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Research Article

Streamlining the Procurement Lifecycle: An Integrated Web-Based Platform for PPMP Consolidation and Document Tracking

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ABSTRACT

The research dealt with the impracticality of the manual administrative procedure, as they came up with a research titled; "Streamlining the Procurement Lifecycle: An Integrated Web-Based System to Consolid and Track Documents in PPMP." The study was aimed at the digitalization of the entire end-to-end procurement process, i.e. through automating the consolidation of multi-campus Project Procurement Management Plans (PPMPs) and real-time tracking of document status. To accomplish this, it has been developed using the Iterative and Incremental Development (IID) model that enabled progress through the constant improvement of requirement, design, implementation, and testing activities. Field experts and end-users tested the system with the help of a research instrument based on the ISO /IEC 25010:2023 product quality framework. The interpretation of the data involved the use of a five-point Likert scale, with the resultant Grand Mean of 4.25, according to which the answer is Strongly Agree. It means that the platform proves to be the most effective in all the dimensions considered with the Security scoring the best mean of 4.35. The findings substantiate the fact that the integrated platform manages to simplify the procurement lifecycle by increasing the data integrity and drop in the administrative lead times. The paper identifies this recommendation to use this web-based solution as an alternative to the old manual systems and proposes its future interconnection with larger financial management environments.

Keywords: *Document Tracking, ISO/IEC 25010:2023, Iterative and Incremental Development (IID), Procurement Lifecycle, PPMP Consolidation, Web-Based Platform*

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Background

The swift development of information technology has majorly altered the operations in all industries changing the manner in which organizations render their services, administer information and relate with their stakeholders. Modern day processes in institutions continue to rely more on computer systems and web-based applications to maximize the efficiency, accurateness and availability of the services. Online systems have also emerged as crucial instruments of organizations that deal with swelling transactional demands of diverse users. The data serves to justify the growth of online services since the institution must upgrade the databases and switch their manual practices to automated ones to guarantee their efficiency and data security. In the Philippines, government policies focus on digital transformation to enhance the provision of services to the population. The connectivity and automation programs in the country are designed to connect government offices and automate the services provided by the government. As an example, some of these agencies have been already online with service platforms, including the online civil registry request system introduced in the Philippines Statistics Authority and electronic services portal that is used in the Department of Labor and Employment to process documentation (Bersales et al., 2017).

Policy by the government enhances the necessity of automation by regulatory structures. A Joint Memorandum Circular by major government institutions dictates the application of modified standards of business permits and licensing systems, where reduced processing of business, simplified business processing forms and there should be integration of transactions which are automated. These reforms motivate local government units to computerize services, standardize forms, and reduce levels of approval to enhance efficiency and reduce the time taken by people when waiting to be served (Katarungan, 2018). These efforts underscore the increased appreciation of the fact that automation helps in bringing about transparency, a fast speed of activity and a better level of satisfaction by the people.

Automation is also critical in the learning institutions where IT facilitates the provision of flexible services that are not limited to time or place. The continued development of digital infrastructure requires the adaptation of organizations across academic institutions that promote more and more collaborative, integrated, and strategic administrative management. On a bigger regional scale, international collaboration and globalization (King, 2018). Therefore, the modernization of the systems is a necessity of state universities or colleges to ensure stability of operations and satisfaction of the needs of the institutions.

In Bulacan State University the procurement and supply offices are still operating majorly using manual and spreadsheet based operations to handle the procurement planning, monitoring and inventory processes. Despite the fact that spreadsheets help in transaction processing, there are still restrictions in consolidating Project Procurement Management Plans, tracking the status of document, updating property transfers, as well as avoiding duplication of records. These difficulties tend to slow down transactions, decrease precision, and decrease transparency to ultimate users requiring procurement services. The fact that the number of requests is constantly growing also contributes to system inefficiencies especially in cases where urgent procurement steps are to be taken.

To address these issues, the current paper suggests the implementation of a multi-level online query system that is used to simplify the work process, increase the accuracy of the collected information, and improve management information. The system hopes to make procurements processes more productive, with fewer delays and more effective management of institutional resources in place through their centralization and automation.

Objectives of the Study

The main aim of this project is to come up with and test a combined web-based procurement information system which will streamline the procurement operations, increase the efficiency of operations, and also increase the security of data within the Procurement Office.

Specifically, this study aims to:

1. To examine and compile the existing workflow procedures, the Procurement Office, its significant transactions, operations, and data flow with the aim to determine the operational bottleneck and improvement opportunities.
2. To create a web-based procurement system, which incorporates the following main features, which would allow to process transactions efficiently, monitor, and manage them. It focuses on the following:
    a. Procurement Request and Approval Management that entails the receipt and management of purchase requests, the processing of resolution of Bids and Award Committee (BAC) and the related generation of purchase orders to the suppliers.
    b. Project Procurement Planning and Consolidation, which deals with the development and finalization of Project Procurement Management Plans (PPMPs) and consolidation of the same to be subject to institutional control.
    c. Inspection, Acceptance, and Document Monitoring, that assists in accomplishing the verification of the delivered items, documenting the results of the inspection and real-time tracking down of the documentation and transaction status.
    d. Price Assessment and Supplier Management, which allows the methodical canvassing of prices, assessment of suppliers, and cost efficient buying choices.
3. In order to realize and apply effective database security features in the web-based procurement system in order to provide data confidentiality, integrity, authenticity and system reliability to protect and integrity sensitive procurement transactions.
4. In order to assess the created web-based procurement information system based on the ISO / IEC 25010:2023 software product quality standard, one should consider its performance with the established quality characteristics, such as the following indicators:
    a. functional suitability,
    b. performance efficiency,
    c. compatibility,
    d. usability,
    e. reliability,
    f. security,
    g. maintainability, and
    h. portability

To identify the level of compliance to the international standards of software quality and facilitation of effective, secure, and user-friendly procurement processes of the system.

Conceptual Framework

Conceptual framework is an analytical tool which is used to structure and explain ideas, to determine how various concepts are related and to orient the research process. Effective frameworks present a clear depiction of the phenomenon investigated and allow grasping the phenomenon, retaining the information more easily, and putting the knowledge into practice.

This paper is a conceptual framework in designing and developing the Integrated Web-Based Platform to PPMP Consolidation and Document Tracking to the Procurement Office of Bulacan State University. The conceptual paradigm from Figure 3 shows the combination of the main parts of the system, the process of procurement transactions, and realization of database security and software quality assessment based on ISO/ IEC 25010: 2023 standards. This structure illustrates the interplay of the system inputs, processing and outputs that can simplify the procurement lifecycle, merge Project Procurement Management Plans (PPMPs), track the status of documents in real time and properly, safely, and conveniently manage procurement data.

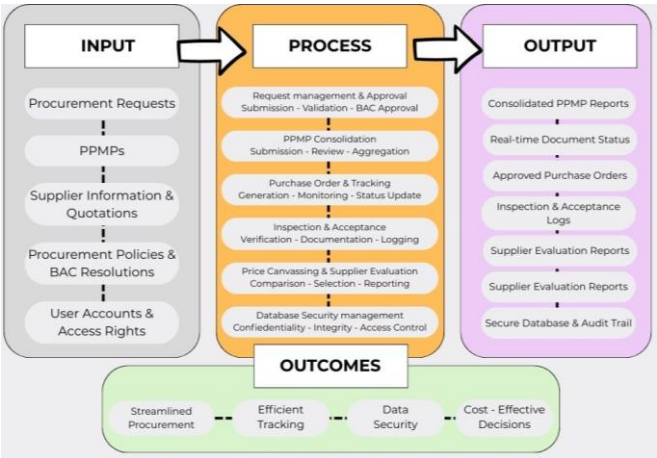

Figure 1. Conceptual Framework of the Integrated Web-Based Platform for PPMP Consolidation and Document Tracking

Figure 1 shows the key data, user interactions, and policy constraints that propel functionality in the system in which signifies the inputs to the Integrated Web-Based Platform of PPMP Consolidation and Document Tracking. Such inputs are procurement requests, Project Procurement Management Plans (PPMPs) by various units, supplier details and price quotation, procurement policies as well as procedure and guidelines, and authenticated user names. Valid, complete data input is critical for downstream productivity and decision support (Dennis, Wixom, and Roth, 2018). This is achieved through the management of effective input in the system. Real time tracking and reporting would also be based on inputs, and these two would aid in transparency and accountability of institutional procurement processes.

The system processes identify how the platform converts the inputs received to valuable services and actionable information. Central processing involves procurement request processing and-approval, electronic consolidation of PPMPs, automatic creation and tracking of purchase orders, inspection and acceptance of purchased goods and services, and price canvassing the ability to compare suppliers and database security. The processes are modeled based on the principles of software quality, and the successful implementation of such processes depends on the systematic integration and the organization of workflows. They are also tested in the ISO/IEC 25010:2023 standard to make sure that the processes are functional, usable, reliable, and secure among other quality measures (ISO/IEC, 2023).

The direct products of the system are the outputs, which results once the inputs have been processed by the system. These outputs include consolidated reports on PPMP, which gives a comprehensive picture of the institutions procurement requirement, customer friendly and user friendly real time document status monitoring, approved purchase orders that can be executed, logs of inspection and acceptance, supporting compliance and records keeping, supplier evaluation and price comparison reports, and transactional data legally stored. Such outputs do not only indicate the operational success of the system, but can also be deployed as important planning, auditing and ongoing improvement resources. Studies show that well developed information systems yield outputs that lead to a higher quality of decisions and efficiency of operations in the various functions of the organization (Laudon & Laudon, 2021).

Lastly, the results of the implementation of the integrated platform are not limited to short-term outputs but a wider scope of the organizational effects. The anticipated results are efficiency in the procurement procedures, less time spent on paper processing, high degree of transparency and accountability, lessened mistakes and duplication in documentation and improved compliance to regulatory provisions.

The enhanced use of the platform by an organization can also lead to improved resource usage and stakeholder satisfaction in line with the institutional objectives of modernization of the service and digitalization. Outcomes also coincide with the definition of information system success where the utilization of the system results in positive performance in the organization and user satisfaction (DeLone and McLean, 2003).

Methodology

In this research, both descriptive and developmental types of research were used, to comprehensively study the procurement procedures and come up with a useful software program.

Research Design

The proponents used both descriptive and developmental research policies in order to be effective in gathering appropriate data and formulating a systematic process of creating integrated software solution to meet the requirements of the client. To study and describe the specifics of the work of the Procurement office, descriptive research method was applied. Such a method is aimed at finding out what is transpiring instead of providing an explanation about how and when and why things take place. According to Akhtar (2016), descriptive research enables its supporters to gather correct data and give a detailed representation of the phenomenon being studied. With this approach, the proponents were able to collect data via interviews, questionnaires, and direct observations, allowing the clear comprehension of the workflow and transaction processes of the Procurement and Supply Offices to the beginning and their final results.

Developmental research approach was attempted to develop practically applicable knowledge, which could be applied in practice, especially on the systematic design and deployment of the proposed platform, Streamlining the Procurement Lifecycle: An Integrated Web-Based Platform to Consolid PPMP and Tracking of Documents. This approach focuses on practice and so the study essentially follows systematic stages that incorporate planning, analysis, design, implementation, and evaluation. To make sure that every stage of the development process would entail the functional requirements and the quality requirements, a Software Development Life Cycle (SDLC) was applied to design a fast and user friendly software solution to the Procurement Office. Research and development research of this nature does not only lead to theoretical knowledge but also offers practical tool and framework which practitioners can directly apply to real life organizational situations (Richey and Klein, 2007).

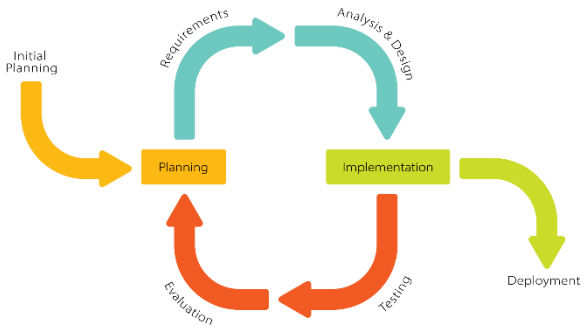

Figure 2. Iterative and Incremental Development Model (Larman and Basili, 2003) (https://en.wikipedia.org/wiki/File:Iterative_Process_Diagram.svg)

As shown in Figure 2, it is based on IID Iterative and Incremental Development Model, which can be used in conjunction with ISO/IEC 25010:2023 very well. Due to the fact that the proponents utilize an evaluation system that relies on certain quality features the Evaluation

stage in the diagram presented in Figure 2 is the stage where the proponents can utilize Likert-scale questionnaire in assessing whether the current iteration fulfills the required standards before proceeding to final deployment.

Respondents of the Study

Johnson (2004) explains that after the evaluation processes, the proponents incorporated the feedback and suggestions of the experts. The research tools were later administered to the respondents using Google forms. Before the distribution, the research finder clarified the importance of the research so that the respondents were aware of the intentions of the research. The participants were allowed one week to response to the questionnaires. The proponents obtained the final results on the Google Forms platform on submission.

After finalizing all the questionnaires, the responses were then counted, tabulated and planned. These figures were used as premises towards further analysis and interpretation. The obtained data, especially those pertaining to the system evaluation criteria, which begins with functional suitability start with frequency, percentage, and mean, which was subjected to statistical analysis. In the meantime, the answer to other objectives was introduced through the use of tables, charts, diagrams, and illustrations to maintain a clear outcome.

The main data collection tool was a questionnaire that was based on the ISO/IEC:25010 2023 standard. To use the modified tool, formal consent was obtained with the former researcher. The employees who were chosen to take the instrument were to assess the development and accuracy of the online procurement system. Quality Characteristics Overview The assessment would cover nine characteristics that are stipulated by the 2023 product quality model: functional suitability, performance efficiency, compatibility, interaction capability, reliability, security, maintainability, flexibility, and safety (ISO/IEC, 2023).

Core Evaluation Components: a. Functional Suitability, it evaluates the completeness of the PPMP submission, report generation, correctness, which is concerned with price canvassing monitoring, and appropriateness with user prompts and transactions notifications. b. Performance Efficiency, it determines the time behavior of asynchronous data requests, resource usage including an indicator of pagination and scrollbars, and large-scale database storage capacity. c. Compatibility, that studies co-existence with concurring applications and was the incompatibility of database-driven report generation. d. Usability, it measures user interaction using learnability, operability which includes search/autocomplete, and visual hierarchy and readability of the user interface. e. Reliability that can achieve maturity/faultlessness that determines consistent data, availability with response rate, fault tolerance, and password recoverability. f. Security, which is able to confirm the confidentiality through the application of encryption, integrity, authorization control, non-repudiation, avoidance of multiple clicks and authenticity of data validation. g. Maintainable, it is based on modularity, it isolates procurement/inventory modules, reusability (BAC templates), and analyzable through dashboards. h. Finally, Portability checks the flexibility of the system as a platform to different web browsers and its ability to support the changes in the operations of the system.

The following five-point Likert scale served as the basis for interpreting the results:

Table 1. Likert Scale

Range	Description
4.21 – 5.00	Strongly Agree
3.41 – 4.20	Agree
2.61 – 3.40	Undecided
1.81 – 2.60	Disagree
1.00 – 1.80	Strongly Disagree

A Likert type of scale presented in Table 1 is important in that it will transform the subjective perceptions of users into objective data, which will then allow performing statistical analysis of the system based on the ISO/IEC 25010:2023 quality characteristics. This systematic methodology means that the assessment is objective and measurable, and the presentation has specific numbers as to what areas should be optimized in a system.

Data Gathering and Analysis

After the preliminary system analysis, the investigator combined the input and technical advice of the specialists and developed the architecture of the platform. The research instruments were then administered online through the use of Google Forms to the target respondents using a digital platform. At this stage, the researcher underscored the importance of the research in order to attain good quality feedback, and ensured orderly distribution process to preserve the integrity of the data. The participants were given one week in order to fill out the evaluation. After this was done, the data were directly pulled out of the responses repository of the platform to be processed. The obtained information were tallied, sorted and tabulated in a systematic manner in order to be used as the basis of the further analysis and interpretation. The quantitative analysis was the ISO/IEC 25010, the quality standards software.

All the metrics of the ISO/IEC 25010 metrics were statistically treated with frequency, percentage, and weighted mean to offer a clear quantitative measure of the efficacy of the platform. The qualitative objectives and the stream of system were also described by means of tables, charts, and diagrams, which will visualize the streamlined procurement lifecycle.

Results and Discussion

1. Analyze and document the current workflow processes of the Procurement Office, including the major transactions, procedures, and data flow, to identify operational bottlenecks and areas for improvement.

The existing manual process of Budget, Procurement, and Supply offices is a multi-hole process wherein individual colleges and campuses are required to create and submit the Project Procurement Management Plan (PPMP). Budgets are checked before each PPMP is reviewed and consolidated by the Procurement Office in the Annual Procurement Plan (APP), which is at the university level. After this, the end-users launch Purchases Requests (PR) that provoke a manual price canvassing mechanism. The present workflow process of the Procurement Office is the following one:

Phase 1: PPMP Initiation Colleges/Campuses feed the data directly to the Web platform. System Action: Mechanical verification to budget parameters.

Phase 2: Automated Consolidation. System Action: Single-click merging of all dispersed PPMPs to the Annual Procurement Plan of a university-wide basis (APP).

Phase 3: PR & Price Canvassing Purchasing Requests (PR) are created by the end-users in the system. The generation of BAC Resolution is done by posting price quotations online in Procurement Office.

Phase4: Document Tracking and Fulfillment.

In terms of System Action, real-time status updates can be issued by using a Purchase Order (PO) and delivering items accordingly, while the Inspection and Acceptance multi-office committee signs digital forms and generates them instantly.

Phase 5: Inventory & Disposal System Action: Automatic storage of inventory records and automatic digitalization of property transfers or requests to make or have properties not serviced.

This cycle is then repeated with the development of BAC Resolutions to establish winning suppliers, creation of Purchase Orders (PO) and delivery of items. The last phases include a multi-signatory and intricate Inspection and Acceptance process that incorporates the representatives of the Procurement, Supply, Accounting, and COA divisions and the end-user. The Supply Office maintains stock after delivery an inventory maintenance in the form of Property Acknowledgment Receipts, property transfer or disposal of unserviceable items. This process includes repetitive coding

and the routing of documents physically, which should be simplified with the help of the integrated web-based platform through the centralized PPMP consolidation and real time movement of documents. Using the ISO/IEC 25010:2023 structure, the turnover of this manual situation to a digital platform, will assure the system is functionally appropriate and reliable (ISO/IEC, 2023). Moreover, with the help of an assessment model, it is possible to structure the evaluation of the quality of the services of administrative information systems (Nuzula & Rochimah, 2023).

Develop a web-based procurement system that integrates the following key features, enabling efficient transaction processing, monitoring, and management.

The central point of information entry into a web-based procurement system is the Home Page (or Main Dashboard) that is depicted in Figure 3 and which is the main frontier on which users can interact with the integrated lifecycle features (Atzl et al., 2019; Iheukwumere-Esotu and Yunusa-Kaltungo, 2022). Within the setting of an embedded solution to PPMP aggregation and documentation tracking, the home page is no longer a point of entry but a tactical dashboard which offers real-time trackability of the procurement lifecycle.

Figure 3. The Procurement Web-based system Home Page

Figure 3 shows that organizations can also increase their efficiency, efficacy, and transparency in the procurement systems by moving beyond the manual using spreadsheets to dynamic home page (Schapper et al., 2006; Lombres, 2019).

a. Procurement Request and Approval Management, which encompasses the submission and tracking of purchase requests, the processing of Bids and Awards Committee (BAC) resolutions, and the generation of purchase orders to suppliers.

As the electronic book in Figure 4, Purchase request (PR) module can be defined as a single centralized online book which allows to track the procurement initiatives in real time and in university entities. This interface presents a tabular list of key data points systematically, such as the Entity Name (e.g., Bustos Campus or College of Architecture and Fine Arts), PR Number and the individual performing the request and approving the transaction. Changing the manual logs to this digital storage will ensure that the data is not modified in any way, and the platform will be very transparent in document tracking lifecycle where administrators will know status of the prioritized items as soon as they are submitted. Additionally, the searching feature and the direct document printing buttons facilitate the administration process, other than using a lot of time to access and process separate procurement documents.

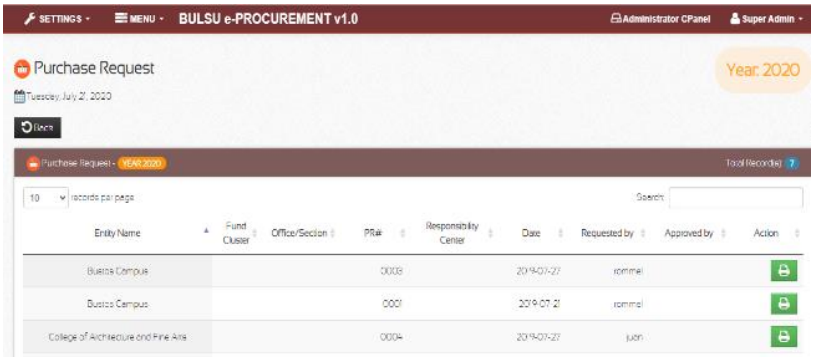

Figure 4. Procurement and Approval Management page

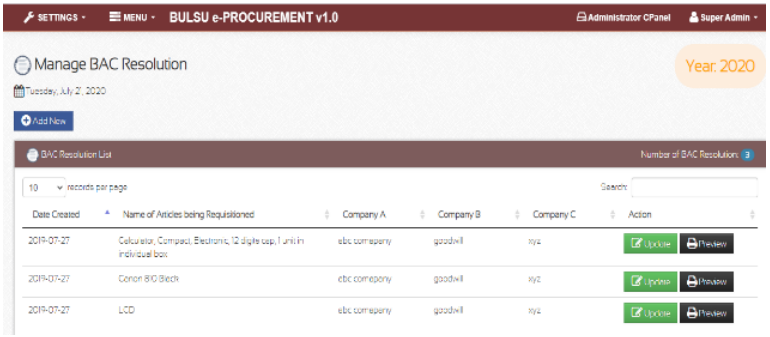

Figure 5. Bids and Awards Committee (BAC) page

As illustrated in Figure 4 and Figure 5, it is the procurement and approval management page that manages all the approved procurement, and BAC Resolution is one of the very important stages of the procurement lifecycle, where a price quotation is done to establish the successful supplier. This interface is an electronic library of bid comparisons and the production of official Bids and Awards Committee (BAC) documentation.

b. Project Procurement Planning and Consolidation, covering the generation and submission of Project Procurement Management Plans (PPMPs) and their consolidation for institutional oversight.

This interface serves as a centralized station by which the different units of the university such as College of Information and communications technology, Busto Campus, College of architecture and fine Arts, and College of Arts and Letters place their annual needs together with respect to their final products.

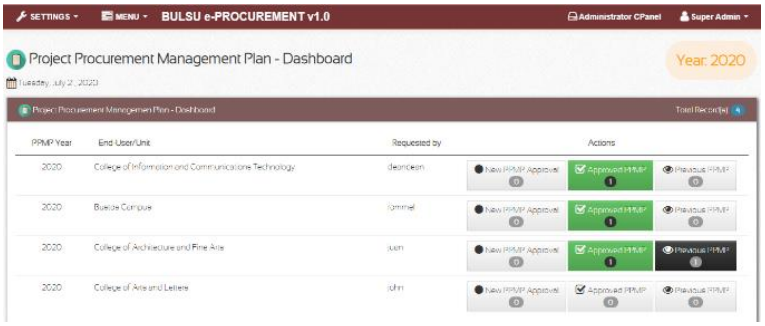

Figure 6. The Procurement Web-based system Home Page

As shown in Figure 6, the first and the most necessary step of the integrated procurement lifecycle is the PPMP Dashboard.

c. Inspection, Acceptance, and Document Monitoring, facilitating verification of delivered items, recording of inspection results, and real-time tracking of document and transaction status.

The Price Catalogue module shown in Figure 7 is utilized to provide the major interface with which the end-users will identify and choose the standardized items as part of the preparation phase of the PPMP preparation stage.

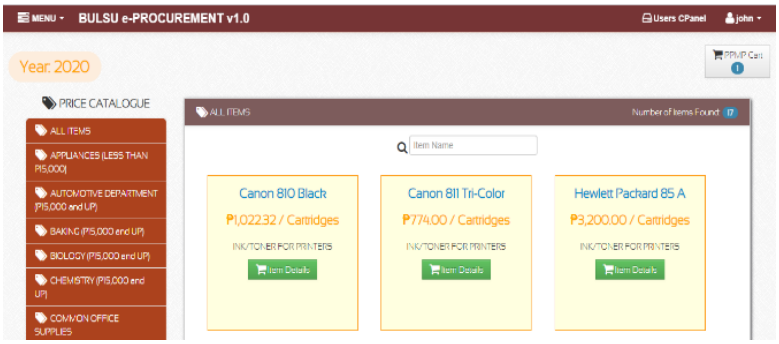

Figure 7. Price Catalogue Page

Figure 7 shows that electronic warehouse makes sure that any ordered item is in accordance with the specifications of the university and the existing prices in the market.

d. Price Evaluation and Supplier Management, enabling systematic price canvassing, supplier assessment, and cost-effective procurement decisions.

This module offers an organized platform to produce the Inventory Custodian Report, which is needed in monitoring items that are given to different end-users within the university system.

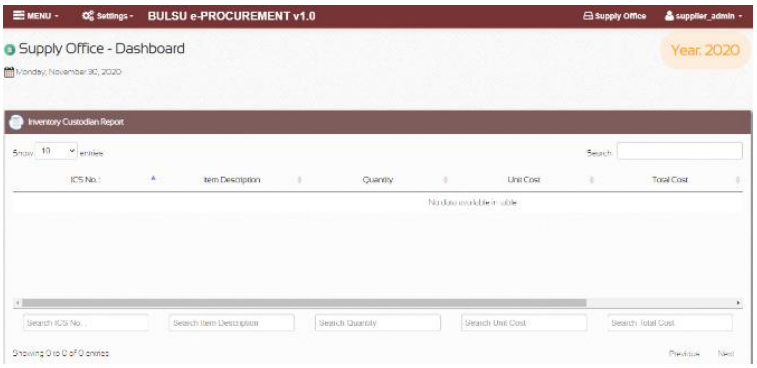

Figure 8. Supply Office Dashboard

Figure 8 depicts Supply Office Dashboard that is associated with the final phase of the integrated procurement lifecycle, which is concerned with post-acquisition accountability and asset management.

Figure 9. Manage Quotation Page

Figure 9 is the module that is most involved in managing the canvassing stage of the procurement lifecycle is the Modify Quotation module. This module will enable the Procurement Office to computerize and trace the price collection procedure of all items that are consolidated of the approved PPMPs.

3. Implement robust database security mechanisms that uses a web-based procurement system to ensure data confidentiality, integrity, authenticity, and system reliability, thereby safeguarding sensitive information and maintaining the integrity of procurement transactions.

In order to fulfill the goal of establishing tight security controls, the integrated web-based platform has used a multi defensive approach at the server-side. This means that the sensitive procurement data, including PPMP consolidations and financial transactions, are ensured confidential, integral and authentic. It has specialized security measures that are used to protect the database against unauthorized access and online attacks. A Firewall is the main perimeter solution to the DDoS attacks, where the malicious traffic is identified and blocked at the IP level prior to connection to an application. In order to adhere to the inadequacies of the procurement modules, we have ModSecurity(Modsec) that is designed to identify and restrict the generic code injections, and as such, still ensures the integrity of the server-side codes. Further, to offer real-time suspicious network scan filtering and automatic attack attempts, BitNinja is incorporated. The integration of these technologies makes the platform reliable towards higher values procurement transactions and also enable a secure system to carry out its operations (ISO/IEC, 2023; Lombres, 2019).

4. The developed web-based procurement information system uses the ISO/IEC 25010:2023 software product quality standard, examining its performance against established quality characteristics.

The demonstration of the web-based platform was the assessment of how efficient it is to simplify the procurement lifecycle which in this case is the consolidation of PPMP and tracking of documents. In order to conduct a complete technical assessment, the system was tested in accordance with the eight product quality characteristics provided by ISO/IEC 25010:2023. This model offers an international standard of software quality, which put emphasis on the extent to which the system has satisfied the needs of users without losing its technical integrity.

The data collected both on experts and end-users was measured on a five-point Likert scale in order to convert the qualitative perceptions into statistical results. This will enable one to be able to granularly analyze the strength of the system (in terms of say, security and performance) and pinpoint areas in which the development should be refined in future with respect to the iterative and incremental development (IID) cycle. The summary of these findings is provided in Table 2 and indicates a high stakeholder agreement with the fact that the system is ready to be deployed.

Table 2. Overall Results of the Evaluation using the ISO 25010:2023

Range	Mean	Interpretation
Functional Suitability	4.25	Strongly Agree
Performance Efficiency	4.28	Strongly Agree
Compatibility	4.21	Strongly Agree
Usability	4.23	Strongly Agree
Reliability	4.21	Strongly Agree
Security	4.35	Strongly Agree
Maintainability	4.24	Strongly Agree
Portability	4.23	Strongly Agree
Grand Mean	**4.25**	**Strongly Agree**

The platform scored a ***Grand Mean of 4.25,*** which is within the Strongly Agree scale. This is an indication that the efficiency of the system in ensuring the smooth functioning of the procurement lifecycle, integrating PPMPs, and managing critical records is highly approved by the stakeholders and specialists. System security is the most desirable attribute with the highest mean of *4.35* indicating a good agreement on the strength of the encryption and access control of the system. Next in line is the Performance Efficiency *(4.28)* which confirms the triumph of asynchronous data processing and efficient use of the resources.

All the eight attributes of quality such as Interaction Capability *(4.23)* and Functional Suitability *(4.25)* had a score that was always above the *4.21* point. This implies that the system is functionally complete, as well as offers a high quality user experience, and is technically stable in a wide range of environments.

Conclusion

The integrated web based procurement system emerges successfully to digitise and simplify the procurement lifecycle as it can automate the key steps in the process starting with the PPMP consolidation and price canvassing, then tracking of documents and automated production of requisite reports e.g. Purchase request and BAC Resolutions. The platform supports this transition by integrating the new features within the current institutional workflow, which means that not only the transition between the manual and the digital processes is smooth and seamless but also more or less functional.

The evaluation of the experts attest to the high standards to which the platform is subjected to ISO/IEC 25010:2023 framework. The convergence of multi-campus PPMP consolidations and real-time monitoring of status are some of the features of the system that shows high functional suitability. Also, asynchronous data processing, compatibility, and capability to interact with users make it performance-efficient and rock-solid offering a responsive and accessible experience with different devices. Having a high level of reliability and privacy in the form of data encryption and access control based on the position, the platform is a stable, scalable and extremely safe solution to revamp the procurement system infrastructure.

Recommendations

Considering the results of the above conclusions, the following recommendations can be offered to make the platform sustainable and effective in the long-term:

1. Proper Implementation of the developed system in the University. The integrated web-based platform should be deployed as soon as possible as it can substitute manual and time-consuming processes thereby drastically reducing the lead times between the administrative programs and simplifying the procurement process.
2. The idea behind the development of the system is the use of iterative Feature Enhancement, which is within the scheme of the Iterative and Incremental Development (IID) model, after use, periodic post-utilization audits are necessary to address new features that can be added to the system as per the changing needs of the organization.

3. Dynamic Security Upgrades that offers the rapidness of the cybersecurity, it is proposed to consider more radical security credentials, including Multi-Factor Authentication (MFA) and Zero-Trust architecture to enhance the high rating of the platform in terms of security.
4. Technical Enhancement of Quality Subcharacteristics:
    a. Reliability - Enhance the recoverability sub-characteristic through the use of automated secure password reset systems to provide availability to the system at all times.
    b. Maintainability - Improve on the modularity by more largely decoupling the procurement and inventory modules and also increase the analytical power of the dashboard to deliver a more in-depth view of important procurement aspects.
    c. Portability - Enhance the system with its capacity to replace legacy software smoothly without data loss or service breakdown or integration into the already existing institutional setting.
5. System Integration that requires further research or scholars need to examine further how to integrate this platform with wider institutional systems which may include Financial Management or Human Resources to form a complete integrated administrative ecotope.

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