**ReQuest: A Progressive Web App-Based Purchase Request Automation System for Technological University of the Philippines**

A Thesis

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# Chapter 1

**THE PROBLEM AND ITS SETTING**

**Introduction**

In order to achieve success, an organization must have different departments and processes that work together effectively. One of the critical components of these organizations is procurement, which ensures that goods and services are acquired in a timely and resourceful manner. Procurement plays a vital role in supporting an institution's operations by managing the acquisition of necessary resources (Jama & Mohamud, 2023). Additionally, procurement involves a crucial aspect known as the purchasing process, which includes steps such as requisition, approval, order placement, and receipt of goods and services. This process can be further enhanced through the use of technology.

In the 2024 State of the Nation Address (SONA), President Ferdinand "Bongbong" Marcos Jr. emphasized the amendment of Republic Act No. 9184, also known as the Government Procurement Reform Act, to Republic Act No. 12009, also known as the New Government Procurement Act (NGPA), which he signed into law. This amendment highlighted the standardization of procurement forms and the institutionalization of electronic procurement, demonstrating the government's recognition of the need for emerging technologies and innovative solutions in procurement.

Consequently, to stay ahead and effectively meet modern demands, organizations must embrace emerging technologies. One of the most impactful advancements in this regard is the utilization of Progressive Web Applications (PWAs). PWAs are web applications that provide a smooth, app-like experience on any device, combining the best features of web and mobile applications. By developing an automated PWA, organizations can achieve real-time access to data, streamline relevant processes, and provide users with a user-friendly interface that simplifies complex tasks. This technological advancement promises to revolutionize the way organizations handle various operations.

Although transitioning the purchasing process of an organization to a PWA holds the potential for significant improvements in efficiency and effectiveness, it is essential to recognize and adhere to the regulations set forth in RA 12009 as this emphasizes the importance of transparency, accountability, and integrity in public procurement processes. Ensuring compliance with these updated regulations is crucial for maintaining lawful and ethical procurement practices.

## Background of the Study

In an institution, having maintained and organized goods and services requires rules and regulations for effective management. The procurement process in the Philippines represents a significant undertaking for the government, involving the acquisition of goods, evaluation of services, and other related activities. Governed by Republic Act No. 9184, also known as the Government Procurement Reform Act, these processes are important for transparency and efficiency in public procurement. However, the new Government Procurement Act No. 12009, stated by President Ferdinand "Bongbong" Marcos Jr., helps to improve the procurement process in the Philippines with the use of technology.

Unfortunately, in an institution, people need a system to manage their data and requests to monitor their activities. The problem with the procurement process at the Technological University of the Philippines is that they lack a proper system for managing purchase requests. This deficiency makes it difficult to track activities and generate reports using Purchase Request (PR) numbers in one system. Additionally, the absence of a centralized system leads to inefficiencies and delays in the procurement process, as manual tracking and record-keeping in Microsoft Excel can result in errors and miscommunication.

To address these issues, ReQuest is being developed as a Progressive Web Application (PWA). This system aims to automate the purchase request process, providing a centralized platform for tracking activities and generating reports. By integrating real-time notifications and automated email alerts, ReQuest will ensure timely communication and updates, reducing delays and improving the efficiency of the procurement process. ReQuest aims to simplify procurement tasks while adhering to the university's strategic goals and budgetary regulations. It achieves this by collaborating with the Project Procurement Management Plan (PPMP). ReQuest's automation will improve transparency and accountability in the procurement process, as well as assist the PPMP in achieving its objectives by ensuring timely and accurate completion of procurement tasks. ReQuest will utilize modern web technologies to offer a user-friendly interface, ensuring that the procurement process at the Technological University of the Philippines becomes more efficient, transparent, and accountable. The implementation of this system is expected to significantly enhance the management of procurement activities, aligning with the updated regulations and technological advancements in public procurement practices.

According to a study by Stritch et al. (2020), our knowledge of the various factors affecting the timeliness and efficiency of procurement processes is limited, especially when multiple policy objectives must be achieved simultaneously. This underscores the importance of developing systems like ReQuest to address these complexities and improve procurement outcomes.

Moreover, the successful implementation of ReQuest could serve as a model for other institutions facing similar challenges. AT Kearney states that procurement compliance is not just about procurement. Instead, it is a holistic effort that spans all departments and is designed to generate value for the company (Pasamonte, 2023). By demonstrating the benefits of automating procurement processes, ReQuest could encourage other educational institutions and government agencies to adopt similar technologies. This widespread adoption would lead to more standardized and efficient procurement practices across various sectors, contributing to improvements in public resource management.

In addition, ReQuest's data analytics capabilities will provide valuable insights into procurement trends and performance. These insights can help administrators and staffs make informed decisions, identify areas for improvement, and develop strategies to enhance procurement efficiency further. The ability to analyze procurement data in real time will also enable the institution to respond more quickly to changing needs and circumstances, ensuring that procurement processes remain adaptive and responsive. Procurement compliance impacts every department, so making this process a participatory effort will ensure a better outcome for everyone (Pasamonte, 2023).

The purpose of this study is to develop a system for the procurement process in purchase requests, which will also enhance the professional development of the procurement staff at the Technological University of the Philippines. By equipping the staff with modern tools and technologies, they will gain valuable skills and experience in managing automated procurement systems. This improvement not only boosts their job performance but also enhances the main purpose of this study which is the procurement process.

## Objectives of the Study

***General Objective***

The general objective of the study is to develop a progressive web application (PWA) system that automates purchase requests for the procurement office in the Technological University of the Philippines (TUP).

***Specific Objectives***

1. Develop a progressive web application with the following features/characteristics:
2. Create, submit, and update PPMP and PR.
3. Notification logs/ tracking or monitoring of requests.
4. Paperless-ready processing.
5. Data analytics in the system dashboard.
6. Audit trail and report logs.
7. Develop a web-based application using the following components:
8. User Interface
9. Canva
10. Adobe XD
11. IDE
12. Visual Studio Code
13. Frontend
14. HTML 5
15. CSS
16. Bootstrap
17. JavaScript
18. Backend
19. PHP
20. Laravel
21. Database Management System
22. MySQL
23. Version Control
24. Github
25. Hosting
26. Heroku
27. Test and improve the system based on functional suitability and reliability.
28. Evaluate the level of acceptability of the system using ISO25010.

**Scope and Limitations**

The study is about the development of a Progressive Web Application (PWA) system that can be used by the procurement office in the Technological University of the Philippines (TUP). The goal is to provide the procurement office with an automated purchase request that streamlines its tasks, as well as switching the process from semi-manual to automated process. Developing ReQuest requires utilizing a variety of web development technologies and frameworks, including Adobe XD and Canva for UI design, HTML5, CSS, Bootstrap, and JavaScript for frontend, PHP and Laravel framework for backend, MySQL for database management, GitHub for version control, Heroku for deployment and any additional tools that might be needed.

This study is beneficial to the procurement office in TUP as it will automate the purchase request process efficiency and enhance accessibility of records through the system. The administrator which is the head of the procurement office has access to all functionalities that are available to the system. It also includes management capabilities for all users of the system.

On the other hand, procurement staff at ReQuest are limited to certain features since the administrator will only assign each staff member based on their tasks in the system. Staff of ReQuest are limited to certain features, such as searching and viewing purchase requests, as well as performing important duties like creating, encoding, and updating. In addition, the generation of purchase requests and exporting them into document formats such as PDF and Excel are also accessible to the staff module. The other users of the system are the end users, who can also view, approve or reject, and put signatures on the purchase request forms.

There are a few limitations with the system. User accounts can only be created and managed by administrators. The compatibility of the device that users will be using to access the system can be through mobile, laptop, or desktop. The device must also have internet connectivity to access and log in to the system. Even though the website alone supports most of its functionality, users can write and store their signatures only on the mobile version, which needs to be set up in landscape mode. Lastly, notifications are only available to users who are logged in to their accounts.

## Significance of the Study

This study focuses on the difficulties encountered by the procurement office at the Technological University of the Philippines (TUP), which presently depends on manual procedures for handling purchase requests. These manual activities are not only inefficient but also expensive and time-consuming. The project addresses the need for more research by identifying and emphasizing these inefficiencies. It plans to achieve this by creating a Progressive Web Application (PWA) that will help streamline the shift from manual to automated operations.

This study will help the procurement office and its personnel, who will benefit from more efficient procedures for generating, revising, and retrieving purchase requests. By automating these tasks, processing times will drop significantly, making procurement procedures more efficient overall. This enhancement will enable the team to concentrate on more strategic and value-added endeavors rather than being burdened by monotonous manual tasks. The PWA will additionally implement instantaneous notifications and automated email alerts for end-users, guaranteeing prompt communication and minimizing delays. This feature is essential for ensuring that all parties involved are kept up to date on the progress of their requests, hence improving the level of transparency and responsibility within the procurement process.

This study will help administrators with comprehensive management features, such as user account management and the incorporation of data analytics. These characteristics will enhance decision-making by offering insights into purchasing patterns and performance indicators. Incorporating personnel and report logs will further improve accountability by monitoring changes and actions related to report generation. The PWA's capacity to produce documents containing the names of the relevant staff members will simplify the documentation process, guaranteeing precise record-keeping and adherence to institutional standards. By posing approved purchase requests, the communication of procurement decisions will be simplified, resulting in a more transparent and accessible process. Implementing this will decrease the workload of employees, mitigate stress, and enhance the precision and effectiveness of document management.

Finally, future researchers can utilize the discoveries of this study to authenticate or support their studies. By employing the techniques and results provided, individuals can create and execute initiatives that enhance the understanding and implementation of automating administrative procedures in educational establishments. This work can significantly influence and encourage future research efforts on this subject.

# Chapter 2

**CONCEPTUAL FRAMEWORK**

This chapter presents the related literature, studies, and systems, a synthesis of the whole literature review, the conceptual model of the study, and the operational definition of terms relevant to ReQuest: A Progressive Web App-Based Purchase Request Automation System for Technological University of the Philippines.

## Review of Related Literature

This part contains related literature of the ReQuest: A Progressive Web App-Based Purchase Request Automation System for Technological University of the Philippines.

***Procurement***

Based on the article of Young (2024) on Investopedia, procurement is the process of purchasing goods and services, typically within a business context. Institutions can be either buyers or sellers, depending on the purpose of the purchase request. Procurement is an important aspect of managing and requesting a company’s resources, allowing organizations to acquire various goods or services. In this article, procurement and purchasing are differentiated, as they are often confused. Therefore, in a procurement system, it is essential to understand the difference between the two to effectively apply purchasing or to purchase request within the procurement process.

According to Jenkins (2024), Procurement involves obtaining goods or services through a structured process, though companies define procurement differently. Some view it as covering all stages from requirement gathering to payment, while others focus on specific tasks such as issuing purchase orders and making payments. Technology can be a big help to reduce procurement costs and administrative overhead by automating and tracking procurement processes. When a significant quantity of supplies or services is needed, an employee or business group submits a formal purchase request. This request alerts the company, typically through department managers, purchasing staff, or the financial team, and includes important details such as price, timeframe, and quantity. The overseeing department can review the request and either approves or denies it. For implementing a system for procurement, understanding these stages and components is key to automating purchase request processes and ensuring alignment with organizational goals.

In addition, according to Government Procurement Policy Board (2024) the 2016 Revised Implementing Rules and Regulations (IRR) of Republic Act No. 9184, also known as the Government Procurement Reform, the Government Procurement Policy Board (GPPB) provides guidance for procurement practices in the Philippines. The IRR aims to modernize and regulate the procurement activities of the Government of the Philippines (GoP) as outlined in Section 1: Short Title and Purpose. It underscores the GoP’s commitment to good governance by adhering to principles of transparency, accountability, equity and efficiency in its procurement processes, as detailed in Section 2: Declaration of Policy. Such laws and regulations are important for implementing systems that comply with procurement standards and ensure proper adherence to relevant legal requirements.

Furthermore, on the Government Procurement Policy Board website (2024), Section 1 states that this act shall be known as the New Government Procurement Act. It outlines the general provisions and principles governing procurement processes across all branches of the national government. According to Section 2: Declaration of Policy, procurement must be guided by key principles such as transparency, competitiveness, efficiency, proportionality, accountability, and sustainability. These principles are essential to ensure that public procurement processes promote good governance, minimize waste, and ensure that public funds are used effectively and efficiently. The Act also emphasizes the importance of using emerging technologies and innovative solutions to streamline procurement processes, making them more organized.

Lastly, in the article by Anath Avva (2022), it is stated that procurement is a business process in the fullest sense of the term. It involves numerous workflows and requires input or action from multiple departments. According to the Deloitte Global CPO Survey 2019, 61% of chief procurement officers (CPOs) agree that procurement-related risks have been rising over the past year and noted the top risks highlighted in the report. Digitizing and automating workflows with procurement software enhances productivity by reducing repetitive tasks and minimizing human errors. This technology applies the process for requesters to send purchase orders and other processes of procurement. The article highlights several key benefits of automating procurement processes. One major advantage is the centralization of data and information through automated procurement software, which enhances data protection by setting rule-based permissions for access. The article emphasizes that major market players are investing in digital transformation and structured workflows, and that procurement automation is seen as beneficial for improving business strategy.

***Purchase Request***

Based on the article of Rebeca Bichahi (2022), a purchase request is a document that states the business needs to buy products or services. When an employee or assigned employee perceives a need to purchase products or services, they can fill out a purchase request form and send it to the appropriate person or department for review and approval. Following approval of the purchase request form, the business will send a purchase order to the appropriate vendor for the requested items. A purchase order is for the approved items that will be sent to a supplier. It is a legally binding agreement that specifies the particular items and price the business intends to purchase.

According to the blog posted on procurify.com (2024), purchase requests are essential in any organization because supplies, materials, and equipment are constantly needed. These items could include machines, consumables, office supplies, and other equipment. In the procurement process, a purchase request is crucial for several reasons. First, it initiates the purchasing process within an organization, starting with the identification of needs and continuing through creation, review and approval, sourcing, creation of the purchase order, order fulfillment, receipt and inspection, payment, documentation, and record-keeping. Second, it serves as an efficient control mechanism by introducing structure, supervision, and transparency. Third, it safeguards the organization against fraud by using the establishment of an approval process, an audit trail, and data analysis to identify and prevent inappropriate purchases. Lastly, it centralizes the procurement process by guaranteeing that purchasing processes are streamlined, standardized, and controlled.

Lastly, Chris Sumida (2024) states the several benefits of using purchase requests. First, effective purchasing and sourcing convey the specifications for the procurement in a clear and concise manner. Second, prevention of unauthorized purchasing guarantees that purchases may only be authorized by individuals with permission. The third is effective resource allocation and budgeting through estimated costs from purchase requests. The last is the creation of an audit trail for purchase activity within an organization. The advantages of automation for managing purchase requests are also covered in the article. These automated processes include data entry, routing approvals, and purchase order production, which reduce human error and guarantee consistency throughout documents.

***Annual Procurement Plan***

Based on Oboloo (2023), an annual procurement plan is a strategic document that delineates the items an organization will acquire in the forthcoming year and its rationale. Establishing an annual procurement plan can guarantee that the appropriate products and services are purchased at the most competitive prices. Furthermore, the implementation of an annual procurement strategy can facilitate the procurement process. It can prevent unnecessary bidding battles and save time and money on procurement efforts by identifying the necessary products and services. Lastly, the implementation of an annual procurement plan can assist an organization in maintaining a sense of organization and concentration on its primary objectives.

According to the Government Procurement Policy Board (2023) Republic Act 9184, all procurements must be within the approved budget of the Procuring Entity and should be planned by the procurement entity. In line with government fiscal discipline, only items crucial for efficient government operations should be included in the Annual Procurement Plan (APP), as detailed in the Implementing Rules and Regulations (IRR).

An Annual Procurement Plan (APP) is a comprehensive document that consolidates all the Project Procurement Management Plans (PPMPs) submitted by different Project Management Offices (PMOs) and end-user units within a Procuring Entity. The APP outlines all procurement actions intended for the calendar year. Moreover, the PPMPs submitted by the PMOs and end-user entities, the Bids and Awards Committee (BAC), manage the preparation of the APP through the BAC Secretariat. The APP is finalized only after the Department of Budget and Management (DBM) approves the Agency Budget Matrix (ABM). Once finalized, the BAC must submit the APP to the Head of the Procuring Entity or an authorized official for approval. Only procurement may proceed if it aligns with the approved APP, which must be consistent with the approved yearly budget and formulated according to the IRR guidelines. The APP should also include engineering design and right-of-way acquisition for Infrastructure Projects.

Additionally, TranZact (2024) states that government agencies may encounter increased costs and overstocking of essential items without appropriate procurement planning. It is necessary to have effective procurement management to ensure that government purchasing decisions are made with precision, as it guides agencies in acquiring essential products and services. This meticulous planning mitigates the inefficiencies that are linked to overstocking and understocking. Furthermore, procurement management guarantees that government entities' commitments are feasible, even when expedited delivery timelines are necessary, fostering realistic expectations. Developing detailed plans for each purchase is facilitated by a strategic approach to procurement, which incorporates analysis of inventory requirements, market research, and alignment with government objectives.

Lastly, contemporary procurement planning tools offer a collaborative platform that enables government teams and suppliers to communicate effectively, facilitating smoother operations. The procurement plans establish clear timelines for completing procurement processes, with time management being a primary focus. Further, strategic procurement planning enables agencies to assess performance and determine whether procurement requirements should be consolidated or divided into distinct contract packages to improve workflow and efficiency.

***Procurement Management Plan***

Based on an article by Overvest (2024), a Project Procurement Management Plan is essential for defining project requirements and outlining the steps necessary to secure final contracts. This plan serves as a comprehensive guide for sourcing products or services and ensuring that procurement processes are executed flawlessly. By including all necessary components for the project, the plan aids in contract implementation and procurement monitoring, contributing to cost and time savings, and enhancing organizational compliance. Furthermore, integrating procurement analytics within the plan allows for a detailed examination of previous processes, providing a foundation for developing cost-efficient strategies and ensuring project success. With that in mind, the Project Procurement Management Plan is not just a procedural document; it is a strategic tool that aligns procurement activities with broader project goals, ensuring that all aspects of procurement contribute directly to the successful delivery of the project.

According to the "Volume 1: Guidelines on the Establishment of Procurement Systems and Organizations" by the Government Procurement Policy Board (2023), the PPMP includes two types: first, the initial PPMP, which is prepared by the Project Management Office (PMO), end-users, or implementing units and is consolidated into an indicative Annual Procurement Plan (APP) during the budget preparation stage; and second, the revised PPMP, which is updated after the General Appropriations Act (GAA), corporate budget, or appropriation ordinance is approved. This revised version is then submitted to the Bids and Awards Committee (BAC) for final recommendation of procurement methods and is consolidated by the BAC Secretariat into the final APP for the Head of the Procuring Entity (HoPE)'s approval. The guidelines emphasize that aligning PPMPs with the agency's budget proposal ensures that procurement planning is in sync with the entity's strategic and operational plans. Once the budget is finalized, PPMPs must be adjusted to reflect approved allocations, including any necessary updates to Technical Specifications (TS), Terms of Reference (TOR), or Scope of Works (SOW). This systematic approach ensures that procurement activities are conducted within budgetary constraints while supporting the agency's priorities and objectives, ultimately enhancing the efficiency and effectiveness of public service delivery.

Lastly, according to Landau (2023), the procurement management plan's complexity and detail can vary, but it should fundamentally include several key elements: defining evaluation criteria for supplier selection, outlining the bidding process, identifying cost methodologies, and conducting a cost-benefit analysis. It should also explain the alignment of procurement activities with the organization’s strategic goals, set timelines, identify stakeholders, and define Key Performance Indicators (KPIs). Additionally, the plan must address resource constraints, legal and payment terms, procurement roles and responsibilities, estimated costs, potential risks and mitigation strategies, and include essential procurement documents such as purchase requisitions, purchase orders, requests for proposals, and requests for quotes. Landau emphasizes the importance of several procurement documents: the Request for Information (RFI) for gathering formal information from potential suppliers; the Request for Proposal (RFP) for soliciting detailed proposals from vendors; and the Request for Quotation (RFQ) for obtaining price quotes to facilitate cost comparison. These components collectively ensure a structured and effective procurement process, aligning procurement activities with organizational objectives and supporting informed decision-making.

***Progressive Web Application (PWA)***

Based on Ray's article (2022), the rise of Progressive Web Apps (PWAs) has contributed to a significant 20% annual decrease in mobile app downloads, marking a notable shift in the app landscape. PWAs, directly accessible through web browsers, are reshaping eLearning by emphasizing responsive web design and optimizing device efficiency. He highlights that the PWAs in Learning Management Systems (LMS) prioritize mobile optimization, swift content loading, and cost-effective maintenance, bypassing traditional app store constraints. This transformative approach by PWAs redefines the learning experience, ensures seamless offline access, and offers improved user interfaces.

According to Klein (2021), Progressive Web Applications (PWAs) are akin to web-based apps that function on browsers such as Chrome and Safari, obviating downloads. They exhibit the look and feel of regular apps but are constructed using HTML, CSS, and JavaScript. The fundamental principles of PWAs encompass being easily discoverable on the web, installable as shortcuts on your device, shareable through links, functional without the internet, and capable of sending notifications. In addition, they are favored for their ease of use, low storage requirements, instant updates, and improved user interaction compared to traditional apps. Tech companies are increasingly investing in PWAs, marking a shift in app development.

In addition, PWAs seamlessly amalgamates the best native apps and responsive websites, furnishing users with an app-like experience without the complexities of a separate application. Progressive web apps (2022) emphasize that not bound by specific devices or operating systems, PWAs are lightweight and accessible, exemplified by Twitter's 600 KB size compared to the Android app's 23.5 MB. Research highlights their performance benefits, offline accessibility, reduced bounce rates, and increased conversions. The success stories of Starbucks, Lyft, Twitter Lite, and Forbes underscore PWAs' impact on user engagement and business outcomes, with significant increases in daily active users, rides, and user interactions, affirming their economic efficiency and versatility across platforms.

Lastly, the importance of PWAs lies in their innovative approach to application development, leveraging web technologies to create versatile applications compatible with various devices. As outlined by MSEdgeTeam (2023), PWAs provide experiences similar to native apps, adapting to diverse device capabilities, offering advanced features, and being effortlessly installable directly from web browsers. They mimic traditional apps with distinctive icons, support push notifications, and operate seamlessly offline. Like websites, PWAs are indexed by search engines, prioritizing user safety. These apps substantially reduce development costs by utilizing a shared codebase and boast unparalleled cross-device compatibility. Success stories like Trivago underscore heightened user engagement, while Microsoft Edge enhances desktop experiences.

***Adobe XD***

Based on the article posted on upwork.com (2022), Adobe XD is a powerful and vector-based tool for digital design and prototyping user interfaces (UI) and user experiences (UX). It is a vital tool for every UX designer because of its many features and applications. Adobe XD can be used in designing a project because of the ability of its features to create wireframes, templates, and prototypes. It has a wide range of built-in UI elements for designing user interfaces. By streamlining the UX/UI design process, Adobe XD not only saves time but also enhances productivity, allowing the developer to enjoy a custom design system.

According to a blog by Matt Smith (2022) and posted on creativebloq.com, Adobe XD is used mainly as a prototyping, user interface, and user experience design tool. Adobe XD is user-friendly because it has a modest array of drawing and typography tools compared with other Adobe apps. One benefit of Adobe XD is its ability to test designs and share the interactive layout with clients.

In addition, the blog titled "The UX Designer's Guide to Adobe XD | DesignLab" by Myre, M. (2022) serves as a guide to learning more about Adobe XD and why it stands out as one of the best interface design tools available. Adobe XD distinguishes itself in experience design software with its intuitive interface and unique feature set. Users are greeted with a clean layout, providing easy access to essential design tools, document assets, and plugins. Transitioning from design to prototype is made more accessible, allowing users to define interactions and animations efficiently. Moreover, Adobe XD provides easy-to-use link-sharing features that increase its adaptability and usefulness for designers working together and accelerate the design of user interfaces. With these features, designers can better meet user expectations and satisfaction, leading to increased appreciation for their work.

Lastly, as the article posted in helpx.adobe.com (2023) explains, Adobe XD powers end-to-end collaboration at every step of the design process, from editing in real-time with other designers to working with developers and designers to gather feedback. With Adobe XD, developers can coedit designs with fellow designers, and with the power of document history, they can resolve coediting conflicts.

***Bootstrap***

Based on the blog written by Zola (2022), the mobile-first approach prioritizes smartphones, tablets, and task-specific mobile applications as primary tools for work. Bootstrap, a widely used CSS framework, supports this approach by providing essential UI components, layouts, and JavaScript tools for creating responsive and mobile-first websites. Bootstrap is available in precompiled or source code form, with its latest version being Bootstrap 5. In computing, "bootstrap" refers to the process of loading a program using a smaller initial program, typically to load an operating system. In machine learning, bootstrapping improves algorithm stability through Bootstrap aggregating or bagging, which involves creating multiple subsets of a dataset. The Bootstrap Protocol (BOOTP) is an internet protocol that automatically assigns IP addresses and boots operating systems without user intervention. Additionally, Bootstrap CDN enhances website speed and user engagement by delivering static content more efficiently. The term "bootstrapping" generally describes the act of "pulling yourself up by your bootstraps," symbolizing the achievement of success from a humble beginning.

According to The Provato Group (2022), Bootstrap is a free, open-source front-end development framework initially developed by Twitter developers Jacob Thornton and Mark Otto. Originally called Twitter Blueprint, Bootstrap was created to improve the reliability of tools used on Twitter and to reduce maintenance time. The framework utilizes HTML, CSS, and JavaScript to facilitate the development of responsive, mobile-first websites and applications. The framework's responsive design automatically adjusts to different device orientations, making it ideal for organizations focused on mobile applications. In addition to its user-friendly interface, Bootstrap offers a set of user interface components and an implementation framework that simplifies the development process. Despite some limitations, Bootstrap’s cost-free availability and wide range of features make it a compelling choice for developers.

Lastly, in the blog of Klein (2024), responsive websites adapt smoothly to various devices, platforms, and screen sizes, ensuring a consistent user experience across all devices. Bootstrap, especially its popular version 4 released in 2018, offers significant advantages, such as a responsive grid system, cross-browser and cross-platform compatibility, and comprehensive documentation that supports developers in building and maintaining websites. However, Bootstrap has its drawbacks. The repetitive style of websites built using Bootstrap can result in a lack of uniqueness, as many sites may look similar. Despite these challenges, Bootstrap remains a valuable tool for front-end developers due to its ease of use, responsiveness, and wide compatibility that makes it a fundamental component in many web development projects.

***PHP***

Based on Astari (2024), PHP is an open-source and server-side scripting language. It is commonly used in the field of web development. Web Technology Surveys report that 78.1% of websites, including Facebook, use PHP. A scripting language encompasses supplementary capabilities for a particular activity or function. It executes scripts embedded within other software environments during runtime and has a more direct and clear code structure. PHP is a server-side scripting language, indicating that a server executes a script's instructions. Subsequently, the server furnishes data upon receiving a request, directs the queries, and arranges the information in a database. PHP is a highly adaptable scripting language well-suited for individuals of all skill levels. PHP is continually updated to align with the newest technology trends. It is beginner-friendly, versatile, efficient, and cost-effective.

According to Arwal (2024), PHP can execute various functions, such as processing form data, producing dynamic content for web pages, maintaining databases, and communicating with servers. PHP can do any task connected to server-side programming, commonly referred to as the backend of a website. For instance, PHP can retrieve data from forms, generate dynamic page content, interact with databases, establish sessions, transmit and receive cookies, and send emails, among other functionalities. PHP possesses many hash methods that can be utilized to encrypt users' data, thereby establishing PHP as a secure and dependable server-side scripting language. PHP possesses several capabilities that render it well-suited for deployment as a server-side scripting language. It will acquire additional knowledge regarding these capabilities in subsequent sessions. PHP has additional functionalities. PHP is compatible with popular operating systems such as Windows, Linux, Unix, and Mac OS X. Most prominent servers, such as Apache, include built-in support for PHP. PHP supports the utilization of a diverse array of databases.

Lastly, Dang (2024) states that PHP Open Source PHP has the advantage of being an open-source language, meaning it is publicly accessible and can be used and distributed without cost. PHP is a programming language specifically tailored for creating websites and integrated into HTML. It effortlessly combines with many web technologies, enabling the development of dynamic and interactive online pages. Security flaws like SQL injection and cross-site scripting (XSS) can surface when PHP code is improperly handled. Developers should exercise discretion and comply with industry standards to guarantee the security of PHP applications. It lacks an integrated debugger and a testing framework, making identifying and resolving problems and errors in your code more challenging. Additional external tools and libraries may be required to enhance the process of debugging and testing. PHP frameworks are compilations of libraries and tools that offer a systematic and uniform approach to creating web applications to optimize PHP's benefits and mitigate its possible limitations. They may leverage PHP's versatility and agility to enhance code quality, security, performance, and scalability. Laravel, Symfony, CodeIgniter, and CakePHP are the leading PHP frameworks.

***Laravel***

Based on the FastFWD article (2022), since its release in 2011, Laravel has become one of the most popular PHP frameworks, surpassing others like Symfony, CodeIgniter, and Yii. Laravel is an open-source PHP framework designed to simplify web development by providing essential components and features for building websites and apps. It follows the model-view-controller (MVC) approach and is primarily a backend framework, though it can be paired with front-end frameworks like Vue.js for enhanced functionality. Developers use Laravel alongside other languages to build custom websites and applications with PHP. By offering a structured framework, Laravel speeds up the development process compared to writing code from scratch.

According to the book written by Stauffer (2023), he describes the evolution of Laravel 1 from its initial release in June 2011, when it introduced a custom ORM, closure-based routing, and a modular system, through its significant revisions. Laravel 2 and 3, released in late 2011 and early 2012, added features like controllers and unit testing. The framework underwent a major overhaul with Laravel 4 in 2013, which integrated Symfony components via Composer and introduced new features such as queues and facades. And because Laravel was now relying on Symfony components, it was announced that Laravel would be mirroring the six-month release schedule Symfony follows. Laravel 5, launched in February 2015, further refined the structure, adding new tools like Socialite and Elixir. Laravel 6, released in September 2019, marked a shift to semantic versioning and removed some global helpers. Throughout its development, Laravel is designed to empower developers by offering clear and simple codes and features. It prioritizes ease of learning and development while ensuring that code remains readable and maintainable.

Lastly, in the blog written by Katariya (2024), Laravel is mentioned as a preferred choice for building websites and web apps, offering enterprises efficient solutions with high versatility. It supports various industries by providing sophisticated tools and features to meet their needs. Key benefits of Laravel include an accelerated development process, which allows businesses to quickly bring products to market. Eloquent ORM simplifies database management with an intuitive interface for querying and defining relationships. The Blade templating engine enables developers to design dynamic UIs effortlessly, facilitating modularization and code reuse. Laravel also encourages unit testing with PHPUnit, ensuring high code quality and fewer bugs in production. The blog emphasizes that Laravel is the best framework to use, regardless of the type and size of the project. With regular updates and continuous improvements, Laravel is expected to include more advanced features and offer additional benefits for enterprises.

***Apache***

Based on a blog written by Morris (2023), the Apache HTTP Server, introduced in 1995, is one of the most widely used web server software, powering around 31% of all known websites, including major platforms like Facebook and LinkedIn. Its open-source, modular design allows for extensive customization, making it versatile and widely supported by hosting providers such as SiteGround and Cloudways. However, while its flexibility is a strength, improper customization can lead to vulnerabilities. Despite this, Apache remains a popular choice, especially for beginners, due to its user-friendly interface and active support community. Frequent updates and a vast array of modules further enhance its capabilities, ensuring it stays relevant in a rapidly evolving digital landscape.

According to Giaquinto (2022), Apache has become the leading web server software, widely adopted by web hosting companies due to its flexibility in managing server environments. It facilitates communication between a website's server and a visitor's device by handling HTTP requests and delivering the requested content as web pages or in simpler terms, it allows visitors to view content on your website. Essentially, Apache enables the functionality of a web server by allowing it to connect with web browsers and process user requests, making it an essential component for website operation and performance. Without software like Apache, a web server is merely inactive hardware, incapable of serving web content and this is the reason why Apache is also known as Apache Web Server.

Lastly, in the blog authored by HostZealot Team (2022), the Apache Web Server's modular architecture is its standout feature, enabling administrators to enable or disable components as needed. The 3 main key multiprocessing modules, such as mpm\_prefork, mpm\_worker, and mpm\_event, offers flexible connection and request handling, optimizing performance, particularly for keep-alive connections. Apache’s cross-platform compatibility with Unix-like systems and Windows Server, combined with its extensive modularity, scalability, and stability, contribute to its popularity. Additionally, Apache supports various programming languages like Python, PHP, and Perl, and integrates well with popular CMS platforms like WordPress, Drupal, and Joomla. Despite its advantages, Apache may not be the best choice for high-traffic sites and requires careful configuration to avoid stability issues. However, it can interpret requests as physical file system resources, requiring additional processing. Apache also regularly receives updates, including security improvements, and is user-friendly with extensive configuration options. Its large community provides strong support, making it easier to resolve any issues that occur.

***MySQL***

Based on the article that was written by Domantas G. (2024), MySQL is an open-source relational database management system (RDBMS) that serves as an effective tool for managing, storing, and retrieving structured data. The prefix My relates to the co-founder's daughter, and the SQL part of MySQL is an acronym for Structured Query Language. MySQL is a well-known database management system for managing and organizing data in databases, which can be used for small-scale projects, large-scale websites, and enterprise-level solutions.

According to Dominik Keller (2023), MySQL is one of the most popular open-source relational database management systems (RDBMS). It was invented and developed by Finish developer Michael Widenus, also known as Monty. MySQL provides the ability to store and manage data on websites. It is freely used and available under the terms of the General Public License (GPL). This helps developers easily build and deploy a web-based platform in a cost-effective way.

Lastly, communicating with databases to store and retrieve data plays a crucial role in web development. Developers can easily integrate PHP with several database systems; when combined with MySQL, it creates a formidable combination. MySQL, a powerful relational database management system, offers a dependable and effective data storage platform that works seamlessly with PHP. By retrieving and modifying data from databases, developers can produce dynamic content through the interaction of PHP and MySQL. Many successful web applications are built on this synergy, providing a solid foundation for performance and scalability. Together, PHP and MySQL offer web developers a potent combination of efficiency, scalability, and customization. Using PHP and MySQL enables the creation of dynamic and feature-rich web applications, whether for developers experimenting with new technologies or companies looking to establish a robust online presence. PHP web development services provide a solid foundation for creating interactive and engaging websites, and working with a reputable PHP web development company in the USA ensures a seamless development process. PHP and MySQL equip developers with the tools and expertise needed to create online applications that adapt to the evolving needs of the digital world, Tomar (2023).

***Heroku***

Based on Salesforce India (2022), Heroku is a Platform-as-a-Service (PaaS) enabling enterprises to create and expand many applications efficiently. Currently, the number of apps developed on Heroku exceeds nine million. It has 140 add-ons, such as security services, intelligence tools, alerts, and add-ons for tracking, caching, emailing, and networking. Instead of writing code, the Platform lets users use popular programming languages or low-code or no-code tools to make apps through a graphical user interface. Heroku enables developers to utilize their favorite tools, including languages, infrastructure, and servers. This lets them focus on business-critical apps that satisfy customers by prioritizing employee and user demands.

Heroku is a fully managed cloud application platform that allows organizations to quickly grow app development without concern about maintenance or support. It utilizes managed container systems known as Dynos, which contain all the necessary codes and resources for constructing, executing, and managing cloud applications. Applications can be distributed directly using widely used mechanisms such as Git, GitHub, or Docker. Additionally, they can be configured to adjust their scale automatically. Heroku manages servers, hardware, and infrastructure, enabling developers to focus on their applications. Users can utilize a comprehensive repository of information, submit a support request, or interact with the Heroku community for assistance as required.

According to Wright (2024), Heroku and AWS have separate roles in the cloud services ecosystem, addressing various demands. Heroku gives a setting that is already set up, making the deployment process easier and faster. On the other hand, AWS (Amazon Web Services) is a highly secure platform for cloud services that provides infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). However, its deployment process is more intricate. Heroku is highly suitable for startups and medium-sized organizations due to its user-friendly interface and efficient deployment capabilities.

In addition, AWS is specifically built to cater to the requirements of medium to big businesses, providing solid solutions that can handle demanding computing tasks ranging from high to extremely high levels. Regarding pricing, there is a significant distinction between the two. Despite its more complex setup process, AWS is a cost-effective option for enterprises with substantial computational requirements.

Lastly, Nam Ha Minh (2021) from CodeJava said that Heroku functions by executing apps within virtualized Unix containers called dynos. The Heroku cloud platform, which operates on the Amazon EC2 infrastructure, manages the management of these dynos. Heroku supplies a dyno for Java-based applications, which includes the Java Development Kit (JDK) and Maven. These tools are necessary for the compilation and execution of Java applications. End users utilize these applications through the Internet, and the traffic is sent to the proper dynos via Heroku's HTTP router. This effective routing technique guarantees that requests are processed promptly and with precision. Scaling an application on Heroku is intended to be simple and adaptable. Users can rapidly expand their capacity by increasing the number of dynos to accommodate more significant traffic or computing requirements. Conversely, they can lower the number of dynos as demand decreases to scale down.

***Git***

Based on the article posted on geeksforgeeks.org (2024), Git is a distributed version control system that makes it possible for developers to efficiently manage and work together on code. It stores project files and its whole history in repositories. Commits capture modifications made at particular times, whereas branches allow for an individual to work on various features or fixes and merge it to combine the modifications made on a branch into the main project after the development. Developers can also work offline and sync their changes by creating a local duplication in their repository. These are the only few features that the article covered that enable team collaboration on projects without losing each other's contribution and provide version control in software development.

According to the article that was published on nobledesktop.com (2022), Git is the most commonly used version control system. It also makes collaboration easier, as it allows modifications by multiple individuals to combine all their work into a single project. An example of an online git host that keeps a copy of files and its history are GitHub and Bitbucket. It makes it simple to collaborate with other developers by centrally storing a copy of a developer Git repository and enabling it to upload and download changes from other developers. After developers set up their remote repository by using GitHub or Bitbucket, they can now upload (push) files and make revision history to it and if another developer makes changes to a remote repo, they can just download (pull) their changes into the local repository of the developer.

Lastly, Duò (2023) tackles the difference between Git and GitHub. Git is a software for local version control system that provides developers with a way to keep track of their work as it develops. It mainly fits well for small-scale projects. On the other hand, GitHub is a web-based application that utilizes git version control for collaborative use. On top of that, GitHub offers social coding, networking, and team management features.

***Agile Methodology***

The researchers will adopt an Agile methodology approach to develop the system. This iterative and collaborative process will ensure flexibility and continuous improvement.

Based on “What is Agile methodology? (A beginner’s guide)” written by Laoyan (2024) The agile approach is a framework for project management that divides work into many flexible stages or sprints. The Agile framework uses an iterative approach. Teams review and analyze their performance at the end of each sprint to identify areas for improvement and modify their plan for the following sprint. Agile techniques in software development offer several advantages, chief among them the flexibility to quickly change course without impairing project progress. Meeting in person with the team is the most efficient way to communicate, according to one of the Agile tenets. It is understandable why customer satisfaction is incorporated into the Agile method, given its pivotal role in software development. Agile teams are able to prioritize features that address customer needs by working together with customers. Teams can adopt an Agile strategy and move on to a new project as those needs change. The Agile framework includes various variations, one of which is Scrum, a popular Agile approach that comprises sprints and is intended for small teams. The Scrum Master oversees the team and is responsible for removing any roadblocks so that other team members can carry out their daily tasks. Every day, scrum teams get together to talk about ongoing projects, obstacles, and other issues that could impact the development team.

In addition, a systematic literature review conducted by Islam et al. (2023) demonstrated a noteworthy upsurge in research interest in Agile project management, especially after 2017. This trend peaked in 2021. The global COVID-19 pandemic's impact is blamed for this increasing trend since it forced organizations to build adaptable and flexible techniques to deal with uncertainty (Mothar et al., 2022). The results underline the need for more research in this area and show how applicable Agile approaches are to solving today's problems. Analysis of well-known writers and nations offers insightful information on the state of Agile project management research worldwide. According to Laato et al. (2022), finding significant publications and authors is made more accessible with the use of the Web of Science (WoS) database. The review recognized vital contributors.

Lastly, in the blog 'State of Agile 2024: Things You Need to Know' by StarAgile (2024), it's clear that agile ways of working are doing well. Almost 97% of companies are using some form of Agile methods, which have been growing in the past few years. These methods make projects more successful, with a 75% success rate compared to older ways of doing things. The market for tools that help with Agile work is getting bigger, now expected to be worth $9.2 billion by the end of 2024. Also, as projects get bigger, more companies, about 65%, are using scaled Agile frameworks like SAFe. These numbers show that Agile is better at adapting to changes, helping teams deal with unexpected problems, and making projects successful.

***ISO 25010***

Based on Britton (2021), ISO 25010 is a key standard in software quality, titled “Systems and software engineering – Systems and software Quality Requirements and Evaluation (SQuaRE) – System and software quality models.” ISO 25010, published in 2011, superseded ISO 9126 from 2001, expanding on the earlier standard by adding two new product quality characteristics: security and compatibility. ISO 25010 outlines two essential quality models: the Quality in Use Model and the Product Quality Model. Both models further subdivide these characteristics into sub-characteristics to provide a detailed framework for evaluating software quality. These models offer a set of quality characteristics that can be used to compare stated quality requirements for completeness. The standard emphasizes that software quality includes both adherence to design and the fulfillment of non-functional requirements. Software quality measurement, as defined by ISO 25010, quantifies the software's performance across these characteristics.

According to the webpage of ISO 25000 (2022), ISO/IEC 25010 is the cornerstone of a product quality evaluation system, determining which quality characteristics will be considered when evaluating the properties of a software product. The quality of a system is defined by how well it meets the stated and implied needs of its stakeholders, thus providing value. These stakeholder needs—such as functionality, performance efficiency, security, and maintainability—are precisely represented in the quality model, which categorizes product quality into characteristics and sub-characteristics. Performance efficiency reflects the degree to which a product performs its functions within specified time and throughput parameters while efficiently using resources like CPU, memory, storage, network devices, energy, and materials under defined conditions. Safety represents the degree to which a product, under specified conditions, can avoid situations that may endanger human life, health, property, or the environment.

Lastly, in the article by Qmii (2023), ISO 25010 is described as an international standard that offers a comprehensive framework for evaluating and managing software quality. Implementing this standard provides significant benefits, including enhanced customer satisfaction by ensuring that software meets user needs and expectations. However, challenges such as stakeholder resistance and maintaining long-term compliance can arise during implementation. Overcoming these challenges requires communication and regular evaluations. Additionally, ISO 25010 helps organizations identify and mitigate risks associated with software development. By following the guidelines set forth in this standard, companies can minimize the chances of critical errors or security vulnerabilities in their software products.

## Synthesis of Review of Related Literature

Based on the data collected by the researchers, we suggest creating ReQuest, a system that automates purchase requests for the Technological University of the Philippines (TUP). This system would be based on a Progressive Web App. This project aims to develop a system that automates purchase requests and enhances the efficiency and transparency of the procurement office at TUP.

The procurement process is an essential function in organizations, and conventional approaches can pose difficulties, such as protracted approval cycles, human errors, and a need for more transparency. Various research in the literature have examined automation as a potential remedy for these problems. The proposed request system can significantly decrease operational durations, improve transparency, and simplify procurement procedures, as evidenced by the studies conducted by Lombres (2020) and Lakmal (2020). These studies highlight the significant and revolutionary effect of automation in procurement, providing a structure for improving efficiency and transparency in allocating resources inside organizations.

Simultaneously, Agile techniques have developed as a vital approach to promote organizational agility and foster continuous improvement. Implementing Agile methodologies, namely Scrum, empowers teams to swiftly adjust to rapid changes in dynamic contexts. Agile processes enable quick and adaptable responses to changing client expectations, which is crucial for modern procurement systems that need to be responsive to organizational needs. Ruslania (2021) highlighted the importance of combining process automation with Agile methods to enhance procurement procedures, enhance service quality, and stimulate organizational growth. This convergence exemplifies the overarching pattern of integrating adaptability with effectiveness in organizational activities.

Web development tools like PHP, MySQL, Laravel, and Adobe XD are essential for building dynamic and scalable applications that fulfill the requirements of modern digital technology. These technologies provide solid and reliable frameworks for developing applications, much like how structured procurement systems establish a solid foundation for effective resource management. The literature highlights the advantages of utilizing prefabricated elements, modular systems, and automation functionalities in web development, as they improve efficiency and decrease the time required for growth. Integrating these technologies guarantees that digital solutions may be expanded, easily maintained, and aligned with company goals. This reflects the benefits seen in automated procurement systems.

The ReQuest solution we provide is specifically built to correspond with TUP's organisational objectives and optimise the efficiency and effectiveness of procurement processes. The ISO 25010 standard emphasizes the need for quality assurance, a common aspect of software development and procurement processes. The literature emphasizes the significance of adhering to quality standards to guarantee that all processes, whether in software development or procurement, fulfill set requirements for efficiency and effectiveness. Yujie Meng (2022) investigated how digital technologies improve the quality of purchasing and supplier negotiations, focusing on ensuring that procurement activities align with organizational objectives. The emphasis on standardization indicates a more significant movement towards attaining uniform and excellent results in every facet of operations.

Moreover, data analysis and reporting have become essential in contemporary procurement methodologies. Paul, Ogugua, and Eyo-Udo (2024) highlighted the profound influence of data-driven methods, transitioning from conventional practices to sophisticated analytical procedures. Pahkamäki (2023) emphasized the significance of Industry 4.0 technologies in strengthening the quality and accessibility of data. Automated reporting tools such as Power BI were found to improve the management of spare part materials and optimize procurement procedures. These improvements highlight the increasing significance of technology in enhancing procurement efficiency and decision-making.

Finally, the web-based system will be tested and evaluated to verify its functional sufficiency and dependability. The evaluation will employ ISO 25010 standards, with a specific emphasis on functional suitability and dependability. This will ensure that the system satisfies the necessary standards and delivers high user satisfaction.

## Review of Related Studies

This part contains related studies and works that have already been conducted on the topic of a web app-based purchase request automation system.

***Procurement Process Automation***

Procurement processes have long been vital to organizational operations, but traditional methods often face challenges like lengthy approval cycles, manual errors, and a lack of transparency. These issues can lead to delays, increased costs, and inefficiencies. To address these problems, many studies have explored automation as a means to streamline procurement, enhance accuracy, and boost overall efficiency. The following review examines these studies, and the technologies used to automate procurement processes.

Based on the study titled "Streamlining Solution for Procurement Management through Automation" (Lombres, 2020), the traditional procurement processes, particularly in government institutions such as the Aurora State College of Technology (ASCOT), were found to be inefficient. The study identified these processes as slow, error-prone, and lacking in transparency, leading to delays, data inaccuracies, and poor inventory management. To address these issues, the study proposed the development of a Procurement Monitoring System (PMS) to automate key tasks. Utilizing the V-Model of the System Development Life Cycle (SDLC), the PMS was designed to streamline the submission and approval of procurement plans, inventory management, and transaction monitoring. The system's implementation resulted in reduced operation times, enhanced transparency, and a simplified procurement workflow. This research underscores the critical role of automation in improving procurement processes by increasing efficiency and accuracy while addressing the specific needs of public institutions. The success of the PMS in resolving common issues associated with manual procurement systems offers a valuable solution for similar organizations facing comparable challenges.

According to the study titled "Web-Based Procurement Management System for Government Universities in Sri Lanka" (Lakmal, 2020), the manual procurement processes in government universities are fraught with inefficiencies, such as slow approvals, errors, and resource mismanagement. Similar to the previous study, this research developed an automated system to address these challenges. The centralized web-based procurement management system, tailored specifically for these universities, streamlines the procurement process by facilitating easier management of purchase requests, approvals, and bid submissions. By employing object-oriented methodology and the Incremental and Iterative Software Development Model, the system enhances efficiency, transparency, and accountability in procurement operations. This advancement, much like the Procurement Monitoring System (PMS) discussed earlier, represents a significant move toward modernizing procurement practices, ensuring more effective use of resources within educational institutions.

In addition, the study titled "Optimizing Procurement Through Process Automation: Case Ruslania," authored by Veronika Garro in 2021, provides a comprehensive analysis of the current procurement processes at Ruslania, emphasizing the necessity for automation to enhance efficiency. Through qualitative research, including interviews with procurement staff, the study identifies how automating e-procurement can minimize manual tasks, reduce errors, and free up employee time for other business activities. The findings suggest that implementing an automated procurement system would significantly improve the overall procurement efficiency and contribute to the company's growth by increasing turnover and improving service quality.

Moreover, the study titled "Performance Improvement of Procurement Activities in Reaching KPI On-Time Delivery and Purchase Requisition to Purchase Order by Implementing E-RFQ Tools and Developing Team Collaboration and Communication" by Zeno Yuldia and Gatot Yudoko (2024) underscores the vital role of e-RFQ tools in enhancing procurement efficiency. The research identifies that delays in the RFQ (Request for Quotation) and EQ (Evaluation Quotation) processes have been major hurdles in achieving the company's KPI targets. By introducing e-RFQ Evaluation Tools, the study aims to address these delays by automating and expediting the quotation process, which improves the speed and accuracy of supplier interactions. This technological solution not only helps in reducing manual errors but also enhances team communication and collaboration. Consequently, implementing e-RFQ tools is crucial for decreasing the delay rates in transitioning from Purchase Requisitions (PR) to Purchase Orders (PO) and achieving the targeted on-time delivery KPI, thus significantly boosting overall procurement performance. Understanding these insights is particularly relevant to our study on automating the purchasing process at our university, as RFQ automation is a critical component in streamlining procurement and improving efficiency.

Furthermore, the research conducted by Muchai Charity Njoki and Dr. Lambaino Nelson into the significant impact of automated procurement systems on organizational performance, specifically within supermarkets in Nairobi City County, Kenya. The study highlights the role of e-tendering and e-ordering as crucial components of these systems, showcasing how their adoption can enhance procurement efficiency, reduce costs, and improve overall organizational performance. The use of a descriptive research design, coupled with data analysis through SPSS, underpins the study's findings, which affirm that the implementation of these automated systems not only streamlines procurement processes but also fosters better relationships with suppliers, enhances customer service, and ultimately contributes to the sustainable growth of organizations in the retail sector. This study provides valuable insights into the strategic advantages of e-procurement in the context of a developing country, emphasizing the need for continued research and adoption of such systems to maintain competitiveness in the global market.

Lastly, in the study "Digital Purchasing and Procurement – Whether and How Digital Tools and Platforms Enable Well-positioned Supplier Negotiations" by Yujie Meng (2022), a comprehensive exploration of how digital tools impact various purchasing activities is conducted. Meng emphasizes the significance of digitalization in enhancing purchasing excellence, particularly in supplier negotiations. This study, like those reviewed previously, underscores the critical role that digital tools play in modern procurement processes. It also builds on earlier discussions by examining how these tools interact with other purchasing activities, such as cost analysis and supplier management, to optimize outcomes. Meng's work thus serves as a cohesive conclusion to the studies reviewed, highlighting the ongoing evolution of procurement in the digital age and the importance of integrating digital strategies to remain competitive.

***Activity Logs/History Logs & Employee Monitoring***

Activity logs, also known as history logs, are records that chronologically document events within a system. They capture user actions, system changes, access attempts, and other significant events. These logs are essential for monitoring activities, ensuring accountability, detecting anomalies, and facilitating compliance. Additionally, when used for employee monitoring, activity logs provide insights into work patterns and productivity, enabling better oversight and management of employee performance. The following study review examines how digital employee monitoring technologies and people analytics impact power relations in the workplace and how these insights will inform our development of a staff log for the procurement office.

Based on Musamih et al.'s (2021) study, the activity logs play a crucial role in their blockchain-based solution for pharmaceutical supply chains. These logs, also known as history logs, meticulously track and record all transactions and activities within the supply chain, ensuring transparency and accountability. Leveraging the inherent immutability of blockchain technology, the audit logs provide a tamper-proof record of events, allowing stakeholders to verify the authenticity and legitimacy of pharmaceutical products. This transparency fosters trust among regulatory agencies, manufacturers, distributors, pharmacies, and patients, contributing significantly to combating counterfeit drugs and optimizing supply chain efficiency. Similarly, our system aims to enhance transparency and accountability by integrating staff logs to track modifications made to purchase requests and report logs to monitor users who generate reports. This approach will help manage the purchase process more effectively and securely, ensuring that all actions are documented, and information is protected.

According to Mirkovic et al.'s (2020) study on using terminal histories to monitor student progress on hands-on exercises, the integration of audit logs plays a pivotal role in assessing and understanding student performance. The study explores the implementation of terminal histories with milestone detection to facilitate rapid and automated assessment of student work during practical exercises. The Monitor component of their system, ACSLE, records crucial data such as terminal input and output, current working directory, username, terminal identifier, and interaction time, providing comprehensive insights into student activities. However, the study acknowledges several challenges encountered during the monitoring process, such as accurately recording terminal input and output, ensuring complete and unique matches between log records, and addressing limitations related to the implementation platform. These challenges highlight the complexity of implementing audit logs effectively to monitor student progress and suggest the need for ongoing refinement and optimization of monitoring tools in educational settings. Our study aims to build upon these insights by further investigating the optimization of audit log systems within the procurement process, focusing on enhancing data management and monitoring tools. We aim to address the identified challenges and improve the efficacy of these tools to ensure transparency, accountability, and data security in the purchasing process.

Lastly, the paper by Manokha (2020) titled "The Implications of Digital Employee Monitoring and People Analytics for Power Relations in the Workplace" delves into how new digital monitoring technologies influence power dynamics between employers and employees. The study reveals that such technologies enhance employers' disciplinary power and affect the self-regulation of workers, leading to increased productivity but also to a greater level of surveillance over individual health and performance. Manokha highlights the minimal resistance from employees, which is attributed to neoliberal economic policies and the less visible nature of modern digital surveillance compared to earlier methods. This analysis emphasizes the risks associated with transforming human workers into data points and machines, stressing the need for continued research into the societal impacts of these evolving monitoring practices and their potential to dehumanize the workforce. We will use this insight as we develop an activity log tracker for employees in the procurement office, aiming to enhance the automation of the purchasing process while carefully considering the balance between efficiency and employee privacy.

***Reporting Systems in Procurement & Dashboard using Data Analytics***

As procurement practices advance, the role of effective reporting mechanisms becomes increasingly vital in enhancing the purchasing process within institutions. Accurate and timely reporting not only boosts transparency and accountability but also supports strategic decision-making and operational efficiency. This review explores recent studies on reporting systems in procurement, including both automated and traditional approaches, to understand their impact on streamlining operations, minimizing errors, and providing actionable insights.

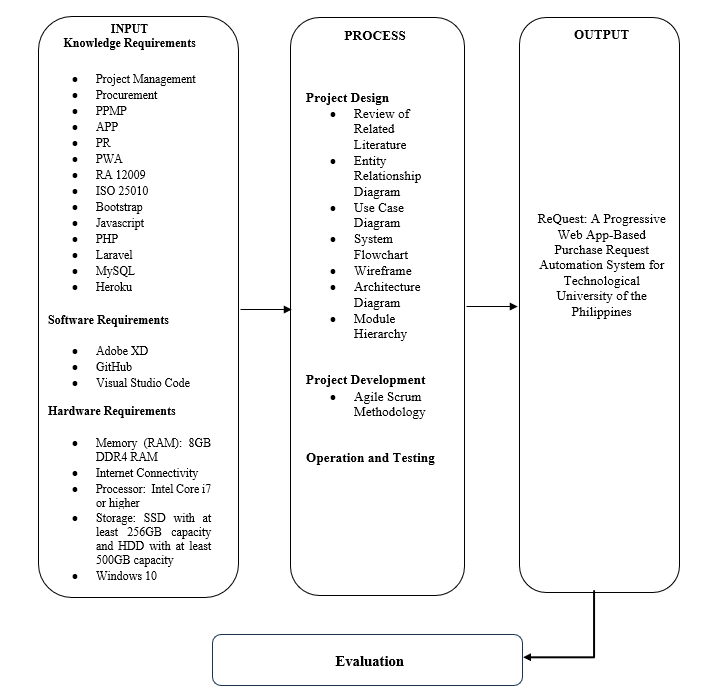
Based on Paul, Ogugua, and Eyo-Udo's (2024) study, "The Role of Data Analysis and Reporting in Modern Procurement: Enhancing Decision-Making and Supplier Management," the transformative impact of data analysis and reporting on contemporary procurement practices is discussed. The authors detail the shift from traditional manual methods to data-driven approaches, highlighting the crucial role of data collection, integration, and analytical techniques such as predictive and descriptive analytics. Their study demonstrates how these advancements allow procurement professionals to gain valuable insights into spending patterns, forecast demand accurately, optimize strategies, and improve supplier relationships. Emphasizing the significance of real-time reporting, the paper illustrates how timely insights into market conditions and supplier performance facilitate informed decision-making and operational adjustments. Additionally, the authors discuss the role of Decision Support Systems (DSS) in synthesizing complex data, supporting scenario analysis, and recommending strategies for cost reduction and risk mitigation. The benefits of data-driven approaches in supplier management are also explored, including the evaluation of quality performance, delivery metrics, and cost competitiveness. The study highlights how data analysis aids in proactive risk management, ensuring supply chain resilience. Looking forward, the paper suggests future research will likely explore advancements in predictive analytics, blockchain technology, AI-driven automation, sustainability, and collaborative platforms to further enhance procurement practices and strategic partnerships in a competitive global market.

According to the study by Arvi Pahkamäki (2023), titled "Ensuring Spare Part Material Availability by Improving Procurement Data Quality with Automated Reporting," the integration of Industry 4.0 technologies is revolutionizing procurement practices by emphasizing the critical role of data quality. The study highlights how automating reporting with tools like Power BI enhances data accessibility and quality, which in turn supports more effective management of spare part materials. By transitioning from manual spreadsheets to automated, visualization-rich reports, organizations can significantly improve data availability and accuracy. This improved reporting capability aids in validating procurement data, addressing low material availability, and optimizing overall procurement processes. The insights from this research demonstrate how automated reporting systems can be leveraged to improve data management and decision-making, ultimately contributing to more efficient procurement operations.

Lastly, a study by Biswas et al. (2020) titled "GO-COVID: A Cross-Platform Application for Real-Time COVID-19 Monitoring" illustrates the effective use of data analytics in developing a comprehensive dashboard for managing pandemic information. This interactive application, designed for both web and mobile platforms, integrates modern AI and ML tools to deliver real-time updates on COVID-19 cases, including confirmed, active, recovered, and deceased statistics at various geographic levels. It leverages geo-tracking to monitor user health and alert them about potential exposure to infected individuals. Key features include visual representations of data through pie charts, line graphs, and geo-graphs, alongside an interactive chatbot for user queries and health predictions. The dashboard's use of REST APIs for data retrieval and Flutter framework for cross-platform compatibility highlights its advanced technical implementation. In our study, it is our aim to also utilize data analytics to create a dashboard for automating the procurement process and generating reports, thereby enhancing the efficiency and functionality of our purchasing system. This study is particularly relevant as it showcases how data analytics can be harnessed to create a dynamic and interactive dashboard, serving as a valuable reference for applying similar techniques to optimize and streamline procurement processes in our own research.

## Conceptual Model of the Study

This part contains related literature of the ReQuest: A Progressive Web App-Based Purchase Request Automation System for Technological University of the Philippines.



The figure above shows the study’s conceptual model, which depicts the overview of the flow and the whole concept of the study.

***Input***

The system has three major requirements. First, the knowledge requirements consist of the following: Project Management, Procurement, PPMP, APP, PR, PWA, RA 12009, ISO 25010, Bootstrap, Javascript, PHP, Laravel, MySQL, and Heroku.

Second, the Software Requirements that the researchers will be using are Adobe XD for the design of the UI, GitHub for version control, and Visual Studio Code for the integrated development environment.

Lastly, the hardware requirements for accessing the system are as follows: a minimum of 8GB of DDR4 RAM is required to function smoothly and have effective multitasking. Smooth operation and access depend on stable internet connectivity. The processor should be an Intel Core i5 or higher. An SSD must have a minimum capacity of 256GB for quick data access, and an HDD must have a minimum capacity of 500GB for any additional storage requirements. The operating system should be Windows 10, and the latest version of a modern web browser such as Google Chrome, Mozilla Firefox, Microsoft Edge, or Safari is required.

***Process***

The system functionality will be developed by automating purchase request tasks in the TUP procurement office. The project design consists of the following diagrams: Entity Relationship Diagram, Use Case Diagram, System Flowchart, Wireframe, Data Flow Diagram, and Module Hierarchy. The process phase also includes the agile scrum methodology and the system development life cycle model that the researchers will be utilizing. And last, the process of operation and testing.

***Output***

The output block displays "ReQuest: A Progressive Web App-Based Purchase Request Automation System for Technological University of the Philippines." The system should be evaluated to determine its acceptability.

***Evaluation***

The evaluation block, which includes ISO 25010, evaluates the system's requirements to meet the various user needs. This tool will be used to examine the system's functional suitability and reliability based on the criteria.

## Operational Definition of Terms

For better understanding of the study, the researchers gave several terms that were defined operationally used in the study.

**Admin** is the head of the procurement office at the Technological University of the Philippines (TUP). This role encompasses managing all system functionalities, overseeing procurement processes, and ensuring compliance with procurement policies and regulations.

**Audit Trail** is an audit log is a record of events, transactions, or activities that are tracked and logged by a system.

**End User** refers to individuals who create purchase requests within the system. They initiate procurement activities but do not have administrative privileges. End Users are primarily responsible for submitting requests and may also review and track the status of their submissions.

**ISO25010** refers to an international standard for software product quality requirements and evaluation (SQuaRE).

**ReQuest** refers to a web app-based purchase request automation system.

**Staff** refer to the personnel within the procurement office who handle and process purchase requests. They are assigned specific roles and tasks related to the procurement process.

# Chapter 3

**METHODOLOGY**

This chapter includes the project design, project development, operating and testing procedure, and evaluation procedure of the study.

## Project Design

The project design of the ReQuest: A Progressive Web App-Based Purchase Request Automation System utilized Use Case Diagram, Entity Relationship Diagram (ERD) System Flowchart, Module Hierarchy Chart, Data Flow Diagram, and Wireframe to ensure clarity, efficiency, and effectiveness in its development and implementation.

**Figure 2**

*Use Case Diagram*

**A screenshot of a computer screen

Description automatically generated**

***Use Case Diagram***

In the Use Case Diagram for the Purchase Request Automation System, the primary actors are Admin, Staff, Budget, and End-User.

The Admin has complete access to all system functions, including the ability to manage user accounts and access controls, view history logs to monitor staff and user actions, change settings in the PPMP section, and manage the APP by updating, deleting, and exporting APP document in PDF or Excel formats.

Staff have access to the dashboard, purchase request, PPMP and PMR sections, profile settings, and login/logout capabilities. The Admin can configure which of these sections are accessible to each Staff member, allowing for dynamic access.

The only forms that End Users can create are PPMP and purchase request forms. Compared to other roles, their access is restricted, but they can monitor their requests via the dashboard or notifications.

Budget actors have access to APP functionalities and can perform login/logout actions. The APP is available for them to view and modify whenever they needed.

Access to a dashboard, profile settings, and login/logout capabilities are available among the four roles.

**Figure 3**

*Module Hierarchy*

****

***Module Hierarchy***

This module hierarchy diagram illustrates the structure of a procurement management system, detailing the various roles, modules, and associated functionalities. At the top level, the system accommodates three primary roles: System Admin, Staff, and End-user, all of whom have access to the system through the Log-in module. Following the log-in, the system is organised into several core modules: User Management, Purchase Request (PR), Project Procurement Management Plan (PPMP), Annual Procurement Plan (APP), Procurement Monitoring Report (PMR), Notifications, History Logs, and Profile Settings. Each module has specific functionalities, such as creating, updating, and deleting user accounts, managing purchase requests, exporting plans, creating and managing monitoring reports, providing notifications, tracking staff and report logs, and enabling users to update personal information.

**Figure 4**

*Context Level Diagram*

***A diagram of a system

Description automatically generated***

The Context Level Diagram for ReQuest: A Progressive Web App-Based Purchase Request Automation System for TUP outlines the system's interactions with its key actors to ease procurement requests. The System Admin provides account credentials and manages comprehensive data, including staff, end-user, and budget details, along with procurement documents such as the Annual Procurement Plan (APP), Project Procurement Management Plan (PPMP), Purchase Requests (PR), and Purchase Management Reports (PMR). The Admin also handles history logs and receives PR details for tracking and auditing. The Budget Department provides account credentials and APP details, supporting budget alignment. Staff members supply account credentials, PR details, and profile information, while receiving notifications and PPMP details through downloads. End-Users provide account credentials, PPMP details, PR details, and profile information, and receive notifications about their request statuses.

**Figure 4.A**

*Data Flow Diagram*

***A diagram of a computer

Description automatically generated***

This data flow diagram (DFD) illustrates how data moves between different user roles—Admin, Staff, End-User, and Budget—and various system modules within a procurement process. The data flow begins with the login process, where account credentials are verified. Admins manage and transmit data related to user accounts, budgets, and the processing of Project Procurement Management Plans (PPMP) and purchase requests (PR). Staff members handle the flow of PPMP and PR data to ensure requests are processed efficiently. End-Users submit purchase requests, and the system sends them notification. The Budget user plays a key role in exchanging budget-related data with the APP, ensuring financial details are properly integrated with procurement activities. The system logs all actions for future reference. This diagram highlights the smooth exchange of data that underpins the functionality of the procurement system

**Figure 5**

*Entity Relationship Diagram*

**A computer screen shot of a computer

Description automatically generated**

***Entity Relationship Diagram***

The Entity-Relationship Diagram (ERD) illustrates the structure and relationships within the Progressive Web App-Based Purchase Request Automation System, known as ReQuest. It includes entities such as Admin, Staff, End-User, and Budget, all identified by unique IDs: AdminID, StaffID, End-UserID, and BudgetID. These entities are interconnected through various relationships, with Admin, Staff, Budget Account, and End-User managing multiple Purchase Requests, PPMP, APP, PMR, User, History Logs, and Settings. However, not all entities have access to every feature, as the system is dynamic, with the Admin controlling access levels through the User entity. The Admin acts as the central manager, handling procurement processes involving End-User, Staff, and Budget for tasks. This interconnected structure promotes efficient procurement processes and data integrity throughout the system.

**Figure 6**

*Log-in Flowchart*

A screenshot of a computer screen

Description automatically generated

This flowchart illustrates the system's log-in process. The user begins by logging in, where they are required to input their username and password. The system then verifies whether the inputs are correct. If the log-in details are accurate, the user is directed to the next step based on their type. The flowchart identifies three user types: Admin, Staff, and End User. Depending on the user type, the flow directs them to different paths or functionalities within the system. Each user type is associated with specific access or tasks labelled Admin 1 and 2 for Staff and 3 for End User.

**Figure 6A black background with white rectangles

Description automatically generated.A**

*End-User Flowchart*

The diagram represents an "End User" workflow for the Project Procurement Management Plan (PPMP). It outlines key actions such as searching, viewing, editing, downloading, and deleting PPMP items. The process includes checks for empty fields before saving changes and provides options for handling approval or rejection of requests.

**Figure 6.B**

*Staff Flowchart*

**A black background with white rectangles

Description automatically generated**

The diagram represents a workflow for a "Staff" user in a system related to managing Project Procurement Management Plans (PPMPs) and Purchase Requests (PRs). The process begins with accessing the PPMP list, where the Staff can search for and view specific details. Actions include downloading details and managing options such as creating or editing purchase requests. The workflow consists of verifying details before saving, with the ability to view limited information from a dashboard, handle notifications, and log out. This flowchart outlines the essential tasks and decision points involved in processing and managing procurement data within the system.

**A black and white diagram

Description automatically generatedFigure 6.C**

*Admin Flowchart*

The flowchart represents the workflow for an "Admin" user in a system that manages Project Procurement Management Plans (PPMPs) and related activities. The process begins with accessing the PPMP list, where the admin can search, view details, and manage projects by downloading, approving, or rejecting them. The admin also has access to a dashboard for an overview of system activities, settings for managing system configurations, and various logs (such as staff and end-user logs) for monitoring actions. Additionally, the admin can manage user roles (e.g., Staff, end users) and perform actions like editing or deleting user information.

**Figure 6.D**

*Admin Flowchart (2)*

**A black background with white rectangles

Description automatically generated**

This flowchart represents the workflow for managing procurement monitoring activities. It begins with creating a Procurement Monitoring Report, where details like the agency name, procurement code, project, end user, early procurement, and mode of procurement are entered. The system then verifies the correctness of these inputs. If the inputs are correct, the report can be saved. It allows users to save details for early procurement activities and manage monitoring plans or reports. Users can search for specific plans, download necessary information, and complete the process once the details are downloaded.

**Figure 6.E**

*Admin Flowchart (3)*

**A black and white screen shot

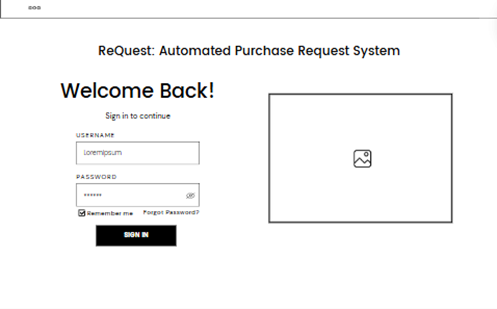
Description automatically generated**

This flowchart outlines the process of managing actual procurement activities within an organization. The process starts with detailing specific procurement activities such as pre-procurement conferences, bid evaluation, award notices, contract signing, and delivery inspections.

**Wireframe**

**Figure 7**

*Sign-in Page*

****

Sign-in page is designed for Admins, Staff, Budget, and End Users to securely access and manage procurement tasks. Users must enter their designated username and password to log in.

**Figure 8 Figure 8.A**

*Admin Dashboard Staff Dashboard*A screenshot of a dashboard

Description automatically generatedA screenshot of a dashboard

Description automatically generated

The dashboard will provide an overview of procurement activities. It will display key metrics such as the number of purchase requests, approved and rejected requests, savings achieved, total budget cost, and total procured amount. Additionally, it will highlight pending items, including abstract pending PRs, proceed pending PRs, and award pending PRs. A graph at the bottom of the dashboard will visually represent these data points.

**Figure 9**

*End-User Dashboard*

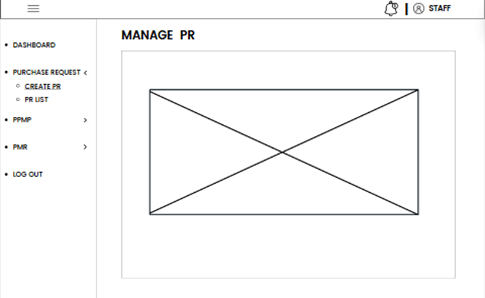
A screenshot of a dashboard

Description automatically generated

The dashboard will display the total number of purchase requests, as well as the count of approved and rejected requests. Additionally, a progress bar will be included to help users easily track the status and progression of their purchase requests.

**Figure 10 Figure 10.A**

*Admin Create PR Staff Create PR*

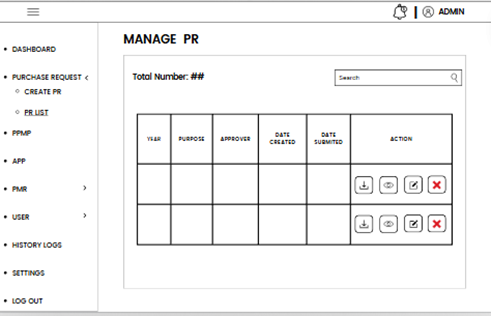
A screenshot of a computer

Description automatically generated

**Figure 10.B Figure 10.C**

*Admin PR List End-User PR List*

A screenshot of a purchase list

Description automatically generated

For Admins and Staff, the screen will feature options to create new purchase requests (PRs) and view PR lists. For both Admin and End Users, the PR screen will present a table displaying their purchase requests, each accompanied by corresponding actions such as download, view, edit, and delete.

**Figure 11 Figure 11.A**

*Admin P*A screenshot of a computer

Description automatically generated*PMP List End-User PPMP List*

A screenshot of a computer

Description automatically generated

**Figure 11.B**

*Staff PPMP List*

A screenshot of a computer

Description automatically generated

The PPMP screen will provide a detailed list of all PPMPs categorized by status: All, Approved, Declined, and Pending. This list will include title, approver, date, status, and actions such as download, view, update, and delete. Admins and End Users will share the same layout, but only Admins will have additional options to edit access dates. The Staff PPMP List screen will have a similar layout but will include fewer actions, limited to download and view, and will not feature editable access dates. The total number of PPMPs will be displayed at the top for quick reference.

**Figure 12**

*Admin PPMP Approval Screen*

A screenshot of a project

Description automatically generated

On the Admin PPMP Approval Screen, when the Admin clicks on the title of a project from the list, they will be directed to the approval interface. Here, the Admin will have the option to either approve or reject the selected PPMP.

**Figure 13**

*Admin View PPMP*

A screen shot of a project

Description automatically generatedA screen shot of a project

Description automatically generated

**Figure 13. A**

A screenshot of a project management plan

Description automatically generatedA screen shot of a project

Description automatically generatedStaff *View*

When the "View" action is clicked on the PPMP screen, both Admins and Staff will see the details of the selected PPMP on their respective screens. Staff will only have access to view the details for review, without options to download or update the document.

**Figure 14**

*End-User Create PPMP*

A screenshot of a computer

Description automatically generated

The End-User Create PPMP screen will allow users to fill out essential details for their PPMP. This includes entering the year, project title, code, general description, quantity/size, estimated budget, and schedule or milestones.

**Figure 15 Figure 15.A**

*Admin Update PPMP Admin Update PPMP Preview*

A screenshot of a computer

Description automatically generatedA screenshot of a project management plan

Description automatically generated

**Figure 16 Figure 16.A**

*End-User Update PPMP End-User Update PPMP Preview*

A screenshot of a computer

Description automatically generatedA screenshot of a project

Description automatically generated

The Admin Update PPMP and End-User Update PPMP screens are essentially the same, featuring similar functionalities and previews. Both screens allow for updating PPMP details such as the year, project title, code, general description, quantity/size, estimated budget, and schedule or milestones. The preview feature enables users to review the updated PPMP for accuracy before finalizing changes by clicking the save button.

**Figure 17 Figure 18**

*Admin APP Screen Budget APP Screen*A screenshot of a report

Description automatically generated

A screenshot of a computer screen

Description automatically generated

The Admin APP screen and Budget APP screen each feature a list of clickable years, allowing users to view or modify APP data specific to the selected year. On the Admin APP screen, Admins can select a year to view or manage the corresponding APP details. Similarly, on the Budget APP screen, users can choose a year to access or adjust budget-related APP information.

**Figure 19 Figure 20**

A screenshot of a computer

Description automatically generated*Admin View/Modify APP Budget View/Modify APP*

A screenshot of a computer screen

Description automatically generated

For the Admin View/Modify APP and Budget View/Modify APP screens, both roles have distinct access and modification capabilities. The admin can access the entire APP form, from the column of code to the schedule for each procurement activity, and has the ability to delete rows representing projects. In contrast, the Budget role can only access and modify the source of funds and estimated budget fields within the APP, without the ability to delete any rows. Additionally, there will be an option to download either APP CSE or APP NON-CSE.

**Figure 21 Figure 22**

*Admin View/Modify APP Budget View/Modify APP*

A screenshot of a computer screen

Description automatically generatedA screenshot of a computer screen

Description automatically generated

For the Admin View/Modify APP and Budget View/Modify APP screens, both roles have distinct access and modification capabilities. The admin can access the entire APP form, working from the column of code to the schedule for each procurement activity, and has the ability to delete rows representing projects. In contrast, the Budget role can only access and modify the source of funds and estimated budget fields within the APP, without the capability to delete any rows.

**Figure 23**

*Admin PMR List*

A screenshot of a computer

Description automatically generated

The Admin PMR List screen will display the total number of PMRs at the top for quick reference. Below, a table will list the PMRs organized by the name of the agency, date, and available actions, including download, view, update, and delete. Admins can also search for specific PMRs within the list, ensuring efficient management and access to records.

**Figure 24 Figure 24.A**

*Admin Create PMR (1) Admin Create PMR (*A screenshot of a computer

Description automatically generatedA screenshot of a computer

Description automatically generated*2)*

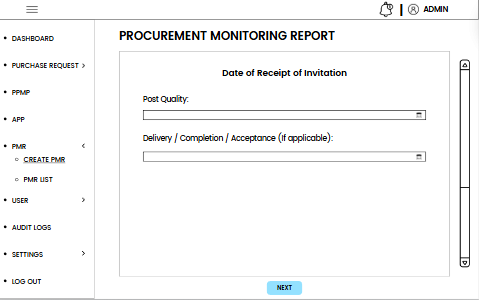
**Figure 24.B Figure 24.C**

A screenshot of a computer screen

Description automatically generatedA screenshot of a computer screen

Description automatically generated*Admin Create PMR (3) Admin Create PMR (4)*

**Figure 19.D Figure 19.E**

A screenshot of a computer screen

Description automatically generated*Admin Create PMR (5) Admin Create PMR (6)*

**Figure 24.D**

*Admin Create PMR (7)*

A screenshot of a computer

Description automatically generated

The Create PMR screen for Admin will include all the necessary fields required to complete the PMR form. After entering all relevant details, Admins can save the form by clicking the "Done" button, ensuring that the PMR is accurately documented and stored.

**Figure 25 Figure 25.A**

A screenshot of a computer screen

Description automatically generatedA screenshot of a computer screen

Description automatically generated*Admin View PMR (1) Admin View PMR (2)*

**Figure 25.B Figure 25.C**

*Admin View PMR (3) Admin View PMR (4)*

A screenshot of a computer screen

Description automatically generatedA screenshot of a computer screen

Description automatically generated

When a specific PMR code is clicked in the PMR List, the Admin will be directed to the Admin View PMR screen, which displays the full content of that PMR. At the bottom of the screen, there will be a download button to save the PMR. Additionally, two buttons labeled "See Completed Procurement Activities" and "See Ongoing Procurement Activities" will be available. Clicking either button will first trigger a pop-up window displaying the relevant activities and then provide an option to download the information.

**Figure 26**

*Admin User Access Level*

A screenshot of a user access level

Description automatically generated

The Admin User Access Level screen will display the total number of users and include a table listing all users along with their access levels. Actions available for each user account include updating or deleting. Additionally, a search function will be available to find specific users, and an add icon will be positioned beside the search bar for creating new user accounts.

**Figure 27 Figure 28**

A screenshot of a computer

Description automatically generated*Admin Create User Account Admin Update User Account*

A screenshot of a computer screen

Description automatically generated

For the Admin Create User Account screen, fields will include name, username, password, sector, user access level, and user type (Staff, Budget, or End User). The Admin Update User Account screen will allow modifications to any of these fields, providing flexibility to update user details as needed.

**Figure 29**

*Admin History Log*

A screenshot of a computer

Description automatically generated

The Admin History Logs screen will initially display all logs. Admins can then choose to filter the view by clicking to show either only the audit trail or the report logs, for more focused access to specific types of log information.

**Figure 30**

*Admin PPMP Settings*

A screenshot of a computer screen

Description automatically generated

The Admin PPMP Settings screen will allow Admins to manage the general descriptions of PPMPs. Admins can update or delete existing descriptions, with an add icon outside the table to facilitate adding new descriptions. Additionally, a Database button will be available to verify whether the changes have been successfully applied to the PPMP form.

**Figure 31 Figure 32**

*Admin Notification Staff Notification*

A screenshot of a notification

Description automatically generatedA screenshot of a notification

Description automatically generated

**Figure 33**

*End-User Notification*

A screenshot of a notification

Description automatically generated

Admin notifications will include updates about new PPMPs, changes to existing PPMPs, and other relevant administrative alerts. Staff notifications will cover updates to PPMPs and additional role-specific alerts. End-User notifications will inform users about the approval status of their requests, access dates for PPMPs, and updates on their PR progress, including new points or changes.

**Figure 34 Figure 35**

A screenshot of a login screen

Description automatically generated*Admin Profile Settings Staff Profile Settings*

A screenshot of a login screen

Description automatically generated

**Figure 36 Figure 37**

*End-User Profile Settings Budget Settings*

A screenshot of a login screen

Description automatically generatedA screenshot of a login screen

Description automatically generated

The Profile Settings Screen offers a comprehensive management tool for users to update their personal and account details. Admins, staff, budget users, and end-users can modify their name, username, and password to keep their credentials secure and accurate. Additionally, both admins and end-users have the option to upload an e-signature, which can be utilized for digital approvals and official documentation.

## Project Development

Klotz (2024) states that the agile scrum methodology combines the scrum framework with the agile philosophy. It works well for businesses who need to complete certain projects, and the Progressive Web App-Based purchase request automation system will be developed using this method. Incremental development-based project management is another aspect of this methodology. This helps the researchers reach the goal of each sprint by identifying the modules and features that have been accomplished in each increment or iteration, which typically spans one to four-week sprints. It also helps researchers to detect any issues encountered, for the team to provide solutions. This method guarantees efficient development throughout the project lifecycle and allows the researchers to increase efficiency.

**Figure 38**

*Agile Scrum Methodology*

A diagram of a scrum process

Description automatically generated

***Phases:***

***Sprint Planning Meeting* -** The development team conducts meetings to allocate the tasks of certain modules or features to team members for the following sprint. Setting up guidelines and standards for development, addressing any risks or bottlenecks that might obstruct the sprint's success, defining the range of tasks that need to be completed throughout the sprint, and estimating the amount of time needed for each task are part of this phase.

***Daily Scrum Meeting* -** The scrum team meets for thirty minutes every day to talk about difficulties and progress, as well as to ensure that each team is complying with the task that was given. This makes it possible for researchers to collaborate and communicate effectively.

***Sprint Review* -** After each sprint, the process included a sprint review. A review meeting occurs to present the finished work to the product owner and obtain feedback from them. The product owner will then determine if the current version is acceptable or if enhancements need to be made.

***Sprint Retrospective* -** At the sprint retrospective, a meeting takes place. The team evaluates what went well, what could be improved, and how they can enhance what they did for the next sprint. By doing this, the team has the opportunity to grow from its mistakes and improve with every sprint.

***Roles:***

***Product Owner* -** The product owner is in charge of managing the backlog of tasks and supervising sprints and releases. Therefore, the product owner carries the responsibility of speaking for the client when it comes to deciding which modules or features will be added to the product, changing existing modules or features, and making the decision whether to approve or reject the completed work.

***Scrum Master* -** Aiding the team in following the scrum process is the responsibility of the scrum master. Instead of participating in decision-making, they use their knowledge and experience to guide the team as they work on the project. A scrum master's responsibilities also include setting up retrospectives, sprint reviews, and agile sprint planning sessions.

***Development Team* -** Individuals with the typical functional roles that are required to finish the project composed of the development team. Delivering the promised and desired product increments is their responsibility.

***Tools:***

***Product Backlog* -** The product owner's needs and requirements for the Progressive Web App-Based Purchase Request Automation System are outlined in the product backlog. It consists of a complete list of user stories, requirements, defects, and features that the development team implemented in the complete product.

***Sprint Backlog* -** The sprint backlog is made up of the tasks that the development team decided to focus on and address during the sprint planning meeting. These tasks are taken from the product backlog and are intended to be completed in the sprint that comes next.

## Operation and Testing Procedure

To guarantee that the operations of the system are correct, the system’s features and functionality were tested. The tests verified every function in the system to see if it is functioning properly as intended.

***Functional Suitability Testing*** was conducted to test if the functionality of the features of the progressive web application can achieve the expected output. The following procedures are the steps that are accomplished in this test. Here's an example of how the Operation and Testing Procedure sections could be defined for the given test case. A sample test case is shown in Table 1.

**Table 1**

*Sample Test Case*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Test Case ID** | |  | | **UC Reference** |  |
| **Objective** | |  | | | |
| **Assumptions/ Preconditions** | |  | | | |
| **Actions** | | **Expected Result** | | **Actual Result** | |
|  | |  | |  | |
| **Status** | PASSED | **Severity** | LOW | **Priority** | MEDIUM |

The table serves as a template for the researchers' test case form. Each row represents a test case, with information such as the test case ID, objective, expected result, action procedure, test data, expected result, and actual result. The test case's status column shows whether it was blocked, executed, failed, or passed. The functioning of the web application is thoroughly tested and validated.

**Table 2**

*Classification of Error Severity*

|  |  |
| --- | --- |
| **Severity** | **Description** |
| Critical | The problem signifies that the process has been completely stopped and cannot continue until it is resolved. |
| Major | The problem causes the system to crash. Nevertheless, some system components are still functional. |
| Minor | The problem does not result in any significant system failure. |

The table provides a clear and comprehensive overview of error severity classification. It displays three severity levels: Critical, Major, and Minor, along with descriptions for each. This table is a fast reference resource for determining the impact and severity of faults within a system. Stakeholders can efficiently prioritize and allocate resources to identify and resolve issues by categorizing errors into various severity categories.

**Table 3**

*Classification of Error Priority Levels*

|  |  |
| --- | --- |
| **Priority** | **Description** |
| High | The problem needs to be resolved as soon as possible since it significantly affects the application. |
| Medium | The problem should be fixed throughout the normal course of development. |
| Low | The problem must be resolved when a more crucial feature is taken care of. |

The table provides a classification of error priority levels, categorized as High, Medium, and Low, as well as descriptions for each. This table aids in the prioritization and allocation of resources to address and resolve problems depending on their impact and urgency.

Development teams may efficiently manage their workflow and guarantee that essential issues are fixed quickly, while less critical problems are addressed at the proper time during the development cycle by assigning the appropriate priority level to each error.

*Functionality and Reliability Testing*

Test cases were collected as shown in Table 4 which summarizes the functionality test cases in every use case, while Table 5 shows the reliability test case summary.

**Table 4**

*Overall Summary of Functionality Test Cases*

|  |  |
| --- | --- |
| **Use Case** | **No. Of Test Cases** |
| Admin |  |
| Budget |  |
| Staff |  |
| End-user |  |
| **Total** |  |

The table shows functionality test cases by use case: “Admin, Budget, Staff, and End-user.” The "Total" row reflects the total number of test cases across all use cases. The table provides a placeholder for capturing and organizing test case information.

**Table 5**

*Reliability Test Cases Summary*

|  |  |
| --- | --- |
| **Test Case ID** | **Objectives** |
|  |  |

The test case ID serves as a unique identifier assigned to each test case, facilitating easy reference and tracking. The objectives of each test case include a description of the goals and purposes, specifically outlining the aspects of reliability being assessed or verified.

**Table 6**

*Testing Procedure for Functionality Suitability*

|  |  |  |
| --- | --- | --- |
| **Modules** | **Steps to be taken** | **Expected Output** |
| 1. Login | 1. From the home screen, click sign-in. 2. Enter existing user details. 3. Click sign-in. | 1. 1. The user will be redirected to the home screen with correct details. 2. Error message will be displayed if the user entered wrong details. |
| 2. Create a new user account | 1. Navigate to the "User" section.  2. Click on the add icon button.  3. Fill in the required user details such as name, username, password, sector, user access level, and user type.  4. Specify the user's role as role as "Staff," “Budget,” or "End-user."  5. Submit the form to create the new user account. | 1. The new user account is successfully created and added to the system.  2. The user can now log in with the provided credentials and access the appropriate functionalities based on their assigned role. |
| 3.Update existing user account information | 1. Navigate to the "User" section. 2. Click on the edit button to access their account details. 3. Modify the necessary information such as username, user access level, or role. 4. Save the changes. | 1. 1. The user's account information is successfully updated with the new details. 2. 2. The changes made are reflected in the system, and the user can log in using the updated credentials. |
| 4.Delete an existing user account | 1. Navigate to the "User" section. 2. Select the user's account. 3. Click X button. 4. Confirm the deletion action when prompted by the system. | 1. 1. The selected user is successfully deleted from the system. 2. 2. The user will no longer be able to access the web application using the deleted account credentials. 3. 3. Any associated data or records linked to the deleted user account are removed from the system’s database. |
| 5. Create PPMP | 1. Navigate to the “PPMP” section. 2. Click on “Create PPMP” button. 3. Fill in the required information such as general description, quantity/size, estimated budget, etc. 4. Click the “Create” button to submit the PPMP record. | 1. The PPMP record is successfully added to the system's database. 2. All provided information about the PPMP is accurately recorded and saved. 3. The newly added PPMP is now included in the list of PPMP’s managed by the system. |
| 6.Update PPMP | 1. Navigate to the “PPMP” section. 2. Update the details of the PPMP, such as general description, quantity/size, estimated budget, etc. by clicking the “Pencil” icon. 3. Modify the relevant details of the constituents’, such as name, age, address, contact details, etc. 4. Review the changes to ensure accuracy and completeness. 5. Save the updated PPMP information. | 1. 1. The PPMP information is successfully updated in the system's database. 2. 2. All modifications made to the PPMP details are accurately recorded and saved. 3. 3. The updated information is reflected in the PPMP record within the system. |
| 7.PPMP Access Period | 1. Navigate to the "PPMP" section. 2. Select the Edit button in Access Start to set when the PPMP will open. 3. Select the “Edit” button in Access Ends to set when the PPMP will close. | 1. The access period for the PPMP in the end-user view are accurately saved.  2. The updated information for the access period is reflected in the PPMP section within the system. |
| 8.Update PPMP Status | 1. Navigate to the "PPMP" section. 2. Click the “Eye” icon to view the PPMP in the list. 3. Click the approve button to approve PPMP or the reject button to   reject PPMP.   1. Select the “Download” button   to download a copy of the PPMP file. | 1. Admin will be directed to the list of all PPMPs submitted by the end-users.  2. The details of the PPMP are displayed  along with the approve and reject buttons.  3. The approving authority can leave notes for the PPMP author through the textbox that appears.  4. PPMP is downloaded. |
| 9.Update APP | 1. Navigate to the "APP" section. 2. Click on the chosen year in the APP list. 3. Click the “Edit” button to update the APP and hit the save button. | 1. The APP are displayed by year.  2. All the list of APPs in a year are displayed. 3. All modifications made to the APP details are accurately recorded and saved. |
| 10.Generate APP Document | 1. Navigate to the "APP" section. 2. Click on the "APP CSE" button. 3. Click on the "APP NON-CSE" button. | 1. The announcement is successfully posted on the web application, making it visible to the audience. Users can access the announcement to stay informed about important updates, news, or events related to the Office of Senior Citizens Affairs. |

|  |  |  |
| --- | --- | --- |
| 11. Create PMR | 1. Navigate to the "PMR" section. 2. Click on “Create PMR.” 3. Fill in the required information such as the annual procurement activities, list of invited observers, source of funds, date of receipt of invitation, and remarks. | 1. The PMR record is successfully added to the system's database.  2. All provided information about the PMR is accurately recorded and saved.  3. The newly added PMR is now included in the PMR list managed by the system. |
| 12.Generate PMR File | 1. Locate to “PMR” section. 2. Click on “PMR List.” 3. Select the “Download” button to download a copy of the PMR file. | 1. The user is directed to the PMR section.  2. The list of PMRs is shown.  3. The PMR file is downloaded. |
| 13.Update PMR | 1. Locate to the "PMR" section. 2. Click the “Edit” button. 3. Click the save button. | 1. All the list of PMR is shown.  2. The details of the PMR are being modified.  3. All modifications made to the PMR details are accurately recorded and saved. |
| 14. History Logs | 1. Locate to “History Logs” section. 2. Click on “Audit Trail” button. 3. Click on “Report Logs” button. | 1. All history logs are successfully accessed and displayed.  2. Track user actions, system changes, or security-related events.  3. Track which users generate files |

Reliability Testing will be conducted to assess how the system performs under specified environmental conditions. It also assesses the system performance for a specified period of time. The table below contains a collection of test cases for various modules or functionalities of a system or application. Each row represents a specific test case, and the columns record the information of the test case, such as the test case ID, the procedures to be performed to run the test case, and the expected output or outcome of the test case.

The table includes various functionalities such as login, account management, file management, and other administrative activities like generating reports and audit logs. Each functionality is tested to ensure that the progressive web application for the procurement office in TUP performs as expected. It is easier to follow and manage the testing process when the test cases are documented and organized in a table, ensuring that each capability is completely tested and validated against the given processes and expected outcomes.

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