

Streamlining Solution for Procurement Management through Automation

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Keywords: Automation, Information System, Inventory, Procurement

Abstract: The study on Streamlining Solution for Procurement Management through Automation is developed to address the need for a reliable and secured information system for monitoring procurement processes and inventory of supplies and equipment. ASCOT practices the manual process of doing transactions resulting to problems such as slow processing, lack of inventory, poor monitoring, data inaccuracy, and issues on transparency. Thus, the objective of this study is to end the cycle of errors and delays in procurement processes, through the development of Procurement Monitoring System that automates the procurement transactions. To obtain the necessary data, the researcher conducted interviews to collect information needed in analysing the process and flow of transactions. The researcher used the developmental method of research in undertaking the study and used V-Model of the SDLC for the development of the system. To evaluate the acceptability of the system, the researcher used the questionnaire adapted from ISO 25010 Software Product Quality Standards. The evaluation shows an overall mean of 3.69 denoting that PMS was found conformed to the software quality requirements. The system has successfully reduce the time of operation and simplify complicated tasks in terms of recording supplies and monitoring transactions while the user can track every transaction movement.

1 INTRODUCTION

Procurement processes in government institutions is not only taxing, tedious, and prone to errors; but can also take a lifetime if manually done. It is a common knowledge shared by people working in the government. There is no doubt; the manual procurement activity system of government agencies needs reform. Procurement is the process of acquiring of goods, services or works, and the contracting negotiation for infrastructure projects from a supplier or contractor, often via tendering of bid process[3]. The process followed in public procurement involves formulating an annual plan detailing the approved procurements with specifications for the fiscal year; after which, the procurement unit proceeds to purchasing the goods based on the specified schedule. These activities involve the participation of suppliers, contractors, requesting parties (requisitioners), end-users, personnel of the Procurement Management Unit (PMU), Budget Office, Supply Office and the Head of the procuring entity. From the preparation, approval and submission of various documents

needed, the availability of the signatories usually pose as burden in undertaking the process.

As time and industry demanded the need to upgrade the processes from manual to automated, the government has promoted what is now known as e-government initiatives. Government agencies directed themselves in implementing IT systems to deliver better services; hence, cutting the red tape and reducing the required time in most transactions. This technological reform aimed to deal with the longstanding problems that constraint many government agencies from ensuring proper planning and budgeting, combating corruption, and strengthening accountability. The Philippines, in its effort to have a more efficient, economical, accountable, and transparent public procurement system, launched the Philippine Government Electronic Procurement Services (PhilGEPS) in accordance to its mandate on the Government Procurement Reform Act of 2003. PhilGEPS is the central portal of all public procurement activities that provides both government agencies and suppliers with a transparent and competitive environment[1]. In spite of the reform, government offices were still

experiencing difficulties in the procurement process. And the Aurora State College of Technology (ASCOT) was no different in facing such problems.

ASCOT is a fast growing academic institution as manifested by its numerous development projects. However, the College is no different from other agencies that failed to take advantage of technology as it still practices traditional or manual process of doing transactions. The practice resulted to common problems such as slow procurement processing, lack of inventory, poor monitoring, data inaccuracy and issues on transparency that further resulted to misinformation and other related problems. One problem commonly encountered in the procurement process was that end-users often request items with no proper specifications, resulting to delay in the approval of request for such items. The PMU personnel therefore would have to re-coordinate and ask the end users over and over again for specifications. Another problem encountered was the cyclical delay in consolidating the Annual Procurement Plan (APP) and Project Procurement Management Plan (PPMP) of Academic Departments and Administrative Units because of the late submission of departmental APPs and PPMP. On the other hand, the Supply Office had no precise inventory system to track the status of issued supplies and transferred equipment, which often led to data inaccuracy, loss of records, and human errors. The foregoing issues and concerns prompted the researcher to think of a solution to end the cycle of errors and delays in procurement processes. She firmly believed that the problem could be addressed through the development of PMS that would automate the procurement transactions and processes by incorporating modules on procurement, inventory and supply monitoring for a more accurate and faster transaction. This system would reduce the time of operation and simplify complicated tasks in terms of recording supplies and monitoring transactions while the user can, at the same time, track every transaction movement done.

2 LITERATURE REVIEW

Different studies and reforms focused on eliminating the problems usually experienced in the procurement process were conducted. Most of the studies are on fostering fair competition, increasing transparency, standardizing procedures, ensuring proper planning and budgeting, and combatting corruption. The following related literature and studies from both foreign and local researchers present a survey of the

concept, ideas, generalization and conclusion that bear relevance to the present study.

The research work of Seth Jones, David (2013) examined the features and impact of recent reforms introduced by the Philippine government to deal with the longstanding shortcomings in its procurement system. The findings [8] showed that the impact had been less than promised. This was due to limitations of certain provisions of the reforms and weaknesses in both implementation and in the accountability of the procuring entities. Meanwhile, in a study conducted by S. Kolmykova, T & V. Semenikhina, E & A. Alpeeva, E. (2018), public procurement was defined as a category of the modern economic system with great influence on the formation of the innovative potential of the country and the regions. It performs the most important functions: regulative, reproductive, stimulating, social and innovative. Thus, [7] the study of the public procurement system today is a significant and relevant issue in the field of economic research.

The Philippines, in its effort to have a more efficient, economical, accountable, and transparent public procurement system, has launched the Pilot Electronic Procurement System (EPS) in November 2000[1]. The EPS utilized the accessibility of the internet as a common portal for registration of suppliers and advertisements for bid opportunities. In 2003, the Philippines launched the Philippine Government Electronic Procurement Services (PhilGEPS) in accordance to its mandate on the Government Procurement Reform Act of 2003[1]. PhilGEPS features components that includes Electronic Billboard, used for posting procurement opportunities, notices, awards and reasons for award for government procurement, Suppliers' Registry, used for the registration of suppliers who wish to do business and projects with government agencies, and Electronic Catalogue, the listing of all the goods, supplies, materials and equipment available. The 2016 Revised Implementing Rules and Regulations hereinafter called the IRR, was disseminated pursuant to Section 75 of Republic Act No. (R.A.) 9184, otherwise known as the "Government Procurement Reform Act," for the purpose of recommending the necessary rules and regulations for the modernization, standardization, and regulation for the implementation of procurement activities of the Government of the Philippines[3]. The guidelines in the procurement process serves as the basis of every government institution in conducting their procurement activities in the country.

The different countries around the world has also been battling with different procurement

difficulties, thus researchers from around the world have conducted studies in order to address these problems. The option of implementing e-procurement systems, web-based procurement management system has been an option for other countries and even in some institutions in the Philippines. The following research outputs presented some of the e-procurement systems that were developed and implemented and the impact of these on the procurement development process.

The findings of the study of Benjamin Nyariki Onchoke, Daniel M. Wanyoike (2016) revealed that Internal Inventory Security Procedural Practices, Inventory Auditing and Computerized Inventory Control both individually and collectively have significant positive influence on Procurement Performance[2]. The work of Moe Carl Erik (2014) found out that most of the research in procurement focus on the specific task of requesting, tendering and vendor selection. He accentuates, that more than these, there should be a more longitudinal research that covers the entire process from the requisition up to the delivery and that research approach must focus on issues like stakeholders' involvement and management [6]. On the other hand, the study of Konstantinovna Mitropan, Tetyana (2018) concentrated on a comparative analysis of the types of public procurement mechanisms based on a set of features, has shown the superiority of a centralized type of mechanism that facilitates the introduction of efficient and flexible procurement methods. The direction of this process is determined by the need to implement the principles of validity and innovation, fair choice of the best bidding, prevention of corruption and ensuring the high efficiency of the implementation of public procurement[4]. In addition, the study conducted by Soojung Oh, Hongsuk Yang & Soo Wook Kim (2014) gave a strategic view on providing a new perspective regarding the suitability between e-procurement being used by itself and the IT capability necessary for this. Firms need to find a proper fit between their own information technology (IT) capabilities and IT systems in order to enhance performance[9]. Also, the study written by Masudin, Ilyas & S Kamara, Mohammed & Zulfikarijah, Fien & K Dewi, Shanty (2018) discussed that procurement and inventory management serves as an essential strategy for an organization to deliver a competitive

performance[5]. An efficient procurement and inventory management system will ensure controls over end-user's demands thereby resulting to increase in organizational performance. Adopting for such developments will improve organizations efficiency and effectiveness by automating process, and fostering coordination between the personnel of the organization.

The foregoing reviewed researches highlighted the flaws of the manual procurement processes and strengthen the reason to believe that automation is a key to correcting the said flaws. Previous attempts at procurement automation addressed issues on requesting, tendering, and vendor selection; but not the issues and concerns affecting government agencies in terms of transparency and confidentiality. It is a research gap that the researcher wished to address; hence this study.

3 RESEARCH METHOD

The researcher used the developmental method of research to accomplish the desired output. Through data gathering, the researcher was able to obtain significant information like forms, procedures and guidelines vital to the development of the system that will address the issue on procurement. In developing the system, the researcher used the V-Model of System Development Life Cycle. Using the V-shaped model, all phases of the development cycle has an associated testing phase. The verification phase includes the various designs and coding activities required in the software development process. It involves requirement analysis, functional specification, high level design or the architecture design and the module design. On the other hand, validation ensures that all that development was carried out correctly through the following tests: Unit Testing, to ensure that all bugs or errors in the codes are removed and tested early on; Integration Testing, to ensure that the module and architectural designs are accurate and that all the software's functionalities have been captured in the design; System Testing, to evaluate the functionality of the software and Acceptance Testing, to ensure the acceptability of the system by the user.

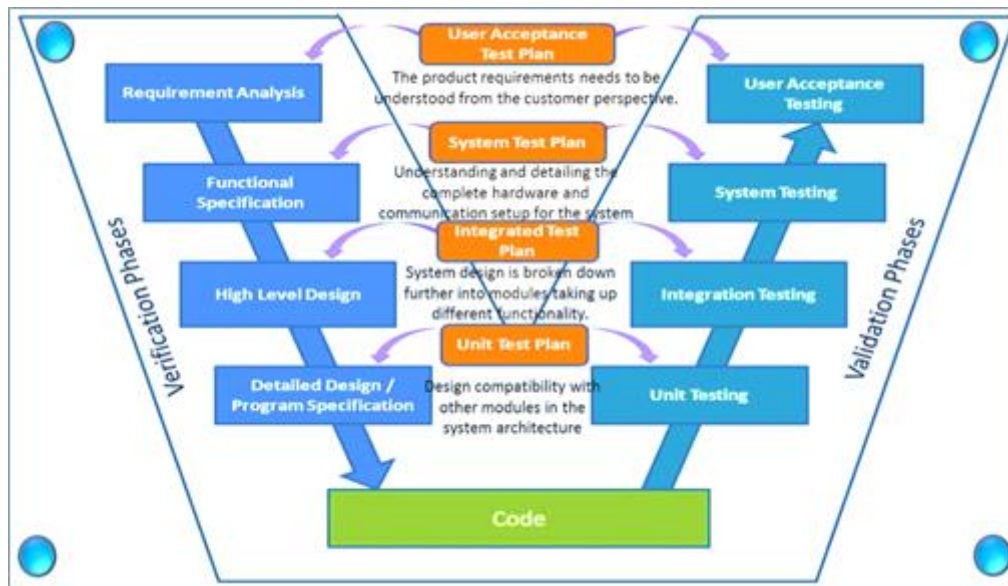


Figure 1: Phases of The V-Model of the SLDC

The figure shows the different phases on the V-Model of SDLC. Under the V-Model, the corresponding testing phase of the development phase is planned in parallel style. So, there are Verification phases on one side of the 'V' and Validation phases on the other side which is linked by the Coding Phase.

3.1 Local of the Study

This study was conducted and implemented in Aurora State College of Technology (ASCOT), Aurora, Philippines. ASCOT is a sole state college in the province of Aurora which caters most of the students from the province and nearby towns.

3.2 Respondents

There were 30 research samples used in the study as respondent evaluators. Half of this 30 were end-users who were all chosen purposively on the basis of their practice in and familiarity with the procurement flow and processes; while the other half were technical experts, also purposively chosen on basis of their technical knowhow and knowledge about system functionality and technicalities.

Purposive sampling was employed since it is a technique applicable when the number of people to serve as primary sources of data and evaluators is limited due to the nature of research design and objectives of the study.

3.3 Research Instruments

To evaluate the features and functionalities of the developed system, the proponent utilized two sets of questionnaire-checklist derived from ISO 25010 Software Product Quality Standards.

The first set was for the IT experts and technical staff; while the second was for the end – users. The set for the IT experts and technical staff consists of items on eight (8) evaluation areas, namely, software product quality indicators namely functional stability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability; while the set for the end users consists of items on three (3) evaluation areas, namely: functional suitability, performance efficiency, and usability. To determine the content validity, reliability, and quality of the instrument, the questionnaires adapted from the ISO/IEC 25010 Software Product Quality Standard were subjected to the review and evaluation of a statistician whose suggestions and comments were noted and incorporated to strengthen instrument validity.

3.4 Data Gathering Procedure

The researcher first conducted a series of interviews to collect information needed in analyzing the process and flow of transactions, and to gather forms and reports necessary in designing a system that would fit to the requirements of the end-user. The system was

then designed and developed according to specifications and in consideration of the existing needs of the end users. When the system was already running, the researcher proceeded to the evaluation stage where the system was used and evaluated by intended users, IT experts and Technical staff. The researcher administered the evaluation materials herself using the two sets of questionnaire based from ISO 25010 Software Product Quality Standard to ensure valid and reliable data. The gathered data were then tabulated and scored after which these were analyzed and interpreted.

3.5 Data Analysis Technique

Process analysis presented textually on the basis of the procedural steps of the V model of the SLDC was employed in analyzing the development phase of the

developed system. The project would be deemed successfully completed upon thorough application of the different phases of the System Development Life Cycle. On the other hand, weighted scores and weighted mean were utilized to determine the acceptability of the PMS on the basis of ISO 25010 Software Product Quality Standards.

4 RESULT

The project was successfully completed through the application of the different phases of System Development Life Cycle. The following table shows the result of the thorough investigation on the different problems encountered in the manual process of procurement and its solution using the developed Procurement Monitoring System.

Table 1: Problem Encountered in the Current Process and its Solutions

TRANSACTION WORKFLOW	PROBLEMS ENCOUNTERED	SOLUTIONS
Consolidation of APP and PPMP	<ul style="list-style-type: none"> - Manual checking and approval of document - Manual encoding and consolidation of documents using excel formulas 	<ul style="list-style-type: none"> - Automation of the submission, approval, consolidation and of APPs and PPMPs through the APP and PPMP File Upload Module, Budget Allocation Review and Approval Module, APP and PPMP Consolidation Module of the PMS
Procurement Process	<ul style="list-style-type: none"> - Hustle of repeatedly encoding information in various forms - Monitoring problems - Storage of records - Transparency of transactions 	<ul style="list-style-type: none"> - Development of the procurement management system that automates the procurement process from the creation of purchase requests up to the printing of certification to the winning bidder. - Notification for posting of information, status and progress of the procurement for transparency were also included
Inventory Management	<ul style="list-style-type: none"> - Manual checking of inventories - Loss of records - Data inaccuracy - Human errors 	<ul style="list-style-type: none"> - Integrate an inventory management system that will monitor and update the status of purchased and released supplies and equipment and will keep track of the issued and transferred equipment

Table 1 detailed the common difficulties in the procurement process and its solution through the development of Procurement Monitoring System that meets the following objectives: (1) develop a procurement management system that automates the submission, consolidation and approval of APPs and PPMPs and the procurement process from the creation of purchase requests up to the printing of certification to the winning bidder and (2) integrate an inventory management system that monitors and updates the status of purchased and released supplies and equipment and keep track of the issued and transferred equipment.

For the software acceptance evaluation, the following tables show the results made by the IT Experts, Technical Staff and End-Users on the developed system based on ISO 25010 Software Product Quality Standards.

Table 2: Summary of Evaluation Results of the Procurement Monitoring System by the IT Experts and Technical Staff

ISO Quality Standards	IT EXPERTS AND TECHNICAL STAFF	
	Weighted Mean (WM)	Qualitative Description
Functional Suitability	3.67	Very Functional
Performance Efficiency	3.53	Very Efficient
Compatibility	3.67	Very Compatible
Usability	3.72	Very Usable
Reliability	3.53	Very Reliable
Security	3.69	Very Secured
Maintainability	3.82	Very Maintainable
Portability	3.69	Very Portable

As presented in the table, the system got a qualitative rating of Very Functional with an over-all rating of 3.67. This results imply that the PMS provides all the essential features and functionalities necessary for the procurement operation such as monitoring of requested, procured, delivered and transferred supplies and equipment of the College. Meanwhile, the computed over-all rating of 3.53 for performance efficiency denotes that the system is very efficient in providing accurate and appropriate reports and outputs while working under minimal system requirements. Likewise, the calculated overall rating of 3.67 for Compatibility indicates that the system is very compatible, and thus, can be used

simultaneously with other applications and can share the same hardware or software environment without affecting the performance of other applications. Moreover, the overall rating of 3.72 with a qualitative description of Very Usable for Usability denotes that the system can be used to achieve specified goals with effectiveness, efficiency and satisfaction as made evident by its user-friendly interface. Moreover, the rating of 3.53, qualitatively described as Very Reliable for Reliability implies that the GAMPS consistently provide features for recovery in case of failures or any untoward incidents. The shown overall rating of 3.69 for Security denotes that all information stored in the database of the PMS is secured and it features the creation of different levels of access for users provided by encrypted password so that unauthorized users cannot enter and alter information within their scope. Also, the system got an overall rating of 3.82 for Maintainability which implies that the PMS's updates can easily be done because the system's components and structure are easy to understand. Furthermore, the computed overall rating of 3.69 for Portability indicates that the system can be used in different environments or operating system without experiencing problems or difficulties.

The results of the evaluation show that the PMS complied with the different software quality criteria of the ISO 25010 Software Product Quality Standards. This implies that the developed system is a quality software product that can be implemented and integrated in the workflow of transactions of the procurement and monitoring of supplies and equipment.

Table 3: Summary of Evaluation Result of Procurement Monitoring System by the End-Users

ISO Quality Standards	END-USERS	
	Weighted Mean (WM)	Qualitative Description
Functional Suitability	3.73	Very Functional
Performance Efficiency	3.64	Very Efficient
Usability	3.77	Very Usable

The table shows the assessment of the End-users on the developed system based on selected criteria from the ISO 25010. The result implies that the developed system is functionally suitable for the needs of the end-users as shown in the overall rating of 3.73, qualitatively interpreted as Very Functional. The PMS provides operational functionalities in terms of procurement management, automated submission and approval of Annual Procurement Plan

(APP) and Project Procurement Management Plan (PPMP), and an inventory module for the monitoring of requested, procured, delivered and transferred supplies and equipment of the College. The over-all rating of 3.64 that the system obtained on Performance Efficiency implies that it can work using minimum system requirements and still provide accurate and timely results. Additionally, the 3.77 overall rating in Usability denotes that the system can be used to achieve specified goals with effectiveness, efficiency and satisfaction as made evident by its user interface that is easy to learn and adapt with.

The results indicate that the end-users were ready to accept and adapt the system and integrate it in their process and workflow of transactions. This implies that the system is Very Functional, Very Efficient and Very Usable and therefore can highly be recommended for use in any SUC, particularly in ASCOT.

5 DISCUSSION

The study focused on the development of Procurement Monitoring System for Aurora State College of Technology that features the computerization and automation of the processes and flow of transactions in the budget, procurement and supply monitoring of the College. This includes the development of modules: 1) Dashboard, 2) APP and PPMP File Upload Module, 3) Budget Allocation Review and Approval Module, 3) APP and PPMP Consolidation Module, 4) Procurement Management Module, 5) Inventory Management Module, and (6) System Setting Module that handles the submission, approval and consolidation of Annual Procurement Plan (APP) and PPMP, and monitors budget allocation as well as the whole procurement process including reliable inventory system for the supplies and equipment of the College. The system works on a Local Area Network set-up wherein there are three sets of user admin accounts for Budget Office, Procurement and Planning Management Unit, Supply Office and a user account for Academic Department and Unit Office Heads with different functions and level of access and restriction based on their respective functions.

The project was successfully completed through the application of the different phases of System Development Life Cycle where each phase is described and explained below.

5.1 Planning

The proponent conducted series of interviews to the concerned offices to study the methods, processes and flow of procurement and inventory of supplies that leads her to the identification of the problems encountered in manual process. In addition to the information gathered from the interviews, the proponent also studied the policies and guidelines of RA 9184; the Government Procurement Reform Act for the identification of features and functionalities of the proposed system and in order to ensure that no existing rules was violated. Then, the researcher created a list of activities and schedule of the implementations of the development phases through a Gantt Chart.

5.2 Analysis

The researcher conducted an in-depth analysis of the process and flow of the current setting to determine where the proposed system would be integrated and implemented. From the given inputs, a data flow diagram for the existing workflow and developed workflow was created. A use case diagram was also designed upon identifying the persons who would be involved in the proposed work flow. The software and hardware requirements were also identified in this phase to determine the most appropriate and best suited specifications for the system.

5.3 Design

The researcher used different models to create and establish the design of the system and database. She also used data normalization to eliminate redundancies and to determine which fields would be linked to certain tables. A data dictionary was also formulated to show the types of data used and the length of each field. Lastly, an entity-relationship diagram was also designed to explain the relationships between the tables used in the development of the study.

5.4 Coding

The researcher used PHP scripting language in writing the source code of the system while Bootstrap, HTML and CSS was used in designing the system's graphical user interface. In establishing the database of the system, the researcher employed My SQL to hold all the data, information, and records of the system.

5.5 Testing

In this phase, the system was installed in different computers to test its appearance and performance in different environments. It is then subjected to Performance Testing, System Flow and Error Testing and Typographical Testing to check system flow error, output generation errors, typographical and other errors that might be encountered in using the system. All errors and bugs were gathered and skillfully resolved upon the release of the final version of the system.

5.6 Implementation

The system was properly turned-over to the intended offices and was installed in their respective computer units. An orientation on how to use the system was conducted for the users after they were requested to evaluate the system based on the criteria adapted from ISO 25010 Software Product Quality Standards.

The PMS was found conformed to the software quality requirements adapted from the ISO 25010 Software Product Quality Standards such as functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability and portability, based from the results of the software acceptance evaluation made by the IT Experts, Technical Staff and End-users.

6 CONCLUSIONS

The Procurement Monitoring System was successfully developed through the different phases of the V-Model of the System Development Life Cycle and may therefore be implemented in any State University and Colleges in the Philippines. It complies with the requirements specified in the ISO 25010 Software Product Quality Standards in terms of Functional Suitability, Performance Efficiency, Compatibility, Usability, Reliability, Security and Maintainability, and Portability. The system provides a reliable, accurate and secured information system that can address the problem of government offices in terms of procurement, monitoring, and inventory of supplies and equipment. This system reduce the time of operation and simplify complicated tasks in terms of recording supplies and monitoring transactions while the user can, at the same time, track every transaction movement done.

The Researcher recommends that the developed PMS be implemented for use of any State University and College or any government office in the

Philippines for the effective monitoring of budget allocation, procurement management and supply inventory. They may support the implementation of the PMS by providing the hardware requirement (server computer, work stations) and network arrangement essential for the full operation of the system. Upon the implementation of the PMS, they may also conduct advance training for users regarding the procedures and how the system will be properly and effectively utilized and maintained.

To facilitate additional learning, further studies may be conducted to determine the effectiveness of the PMS as compared to the traditional or manual process and may opt to develop an upgraded web-based procurement management system to enhance more features and functionalities of the system.

ACKNOWLEDGEMENTS

The author gratefully acknowledge the contributions of Prof. Alexander S. Cochanco, and Dr. Manuela P. Gutierrez, for the unending and untiring support, efforts and encouragement, and most specially, for the brilliant ideas and suggestions toward the completion of this research and to the ASCOT personnel for the warm and supportive accommodation as well as for the time they extended to provide all the printed materials, like rules, policies and procedures, manuals and other forms.

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