeps its data, sometimes they will find out that they have different data concerning the same issue.

METHODOLOGY

The methodology for this project consists of five phases. Figure 1 shows the phases, and the following paragraphs explain the details.

Figure 1

Phases Involving Developing Tender and Asset Management Systems



Project Planning

To develop a project, in-depth discussions were conducted with primary stakeholders to define the Tender and Asset management system development objectives clearly. With the defined project objectives, an imagined system design was mapped. These sessions enabled valuable insights, identified user requirements, and ensured the envisioned system aligned with the stakeholders' needs. Once the imagined concept took shape, the project's scope was defined. Next, a comprehensive project schedule and timeline were created to ensure efficient project management and timely delivery. A Gantt chart was prepared to visualise the project schedule and task dependencies.

Requirement Gathering

The requirement-gathering process began with an extensive literature review. A thorough search of past projects, academic studies, research papers, and relevant literature related to Tender and Asset Management Systems was conducted. Various websites, industry forums, and online resources dedicated to Tender and Asset Management were explored to enrich understanding of the system further. By studying these cases, valuable insights were gained into how different industries and sectors approached their tender and asset management challenges and the best practices they employed to achieve success.

Project Design

During the project design phase, in-depth discussions with stakeholders, end-users, and subject matter experts to define the key features and requirements of the Tender and Asset Management System were conducted. These discussions help comprehensively understand the stakeholders' needs, business processes, and desired outcomes. A solid foundation for the system's design was established by

documenting the essential functionalities and performance expectations. Based on the defined features and requirements, the overall structure and architecture of the Tender and Asset Management System were designed. The significant deliverables that would be produced at different stages of the development process were identified. These deliverables included design documents, wireframes, prototypes, and test plans.

Project Development

This phase began by translating the defined requirements and system design into actual software components. This involved implementing the various functionalities and features outlined during the requirement gathering and project design phases. Each requirement was mapped to specific software modules, and the design was transformed into code. Dart was the primary mobile programming language for developing the Tender and Asset Management System. As Dart is the language of choice, a cross-platform mobile application, ensuring that the system could run seamlessly on both Android and iOS devices, was able to be developed. The system required a robust database to store and manage data efficiently. The MySQL database was chosen as the application database because it can store relational data and allows for simple to complex database queries.

Project Evaluation

Project evaluation was carried out after the project was developed. User evaluation involves gathering feedback and insights from the system's end-users. The type of evaluation for the Tender and Asset Management System application is usability evaluation. The usability evaluation conduct participants were recruited through a Google Form questionnaire. The objective of the usability evaluation for the Tender and Asset Management System is to assess and measure the effectiveness, efficiency, and satisfaction in terms of usability. Participants in this usability evaluation are staff members and managers in the organisation and supplier.

DESIGN AND DEVELOPMENT

Table 1 below lists the functional requirements, while Table 2 lists the non-functional requirements for the Tender and Asset Management System for Office Equipment.

Table 1

The Functional Requirements for the Tender and Asset Management System for Office Equipment

Requirement ID	Requirements Description	Priority
TAMS_01	**Log In**	
TAMS_01_01	The system will allow staff, suppliers, and managers to log in.	M
TAMS_02	**Manage Asset**	
TAMS_02_01	The system will allow staff and suppliers to add new assets.	D
TAMS_02_02	The system will allow staff and suppliers to view new assets.	M
TAMS_02_03	The system will allow staff and suppliers to edit new assets.	D
TAMS_02_04	The system will allow staff and suppliers to search for new assets.	D

TAMS_02_05	The system will allow staff and suppliers to delete new assets.	O
TAMS_03	**Submit Tender**	
TAMS_03_01	The system will allow suppliers to view tender advertisements.	M
TAMS_03_02	The system will allow suppliers to submit tenders.	M
TAMS_04	**Manage Tender**	
TAMS_04_01	The system will allow the manager to view tender details.	M
TAMS_04_02	The system will allow managers to evaluate the tenders based on pre-qualification requirements.	D
TAMS_04_03	The system will allow the manager to edit tender details.	D
TAMS_04_04	The system will allow the manager to search for tender details.	O
TAMS_04_05	The system will allow the manager to delete tender details.	O

Table 2

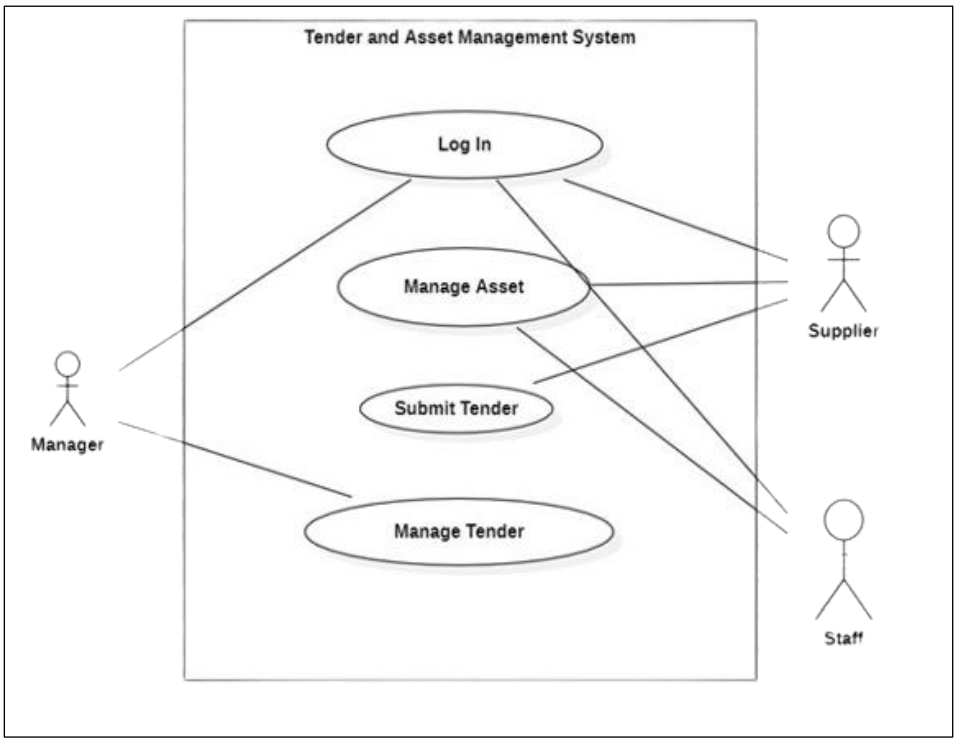
The Non-Functional Requirements for the Tender and Asset Management System for Office Equipment.

Requirement ID	Requirements Description	Priority
TAMS_05	**Security**	
TAMS_05_01	The user can only make a tender if the user has created an account.	M
TAMS_06	**Usability**	
TAMS_06_01	Notification will be sent to the manager if the assets are running low.	M
TAMS_06_02	Notification will be sent to the manager if the user's tender is successful.	M
TAMS_06_03	The user should be able to use the interface quickly.	M
TAMS_07	**Availability**	
TAMS_07_01	The user should be able to make a tender based on the availability.	M

A use case diagram, as shown in Figure 2, visualises the operation or function the system will perform. It also visualises the system's manager, supplier and staff interaction. The manager is the person who approves or rejects the bid; the supplier is the one who bids the tender, and the team is the person who manages the whole system.

Figure 2

Use Case Diagram

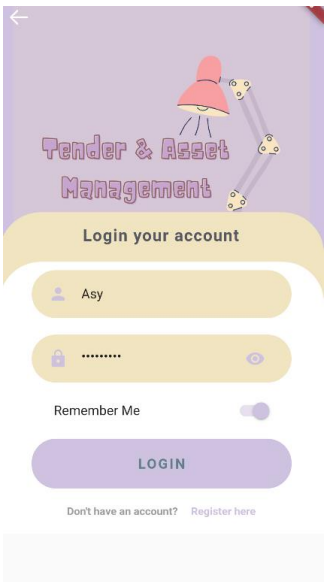


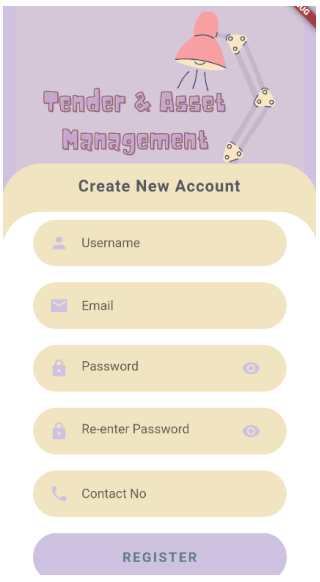
PROTOTYPE DEVELOPMENT

The prototype was developed, and some interfaces are discussed in the following paragraphs. The interface can guide the user in using the system.

Figure 3

User Login Page and Registration Page





The left side of Figure 3 displays the login page of the Tender and Asset Management System. To access the system, users are required to log in using their unique username and password. The right side of Figure 3 displays the Tender and Asset Management System user registration page, where users can create their accounts by providing information such as username, email address, password, and contact number.

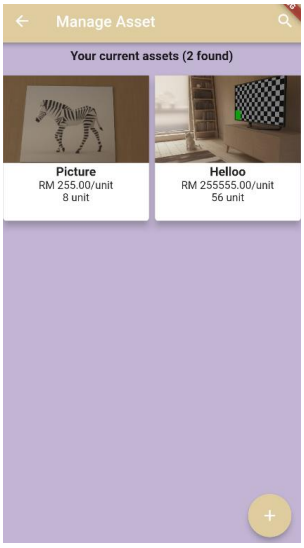
Figure 4

Main Page

The Tender and Asset Management System has three users: staff, manager, and supplier. This is shown in Figure 4. The manager link is for a manager to approve an added new product and the quantity item that has been changed. Staff link: The user link allows the staff to add items to the application, while the supplier link allows a bidder to bid on any item on open tender.

Figure 5

Manage the Asset Page and Add A New Asset Page



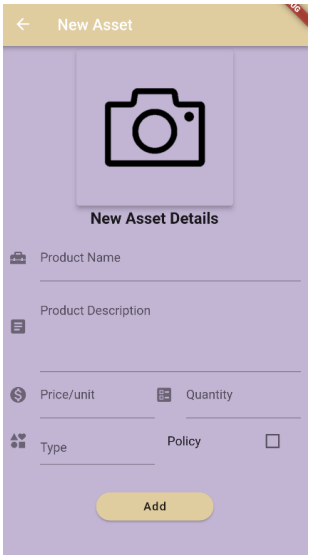
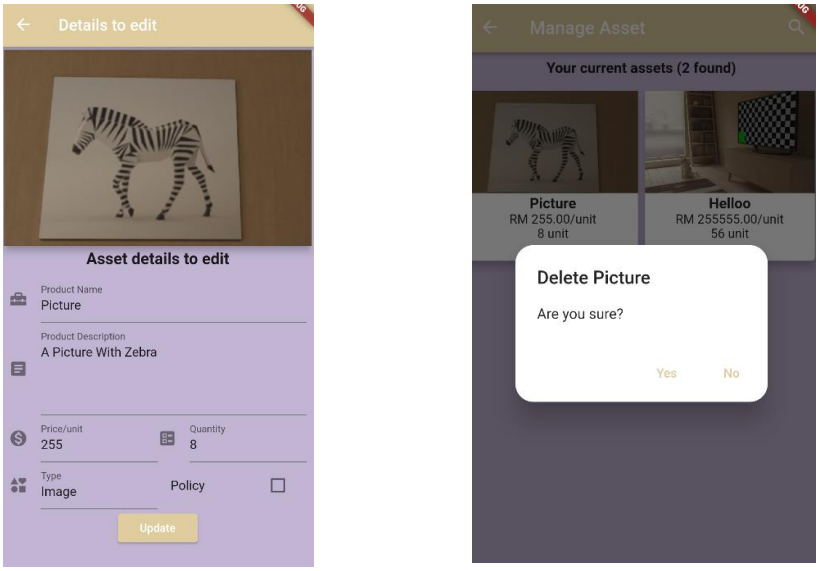


Figure 5 (left side) displays the manage asset page designed specifically for staff, providing them with the tools to manage assets efficiently. The right side of Figure 5 illustrates the new asset page for the team,

enabling them to include a product name, description, price, quantity, and type, along with an image, while adding assets to the system.

Figure 6

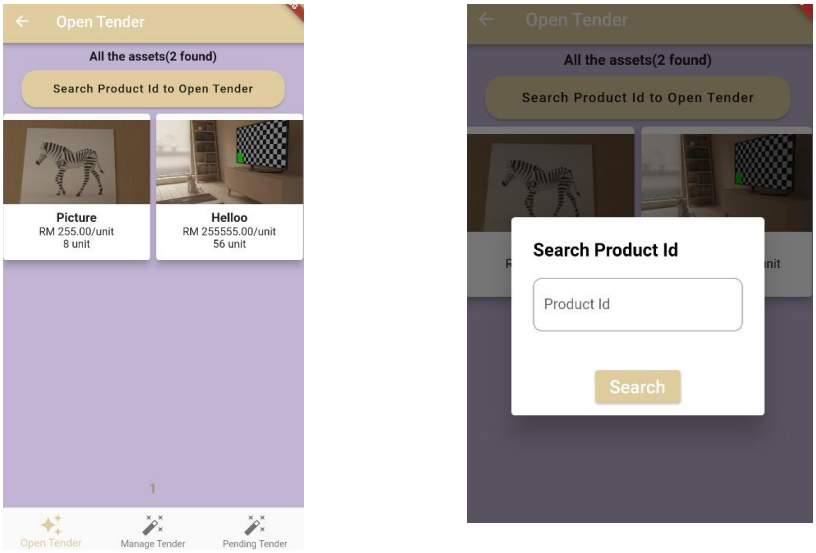
Editing Asset Details Page



The left side of Figure 6 demonstrates the asset editing feature for staff, allowing them to modify asset details as needed. Staff can directly edit the information in the text boxes, deleting and replacing words to update the asset details. The left side of Figure 6 shows the staff can press and hold for some time at the interface to delete the asset. The staff can do this if they want to delete any wrongly added assets.

Figure 7

Open Tender Page

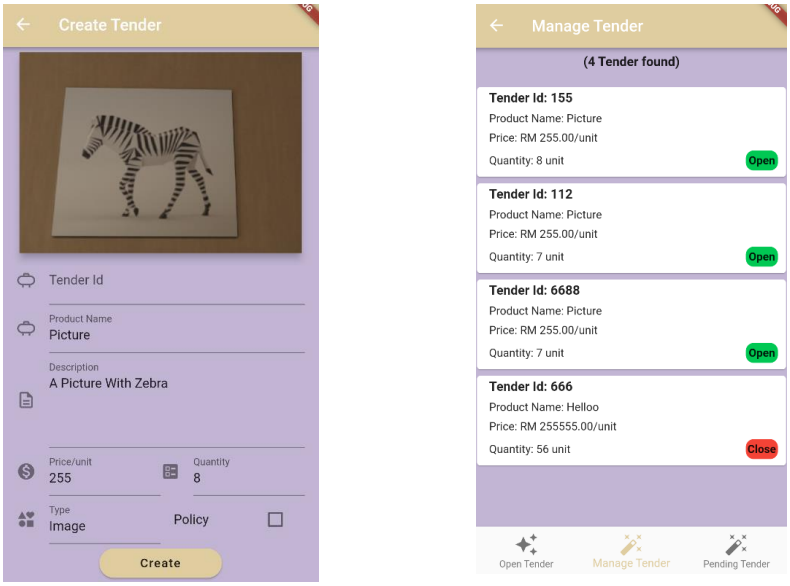


The left side of Figure 7 displays the open tender page, specifically designed for managers, enabling them to initiate and manage tender processes within the system. Figure 7 (right side) illustrates the open tender page for managers, where they can search for specific product IDs to initiate a tender. The product ID is

auto-generated when an asset is added by the staff, making it easier for managers to select and open tenders for specific assets.

Figure 8

Create and Manage the Tender Page



The right side of Figure 8 displays the tender page for managers, allowing them to manually insert the desired tender ID when creating a new tender. Figure 8 (left side) depicts the tender initiated by the manager. The status of the tender (open or closed) is indicated using the colours green or red, making it easy for users to identify the status quickly.

Figure 9

Close or Delete Tender Dialogue

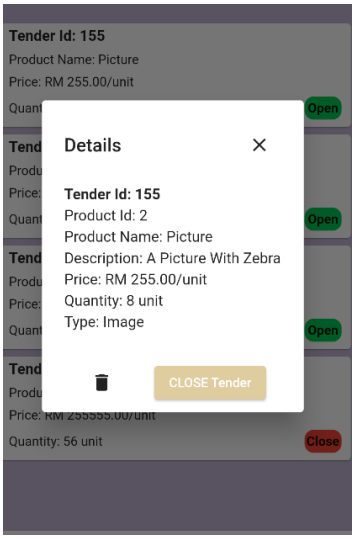


Figure 9 displays a dialogue box that enables the manager to make decisions regarding the tender. The manager can either delete the tender or close it by clicking on the respective buttons provided in the dialogue.

Figure 10

Approve or Reject Tender Dialogue

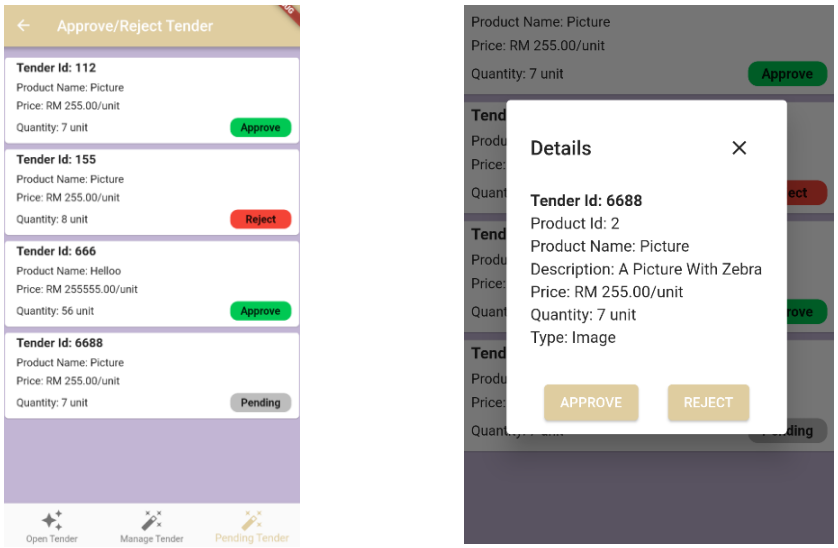


Figure 10 (left side) illustrates the tender submitted by a supplier. The status of the tender (approved, rejected, or pending) is indicated using the colours green, red, or grey, respectively, making it easy for users to identify the status quickly. Figure 10 (right side) displays a dialogue box that enables the manager to make decisions regarding the tender submitted by a supplier. The manager can either approve or reject the tender by clicking on the respective buttons in the dialogue.

Figure 11

Tender Advertisements Page And Submit Tender Page

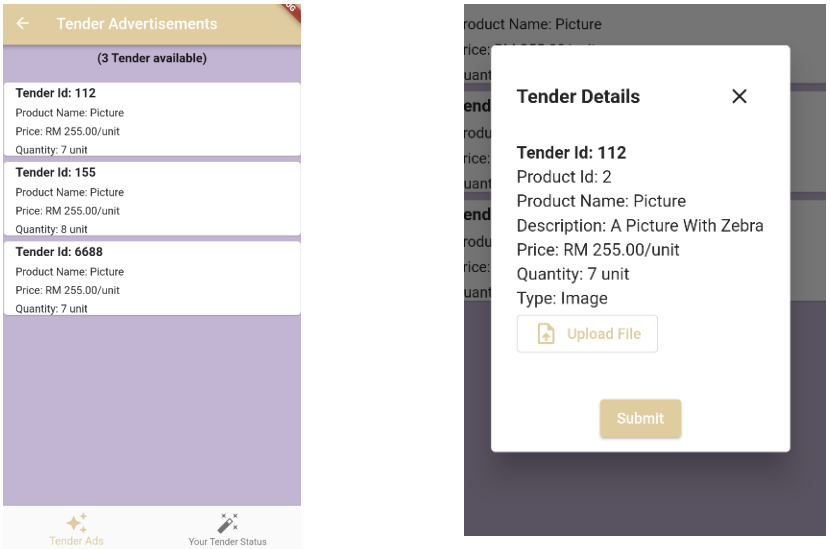


Figure 11 (left side) showcases the tender advertisement page, where suppliers can view and access available tenders to participate and submit bids. Figure 11 (right side) depicts a dialog box that enables suppliers to submit their tenders along with the required documents.

Figure 12

Supplier Tender Status Page

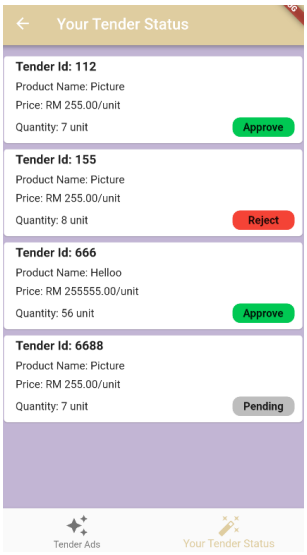


Figure 12 illustrates the tender status page for suppliers, where the status of their submitted tenders (approved, rejected, or pending) is indicated using the colours green, red, or grey, respectively, making it easy for users to identify the status quickly.

EVALUATION

The evaluation used in this project to get feedback from target users is usability testing through the quantitative method. Usability testing is chosen because the project focuses on the application's performance and users' perception of the interface. The application is improved after receiving feedback from the user for further improvement. The objective of this evaluation is to check user requirement functionality. This test aims to evaluate the application's effectiveness in completing its job. This evaluation is a reference for developing the application more user-friendly, meeting user's expectations, resolving the bug and making improvements based on their feedback.

A set of questionnaires made from Google Form and the link for the application's apk is being used as an instrument to go through the field testing of this project. The instrument is helpful to collect the responses and analyse them. Through the instrument, it is expected that the collection of answers should be more accessible and present a result that reflects the objectives of the evaluation. Google Platform includes several questions about the application's usability, such as evaluating user interface and navigation, function and feature and overall experience. User interface and navigation have five questions, while process and quality have six questions. each question has three questions to be evaluated. The collected data justifies how practical the application is for different roles of users.

A participant who wishes to participate in this study needs to follow the procedure for conducting the evaluation. Participants need to download apk with the provided link in Google Forms and download the application. Then, participants use the application with the roles given and interact with the application. Finally, participants must fill out the Google Form to answer the questionnaire for evaluation purposes. Analysis from the feedback is as follows.

User Demographic

Figure 13 illustrates the gender distribution in the given data, with females accounting for 57% of the total and males representing 43%. The chart clearly shows that females form the majority, comprising over half of the defined population, while males make up the remaining portion.

Figure 13

Gender Distribution Among Survey Participants

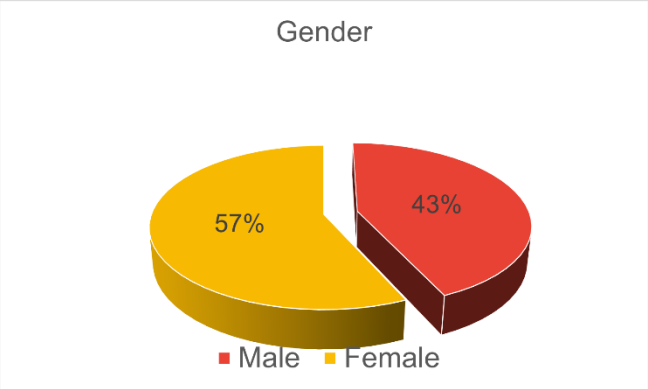
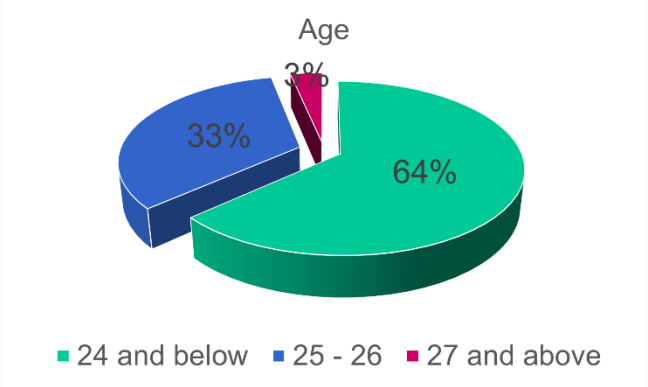


Figure 14 provides an overview of the age distribution within the represented population. The pie chart clearly shows that most of the population is aged 24 and below, followed by a considerable representation in the 25 to 26 age range. In contrast, individuals aged 27 and above constitute a much smaller proportion.

Figure 14

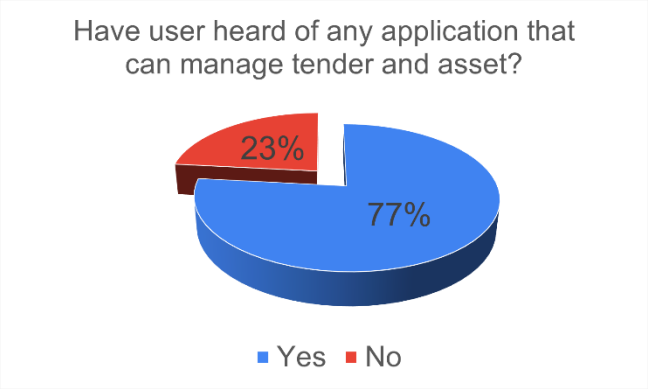
Age Distribution Among Survey Participants



In Figure 15, most of the participants, 77% of them, answered 'Yes', indicating that they are aware of applications capable of managing tender and assets. This suggests that a significant portion of the respondents are familiar with such tools. Conversely, 23% of the participants answered 'No', signifying that a smaller proportion of the respondents were unaware of any tender and asset management applications.

Figure 15

Awareness of Tender and Asset Management Applications

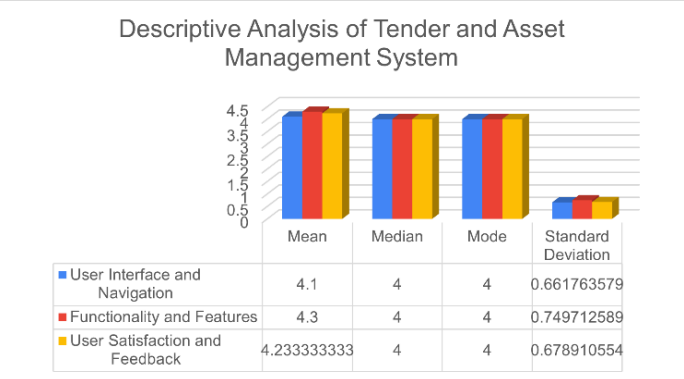


Descriptive Analysis

Figure 16 displays the descriptive analysis of the Tender and Asset Management System, which evaluated three distinct sections: 'User Interface and Navigation', 'Functionality and Features', and 'User Satisfaction and Feedback'.

Figure 16

Descriptive Analysis of Tender and Asset Management System



In the 'User Interface and Navigation section,' the participants rated their experience with a mean score of 4.1. The median and mode were 4, indicating that most respondents rated 4. The standard deviation of 0.66176 suggests that the ratings were relatively clustered around the mean, with moderate variability. For the section 'Functionality and Features', the participants provided an average rating of 4.3, indicating a slightly higher level of satisfaction than the previous section. Once again, the median and mode were both 4, implying that the most common rating was 4. The standard deviation of 0.7497 suggests a slightly greater spread of ratings compared to the first section. In the final area, 'User Satisfaction and Feedback', the participants expressed an average rating of 4.23. Like the other sections, the median and mode were 4, indicating that 4 was the most frequent rating. The standard deviation of 0.6789 suggests that the ratings were relatively close to the mean, with a moderate level of dispersion.

Most of the feedback from respondents shows positive feedback during the evaluation test for the prototype. Overall, most users are satisfied with the application prototype's functions and usage and the application's overall satisfaction. The evaluation testing has shown positive feedback, which has proved

that the application is useful, and it might help companies to add products and sell products more efficiently.

In summary, this system facilitates proficient management of assets and tenders within organisations, accomplishing all objectives of the Tender and Asset Management System. Consequently, it is advisable to enhance the system's functionality to enhance its professionalism and efficacy in terms of usability in future iterations. Some suggestions can be improved in the future. The payment system can be integrated to facilitate the completion of the tender process for suppliers and organisations. For now, the user needs to send the evidence of payment to the system manually. Furthermore, the notification function can be added to the system every time the bidder succeeds in the bidding or not. Currently, the bidder needs to check manually.

CONCLUSION

In conclusion, this project has described the development and the design of a Tender and Asset Management System for Office Equipment designed for sellers and buyers to do bidding selling and seamlessly flow to asset management. By implementing this system, the seller can promptly send the required quotation to the buyer once the administrator approves a transaction. This streamlined process enhances efficiency and reduces unnecessary waiting times, benefiting both tenders and vendors in their business interactions. Overall, integrating tender and asset management systems for office equipment offers numerous advantages, including cost savings, streamlined processes, enhanced decision-making, and better utilisation of office assets. These benefits contribute to a more efficient and cost-effective office environment.

ACKNOWLEDGEMENT

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

REFERENCES

Chen, J. (2021). Bid: *What It Means, How It Works, Types, and Examples.* https://www.investopedia.com/terms/b/bid.asp

Goswami, Y., Agrawal, A., & Bhatia, A. (2020). E-governance: A tendering framework using blockchain with active participation of citizens. In 2020 *IEEE International Conference on Advanced Networks and Telecommunications Systems (ANTS)* (pp. 1-4). IEEE.

Kenton, W. (2022). Tender in Finance Definition: How It Works, With Example. https://www.investopedia.com/terms/t/tender.asp

Lux, A., Schäfer, M., Bergmann, M., Jahn, T., Marg, O., Nagy, E., ... & Theiler, L. (2019). Societal effects of transdisciplinary sustainability research—How can they be strengthened during the research process? *Environmental Science & Policy*, 101, 183-191.

Lyandau, Y. V., & Umnova, M. G. (2021). Development of Management System of Public Procurement Participation in Supplier Companies. *Quality-Access to Success*, 22(182).

Mirzaei, M. J., Amirioun, M. H., Kazemi, A., & Dashti, R. (2020). Optimal contracting strategies for public-lighting asset management: A case study from Iran. *Utilities Policy*, 64, 101048.

Pais, E., Farinha, J. T., Cardoso, A. J. M., & Raposo, H. (2020). Optimising the life cycle of physical assets—A review. *WSEAS Trans. Syst. Control*, *15*, 417-430.

Simon, L., Jefferies, M., Davis, P., & Newaz, M. T. (2020). Developing a theoretical success factor framework for the tendering phase of social infrastructure PPPs. *International Journal of Construction Management*, *20*(6), 613-627.

Van der Lei, T., Herder, P., & Wijnia, Y. (2012). *Asset management.* New York, US: Springer.

Vanier, D. D. (2001). Why the industry needs asset management tools. *Journal of Computing in Civil Engineering*, *15*(1), 35-43.

Woodhouse, J. (2019). What is the value of asset management? *Infrastructure Asset Management*, *6*(2), 102-108.