



Analysis and Design of Enterprise Resource Planning System for a Coffee Shop

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ABSTRACT

In the past few decades, process automation has been an increasing trend in businesses seeking to increase operational efficiency and improve customer experience by streamlining their processes. However, Koffie Pauze, a local coffee shop in Davao City, Philippines, has not been benefiting much from this information technology revolution, which results in a setback on its productivity, profitability, and competitive advantage. This paper is structured as a software development project for Koffie Pauze to deliver a solution through an Enterprise Resource Planning (ERP) system, which covers automation of their existing processes in Point-of-Sales (POS), kitchen, loyalty and rewards, and network management for their employees and customers. To improve customer experience, a self-service kiosk is introduced to the business environment and as well as a "Grab-and-Go" scheme of purchasing goods through a mobile application for on-the-go customers. The primary focus of this paper is to provide stakeholders detailed documentation on the planning, development, testing, implementation, and maintenance of a software solution using V-Model that aims to solve the challenges experienced by the business.

Key words: Enterprise system, management information system, POS, V-model

1. INTRODUCTION

As business management software becomes more relevant in the industry, there is a need to improve the services provided by businesses to consumers. A repetitive and strenuous business process is the most common factor in considering modernization in an attempt to automate and simplify tasks. In a bid to maintaining competitive advantage, businesses have considered investing in information systems to streamline their services to improve operational efficiency and productivity of employees [1].

However, there are still some businesses that are hesitant to adopt the technology due to the concerns on the relevance and quality of services the information systems provide to them [2]. In order to address this, a software development project plan could help a business gain insight into how an information system could help them achieve their business objectives. This allows them to realize opportunities that they could use to earn savings and increase profitability [3]. The software development project plan also serves as a contract

for a project sponsor, which provides both parties a tool for monitoring the processes, resources, and progress of the chartered endeavor.

The software development system for Koffie Pauze described in this paper encompasses two environments: a platform for employees and a platform for customers. The system is designed to improve the current business processes through automation. It also introduces new means for customers to conduct transactions with the business.

Koffie Pauze is a coffee shop located in Roxas Avenue, Davao City, Philippines. Having a locational advantage has allowed the business to strategically attract a large number of customers. The coffee shop occupies a 2-floor room with an area of 170 square meters, two-thirds (2/3) of which is dedicated to the customer's lounge, and the rest is for the business operations such as the counter, admin office, and kitchen. It also has two private function rooms, which can be utilized for small business meetings.

Currently, Koffie Pauze is experiencing problems in overseeing the customers' orders, especially during peak hours. In Koffie Pauze, an employee takes a customer's order at the counter then proceeds to the coffee bar and the kitchen to inform the barista and the chef to prepare the orders. If there are a lot of customers and orders, the kitchen crew will use a sheet of paper to keep track of the orders. They will list down the orders and cross-out those orders which are already done. During peak hours, the process is difficult to sustain since orders are frequently mixed up in the bar and kitchen queue and therefore result in the delay of orders and customer complaints, which decreases overall customer satisfaction. This is also true for the serving of food. After the chefs prepared the food, orders are brought to the counter. Sometimes, customers with the same orders get orders not intended for them.

Aside from this, another issue is the poor management of their network. Individual customers hog the network bandwidth throughout the day, which results in slow network connections, and only a limited number of customers can benefit from wireless communications. Sometimes, customers order a single drink and stay all day to avail of the WiFi. If other customers come and there are usually no more vacant seats, they would not dine anymore, and it's a potential loss of sales for the business. Every day, the manager needs to configure the router to change the wireless settings.

Koffie Pauze is also offering a rewards program for its loyal customers. They are given a card for it to be stamped every

time they visit the establishment. The problem is, sometimes, customers tend to forget their cards or lose it, which makes them unable to get the opportunity to earn points or claim their rewards.

The business has been in search of a solution to these problems. They have contacted several local suppliers who offered them a generic Point-of-Sales and Inventory System for ₱139,000.00. Similarly, Software-as-a-Service (SaaS) solutions are abundant online, though, still fall short to their requirements.

A website, *Instore*, has compared several proprietary software to identify its pros and cons. *Ambur* Point-of-Sales app costs \$139.00/month for two to three devices connected. Another alternative is *UpServe*, which costs \$99.00/month for one terminal plus \$50.00 for each additional terminal license. *Lavu*, on the other hand, offers \$69.00/month for each terminal. However, this software does not support the loyalty system and network management. Hardware costs are also not yet part of the charges. A more sophisticated software solution from *Revel Systems*, though without network management, offers an initial setup for \$1500.00 and a recurring monthly subscription of \$200.00 [4]. These software seem to have low upfront costs; however, costs can be higher in the long run due to subscription-based payments.

Ultimately, the stakeholders have decided to go for a customized software solely for Koffie Pauze. The system may have a high upfront cost compared to off-the-shelf alternatives, but the scalability of customized software is second to none.

2. METHODOLOGY

2.1 Data Collection

To determine the needs of the user, several ways to collect data were undertaken, such as interviews, observation, and documentation. The interview method is a question and answer process done along with stakeholders. Data collection techniques by making direct observations to the site were conducted, followed by proper documentation and tracing of documents to be used in the design and analysis of the management system.

2.2 Quality Control

Quality control is an essential part of any project to allow organizations or teams to ensure the highest quality outcomes possible [5]. According to the Project Management Book of Knowledge, there are three essential processes in this knowledge area: plan quality management, perform quality assurance and control quality. In quality management, quality standards are identified to set how outcomes are measured. In quality assurance, the quality requirements and the results from quality control measurements are audited to ensure that appropriate quality standards and operational definitions are used. In quality control, the results of executing the quality activities are monitored and recorded.

To commit to quality standards, V-Model was used for developing and testing the software. The V-Model stands for verification and validation. This model is similar to the waterfall model that follows a sequential path of process execution. The testing of the outcomes has a corresponding phase in the development phase. Figure 1 shows the structured V-Model software development lifecycle used in the study.

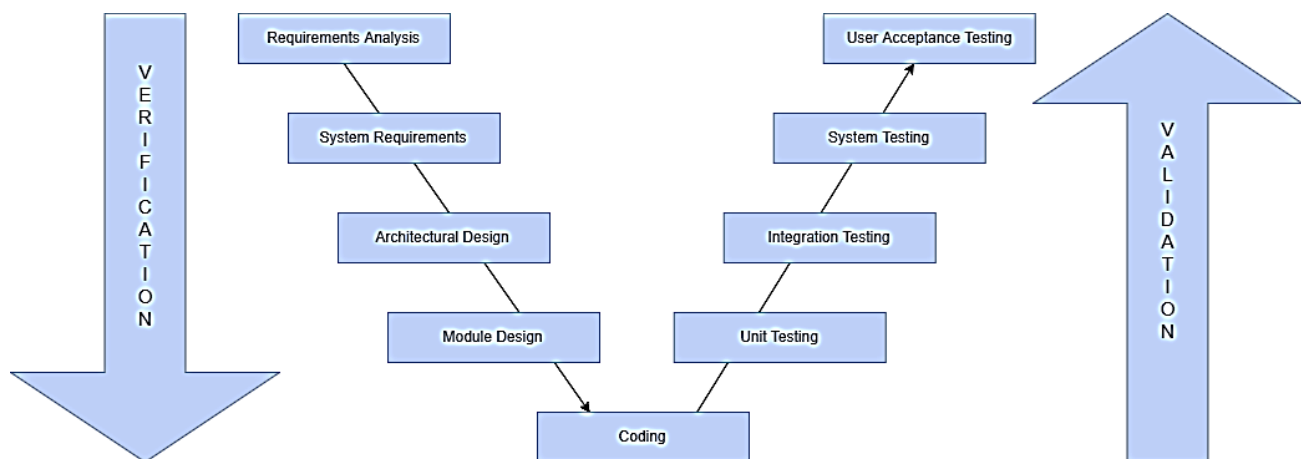


Figure 1: V-Model diagram

According to [6], verification and validation are essential to establish assurance that the system is ‘fit for purpose.’ Verification is done to ensure that the software conforms to the specifications set. While in the validation, the software is ensured to perform correctly using a given set of test cases that reflect the systems’ expected use.

2.2.1 Verification Phase

The following are the steps in the verification phase and their corresponding test in the validation phase:

- User Requirements Analysis – The goal of this process is to provide a clear understanding of requirements as an early input to the development of the project. During this phase, it is expected to communicate with the client to elicit, analyze, and

record requirements. User requirements are used as an input for the user acceptance testing.

- System requirements – Once data have been analyzed, the system requirements are detailed to capture the complete description of how the system is expected to perform. Requirements are also studied and investigated as to how these could be implemented. The software requirement is used as an input for the system testing.
- Architectural design – In this phase, the system is broken down into various modules, and the relationships between these modules are defined. If all modules are integrated, it should answer or result in the system requirements. The architectural design is used as an input for integration testing.
- Module design – Each module identified in the architectural design is detailed in this process. The module design defines the actual logic for each module and how it interacts with other modules. The module design is used as an input for the unit testing.

2.2.2 Validation Phase

There are several tests done in this phase, namely: unit testing, integration testing, system testing, and user acceptance testing, which also corresponds to the processes undertaken in the verification phase. Before testing, test acceptance criteria must be set to define standards which the system should meet to be accepted by the client.

Acceptance testing is conducted to determine whether a feature, functionality, or system has met the requirements specification. Each acceptance test must result in the following conclusions to wit: (1) Accept as delivered, (2) Accept after the requested modifications have been made, and (3) Do not accept. The V-Model used in this study is

comprised of four main testing phases, namely: unit testing, integration testing, system testing, and user acceptance testing. Additional non-functional testing is also executed.

2.3 System Framework

The paper aims to address the current state by developing an enterprise resource planning (ERP) system that includes the following modules:

- Administrator Module – This module allows the administrators to manage data and modules of the system.
 - Reports Module – This module allows the administrator to generate reports needed by the business.
 - Dashboard – This module provides an overview of the business operations conducted through visualization and data analytics.
- Point-of-Sales Module – The module allows the cashier to encode the orders of customers.
- Order Queuing Module – This module allows the bar and kitchen staff to efficiently monitor orders and its progress.
- Network Management Module – This module allows the administrator to effectively manage network resources such as bandwidth and connected devices.
- Kiosk Module – This module is a self-service technology that allows the customer to manage their rewards points and account.
- Mobile Application – This application allows access to the customers’ rewards and as well as the grab-and-go ordering system.

Figure 2 shows a graphical representation of the project framework.

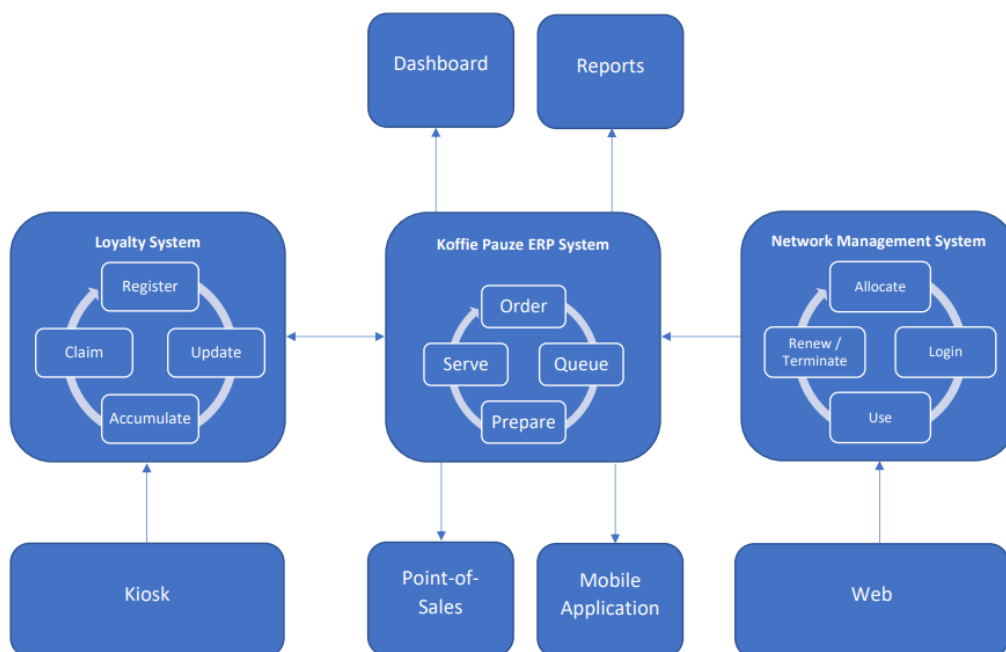


Figure 2: Project framework

Figures 3-4 show the system layout and system architecture of the project. The primary users of the system are the cashier, chef, barista, administrator, and customers. The system is connected through a centralized network server which handles all data. A mobile application will be distributed through appropriate platforms.

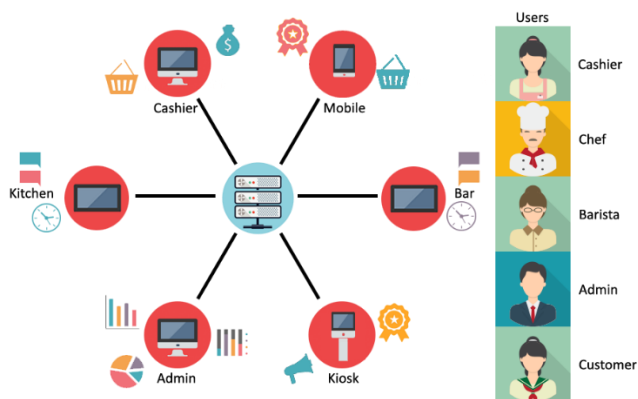


Figure 3: System layout



Figure 4: System architecture

2.4 System Development

There are different environments used in developing the system: development, testing, user acceptance test, and production. In each of these environments, a database server is configured and utilized, which have their own repositories to store data, as shown in Figure 5.

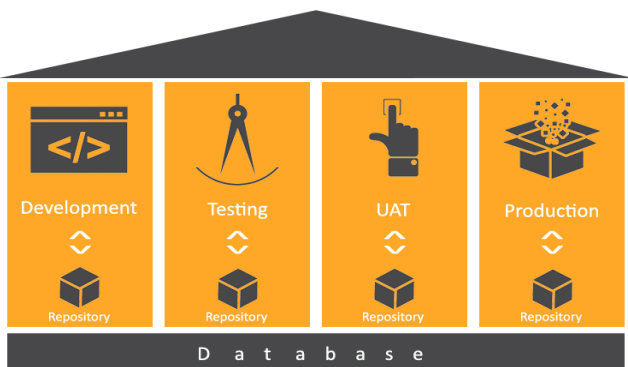


Figure 5: System development architecture

For system development, programmers use workstations as a development server to create all modules and interfaces. For testing, testers use workstations to conduct the various testing activities. However, for the user acceptance test, actual workstations deployed in Koffie Pauze to test the system in its real environment. Lastly, the production environment was set up as a networked system to connect various devices implemented in Koffie Pauze, such as the Point-of-Sale, Kiosk, admin, and the bar/kitchen queue monitoring.

3. RESULTS AND DISCUSSION

3.1 Current Business Process

The order taking process takes more than half of the business process of the establishment; it is when the customer orders the food and beverage he would like to have. The process starts when the customer gives the order to the cashier. After giving the order, the cashier looks for the item from the price list and encodes it to the cash register. The cashier will then inform the customer of the order total. It is also the job of the cashier to accept payments and to write and distribute a list of the orders to the assigned department who will make the order. Aside from that, the cashier will give the customer a buzzer, which will notify him if the order is completed and ready to pick-up. Figure 6 shows the current order taking process sequence diagram.

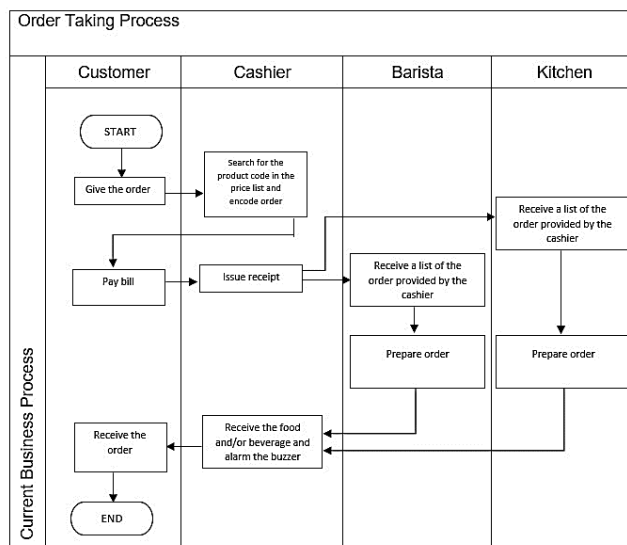


Figure 6: Current order taking process

Every coffee shop has its own way of retaining customers. Most of the shops have their reward system in order to attract customers and at the same time, develop their loyalty to the café. When the customer gives his order, the cashier encodes the order. As part of their standard operation procedure, the cashier will ask if the customer has a rewards card. Currently, the Koffie Pauze has a reward system through providing a mini card to new customers, and every beverage or food they order corresponds to one stamp. Once he reaches ten stamps, he is entitled to avail of one complimentary food or drink. The current reward system process sequence diagram of the establishment is shown in Figure 7.

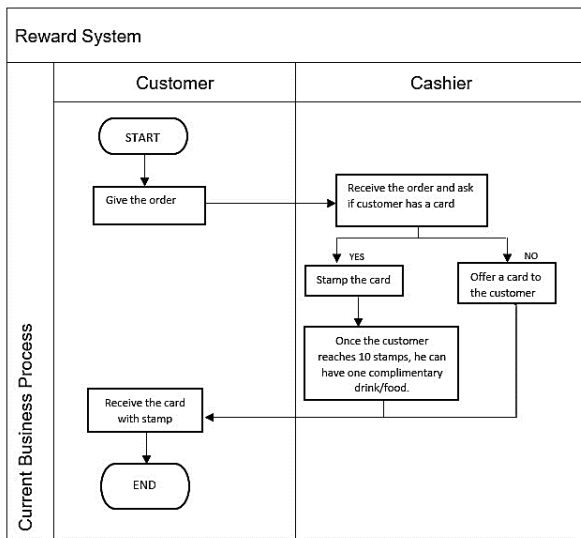


Figure 7: Current reward system process

One of the common problems that cafes encounter is the excess data being consumed by the customers. Koffie Pauze provides a free WiFi connection to its customers who avail of any beverage or drink offered by the café. The process starts when the customer orders his preferred beverage or food. The cashier verifies the order and issues the bill. Once the customer has already paid the bill, a receipt will be given. The customer has the option to ask for the WiFi password or not; if he wishes to use WiFi, he needs to ask the cashier. A one-time password is given by the cashier, which is valid for the entire stay of the customer. The current process for the acquisition of the WiFi password is shown in Figure 8.

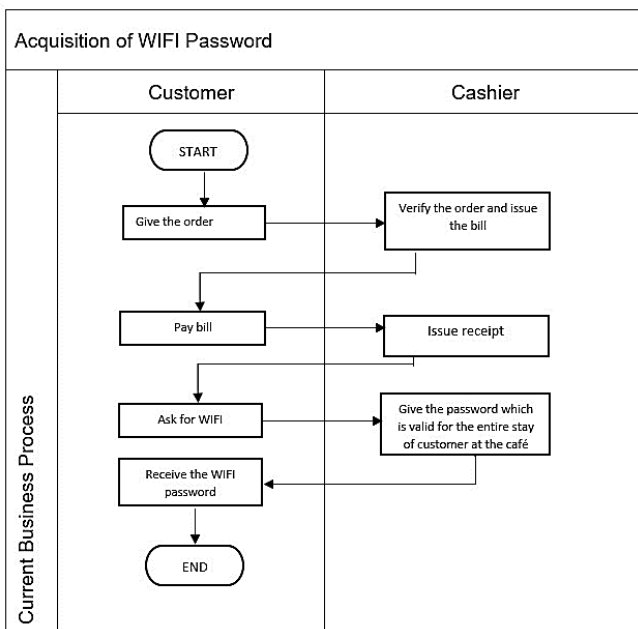


Figure 8: The current process for acquisition of WiFi password

As presented in Figure 9, the cashier endorses the daily sales receipts to the bookkeeper. After endorsement, the bookkeeper encodes all the sales to the excel file and prepares the sales report. The bookkeeper will submit this report to the administrative manager for approval and safekeeping.

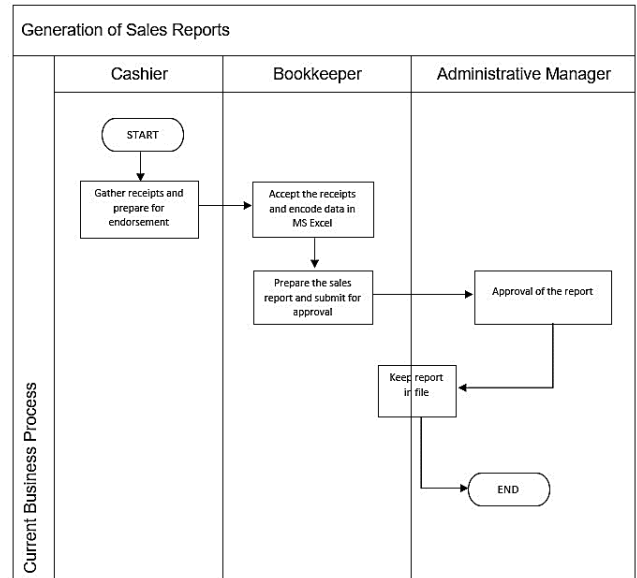


Figure 9: The current process for generation of sales report

3.2 Proposed Business Process

The proposed business process makes the order taking easier by automatically distributing the order to the assigned department instead of letting the cashier write, go to the other department and give a copy of the receipt for the order they need to make. By this, the cashier does not need to travel from one place to another just to deliver the receipt. Hence, it will save effort and more time for the cashier to take the order of another customer. The proposed order taking process (method 1) is shown in Figure 10.

For instance, the customer ordered an iced caramel macchiato and fries. After payment, the macchiato beverage will automatically pop up on the barista’s screen while the fries will appear on the kitchen’s screen. When they are already done making the customer’s order, the kitchen and bar staff will update the queue, and the cashier will be notified. Also, the buzzer that the cashier gave to the customer will alarm.

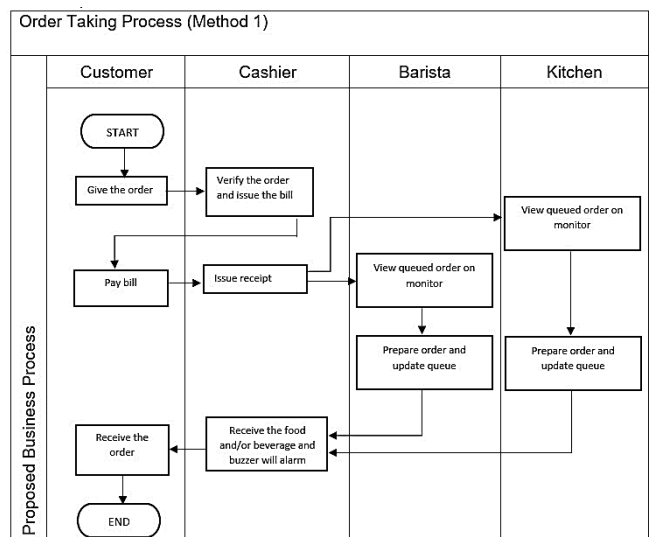


Figure 10: Proposed order taking process (Method 1)

Figure 11 shows the sample user interface for the Point-of-Sales. Here, the cashier can filter the product list by pressing on categories of searching the name of the product. Any item clicked will be added to the order pane on the right side with details about the transaction. All transactions processed will now be automatically queued on respective departments without the cashier exerting much effort of writing down orders and giving them out to the kitchen and bar.

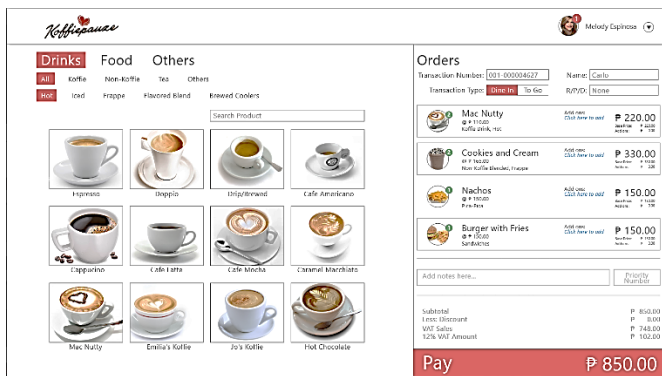


Figure 11: Point-of-Sales system interface

In order to increase the customer base, another proposed business process has been established, as shown in Figure 12. This process is a self-service kiosk wherein the customer can order, top-up currency, and redeem their KPoints. The process starts when the customer inputs his credentials to log in. This would lead to his account. He needs to choose his order and his mode of payment. The kiosk will generate the receipt after the transaction and will automatically reflect the order to the assigned department.

The process will benefit two parties: the customer and the employees. The customer can take his time taking orders, check information on on-going promos, view information about the food and beverage he can order. In addition, the employees can allocate the time saved for another customer.

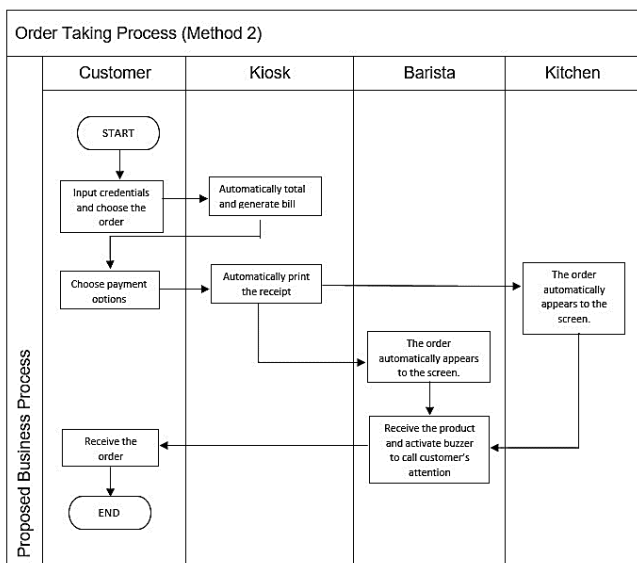


Figure 12: Proposed order taking process (Method 2)

In the method 2 of the proposed order taking process, the customer can freely browse the catalog of products available for purchase. If the customer has sufficient funds in his account, he can order through the self-service kiosk using KPoints or Kash. The Point-of-Sales user interface for method two is shown in Figure 13.

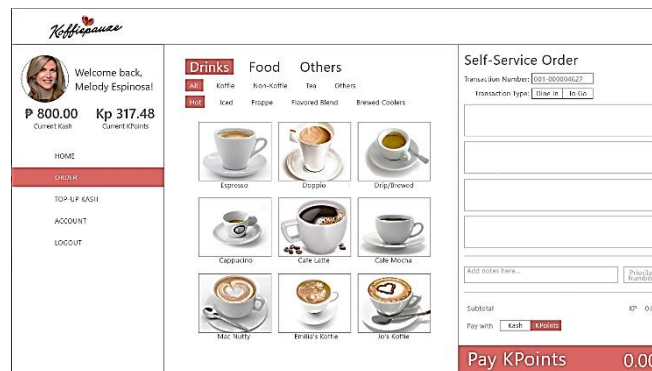


Figure 13: Kiosk Point-of-Sales system interface

Another order taking process introduces the concept of 'Grab-and-Go,' as shown in Figure 14. This is intended for validated customers who are in a rush or hates waiting in line but wants to grab coffee or snacks before heading to their destination. The customer orders through a mobile application that is connected to the order queuing system in the establishment. This new process creates a better customer experience and expands the venue for customers to enjoy the services provided by the business.

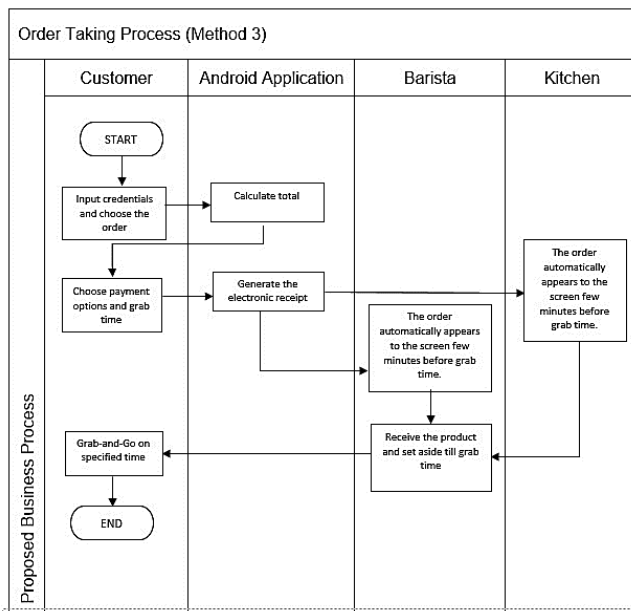


Figure 14: Proposed order taking process (Method 3)

Here, the customer can view the catalog of products that the customers can select. All orders will be put on a cart for checkout. The customer must select a specific time for them to Grab-and-Go before the transaction is finalized. There is no need for the customers to queue anymore since even the payment is made through the mobile application. The system interface for method 3 is shown in Figure 15.

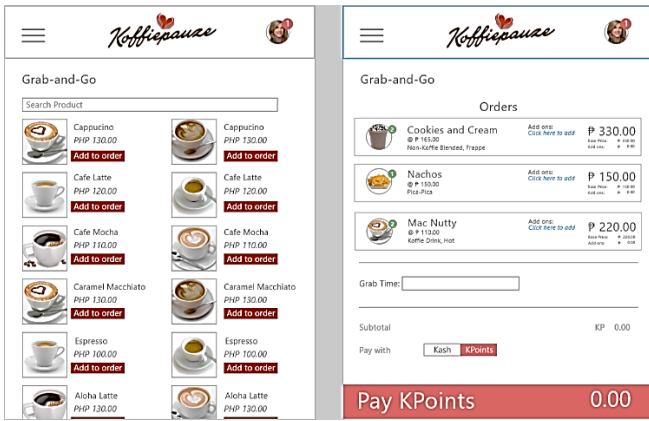


Figure 15: Android mobile application system interface

Every café’s job is to always improve the customer’s experience to achieve customer satisfaction. The proposed rewards system process is shown in Figure 16. Instead of using mini cards and stamps for the rewards program, the cashier will ask for the customer’s code or scan the code in the mobile app in order to record the number of points obtained during the transaction. This makes the process convenient not only for the customer’s part but also for the cashier’s part.

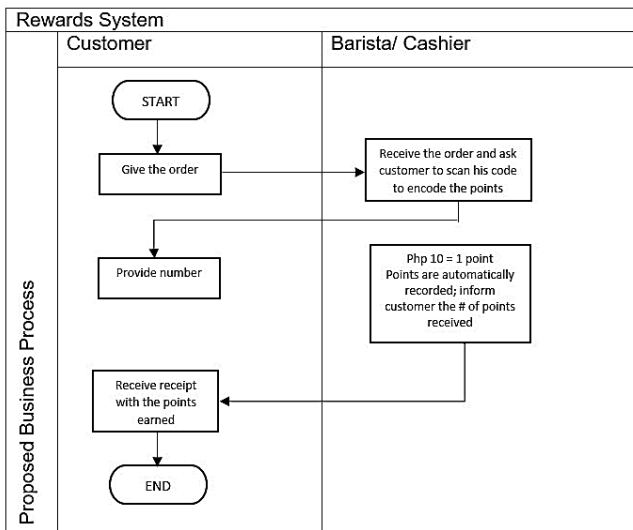


Figure 16: Proposed reward system process

Managing the network will now be efficient for the staff of Koffie Pauze. The proposed process for the acquisition of the WiFi password is shown in Figure 17. In the proposed business process, the manager does not need to change the password every day anymore. Instead, the system automatically generates a unique passkey for each customer that they can use to connect to the wireless network. This way, the cashier also does not need to write the password daily in a piece of paper anymore to give out to the customer upon orders.

In order to address the network connection problem, the café will provide limitations in connecting to the wireless network. Instead of providing an internet connection for the entire stay, he is only given a maximum of four hours and can connect up to two devices. After the duration, the connection is automatically disconnected. Should the customer wish to

resume the connection, he needs to order another product offered by the café. With this, the customers will be encouraged to order more, thus increases the sales of the café.

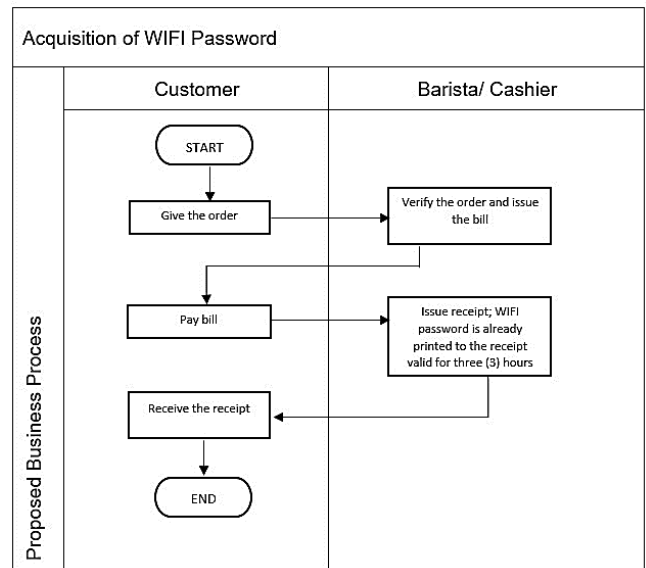


Figure 17: Proposed process for the acquisition of WiFi password

In the proposed process, the cashier does not need to gather all receipts anymore since it is all available in the system database. The cashier can easily generate and print the sales report in just a matter of clicks. The process flow of the proposed generation of a sales report is shown in Figure 18.

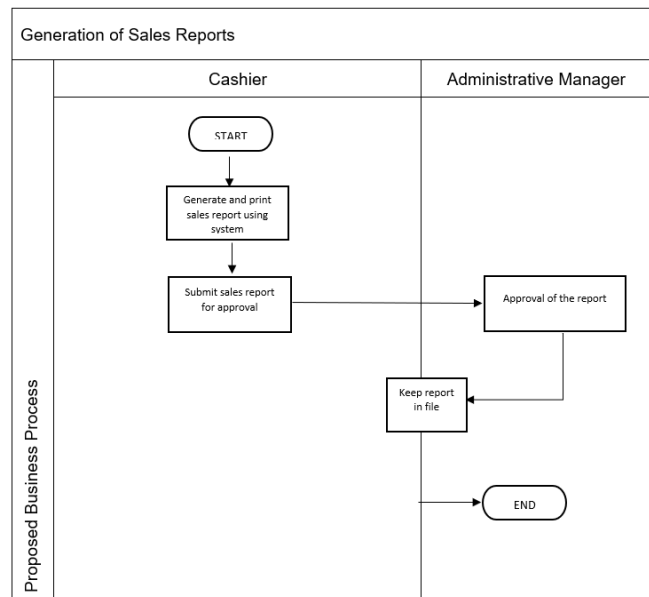


Figure 18: Proposed generation of the sales report process

3.3 Resource Cost and Savings

The proposed point-of-sales and the queuing process is presented in Table 1. Each role that corresponds to the tasks, and the cost to execute each task is also shown in the table. The total cost for the proposed point-of-sales and queuing process for each customer is ₱46.51.

Table 1: Proposed point-of-sale and queuing process cost

Proposed Point-of-Sale and Queuing Process	Cashier / Head Barista	Head Chef	Crew	Manager	Total
	₱87.50/hour	₱87.50/hour	₱62.50/hour	₱100.00/hour	
Placing of orders	0.5 min				₱0.73
Queuing of orders		0.5 min			₱0.73
Preparation of orders		30 mins			₱43.75
Delivering/Monitoring of orders			1.25 mins		₱1.30
Total					₱46.51

The proposed customer rewards process is shown in Table 2. Each role that corresponds to the tasks, and the cost to execute each task is also presented in the table. The total cost for the proposed customer rewards process for each customer is ₱0.73.

Table 2: Proposed customer rewards process cost

Proposed Customer Rewards Process	Cashier / Head Barista	Total
	₱87.50/hour	
Issuing stamp/sticker	0 min	₱0.00
Claiming Rewards	0.5 min	₱0.73
Total		₱0.73

The current network management process is presented in Table 3. Each role that corresponds to the tasks, and the cost to execute each task is also shown in the table. The total cost for the current network management process for each customer is ₱0.

Table 3: Proposed network management process cost

Proposed Network Management Process	Manager	Total
	₱100.00/hour	
Changing WIFI password	0 min	₱0.00
Issuing WIFI password	0 min	₱0.00
Total		₱0.00

The proposed sales generation process is shown in Table 4. Each role that corresponds to the tasks and the cost to execute each task is presented in the table. The total cost for the proposed Customer Rewards Process for each customer is ₱4.59.

Table 4: Proposed sales report generation process cost

Proposed Network Management Process	Cashier	Manager	Total
	₱87.50/hour	₱100.00/hour	
Generate and print sales report using system	2 mins		₱2.92
Approve report		1 min	₱1.67
Total			₱4.59

To compute for the savings for the proposed process improvements, the following tables show the variances and the total savings for a year of operation.

The total savings for the point-of-sales and queuing process improvement using the proposed system per year is ₱93,840.00, as shown in Table 5.

Table 5: Point-of-sales and queuing process savings

Point-of-Sale and Queuing Process	Cost per Order	Average Orders per day	Cost per day	Cost per year
Current Process	₱50.19	75	₱3,764.25	₱1,279,845.00
Proposed Process	₱46.51	75	₱3,488.25	₱1,186,005.00
Difference	₱3.68		₱276.00	₱93,840.00

The total savings for the customer rewards process improvement using the proposed system per year is ₱92,565.00, as shown in Table 6.

Table 6: Customer rewards process savings

Customer Rewards Process	Cost per Order	Average Orders per day	Cost per day	Cost per year
Current Process	₱4.36	75	₱327.00	₱111,180.00
Proposed Process	₱0.73	75	₱54.75	₱18,615.00
Difference	₱3.63		₱272.25	₱92,565.00

The total savings for the customer rewards process improvement using the proposed system per year is ₱1,821.35, as shown in Table 7.

Table 7: Network management process savings

Network Management Process	Cost per day	Cost per year
Current Process	₱4.99	₱1,821.35
Proposed Process	₱0.00	₱0.00
Difference	₱374.25	₱1,821.35

The total savings for the sales report generation process improvement using the proposed system per year is ₱127,245.00, as shown in Table 8.

Table 8: Generation of sales report process savings

Sales Report Generation Process	Cost per day	Cost per year
Current Process	₱29.59	₱10,800.35
Proposed Process	₱4.59	₱1,675.35
Difference	₱25	₱9,125.00

Summing up the savings for the four processes yields a total of ₱197,351.35 savings per year or ₱16,445.95 per month.

4. CONCLUSION

In this paper, an enterprise resource planning (ERP) system is developed and implemented in a local coffee shop. The project followed the V-model for the analysis and design of the software solution to ensure software quality through its verification and validation phases. The implementation of the project has paved the way for the business to streamline its processes. With this at hand, the business is expected to secure savings as much as ₱197,351.35 per year of operations.

Future researchers may consider studying the impact of the project on its stakeholders and evaluate the performance of the ERP system. Further, the use of data mining techniques and algorithms [7]–[12] is recommended as it can be used to analyze data produced by the ERP that is necessary for business planning and decision making.

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