RESEARCH ARTICLE   OPEN ACCESS

Design of a Contactless Product Order and Delivery Information System Integrated with Analytics

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Abstract:

This project aims to design a contactless product order and delivery information system for Gaisano Grand Mall of Panabo, Panabo City. The system incorporates forecasting for market analysis and geo-mapping for location identification, enabling speedy and effective real-time delivery while promoting contactless shopping during the pandemic. The V-Model approach will be utilized for software development and testing to ensure software quality. With a scheduled duration of 240.56 Man-days and a budget of PHP 452,722.46, the project aims to reduce activity time by 61.75%, allowing the business to serve more customers. Adopting a unified system is recommended to streamline data flow, minimize discrepancies, and enhance processing efficiency and accuracy. Overall, this project seeks to improve the delivery process, enhance market analysis, and facilitate safe and efficient contactless shopping experiences for customers of Gaisano Grand Mall of Panabo.

Keywords **—Contactless delivery, delivery systems, information systems, shopping mall, product-order.**

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I. INTRODUCTION

It is somewhat surprising that the demand for contactless deliveries demonstrates popularity in an environment of social distancing. While development works on autonomous vehicles may have paused, for the time being, the stake in autonomous delivery robots owns significance [1]. Outcomes reveal that most businesses sank amidst the pandemic situation. Simultaneously, food, retail, and delivery services elevated the businesses more by leveraging the opportunity and possibility to reduce physical contact during a business while relying on e-commerce to keep their operations running [2]. This research project aims to protect customers' and workers' safety while attempting sales opportunities [3].

Existing studies and applications have shown that the contactless method permits both parties to keep their distance and fulfill orders [4]. Exercising contactless delivery methods like leaving Buy Online Pickup In-Store (BOPIS) [5], deliveries at your door, and installing Smart Lockers [6] are among some of the systems that are becoming increasingly prevalent for the safety of all people involved [7], [8]. According to the survey conducted by Anyline Inc., 70% of Americans desire a contactless digital option to proof-of-delivery signatures for their high-value packages, a practice rejected mainly by last-mile delivery organizations since the outbreak of the current pandemic [9]. Papa John's International Inc., Yum! Brands Inc., and Domino's Pizza Inc. which owns Pizza Hut, have ramped up the zero-contact service

up in recent months as nations across the country limit in-person dining at restaurants [10].

In satisfying the customers' needs, post offices stimulate digital solutions like Mobile POS and Kiosks to advance branch productivity and make the mail depositing process more straightforward and render less human contact. Organizations are utilizing drones to transport mail and parcels in different driving factors in this sector, as drones can implement contactless delivery, which is likely to draw customers in the prevailing pandemic situation and are likely to be embraced in the future. Drones can be used to transport essential mail and parcels to remote locations. Transportation of mail and parcels by drones is in the experimentation step guided to safety checks, high operational expenses, and bound carrying capacity [11], [12].

For people like buying food from outside has regularly been a choice, home deliveries had sorted the times better than anything else. The ongoing pandemic has raised concerns about the safety of ordering food from outside. Many people wonder if it is a safe and appropriate practice to order food during a pandemic. The question is whether it is harmless or not. The reaction to all these inquests is a ringing yes but with a clause. Home delivery by businesses is secure if they are contactless [13], [14].

In the context of lower product hierarchies, the prevalence of abundant data presents a valuable opportunity to employ data pooling as an effective strategy for enhancing forecast accuracy [15]. Accurate sales forecasting plays a pivotal role in the field of retailing, serving as a critical function that enables businesses to make informed decisions, optimize inventory management, and effectively meet customer demands [16]. Market dynamics are crucial for company managers to make informed decisions. Transparency in understanding market trends, consumer behavior, and competition is essential for effective strategies and adaptability [17].

A combination of three methods is employed to accurately forecast Amazon's quarterly sales in 2019 [18]. By utilizing these methods, a comprehensive and reliable prediction of Amazon's sales performance can be achieved, enabling informed decision-making and strategic planning for the company. Sales forecasting plays a crucial role in shaping the sales and marketing strategies of e-commerce enterprises, providing valuable insights for effective decision-making and business growth [19]. The integration of this innovative system presents a significant opportunity for companies to streamline and enhance their transaction recording processes, leading to heightened efficiency and effectiveness. By leveraging this new system, organizations can capture and document every transaction with precision and speed, facilitating accurate record-keeping, improved financial management, and streamlined business operations [20]. In the highly competitive Indian market across various product segments, survival necessitates a profound understanding of consumers' needs. It involves the strategic alignment of product offerings with price points, precise placement, and timely availability [21].

The findings demonstrate that combining forecasts yields more accurate and less biased predictions compared to relying solely on individual approaches. Additionally, a model has been devised to explore the relationship between time series attributes and the efficacy of each approach. These results shed light on how time series characteristics interact with the performance of these methods, particularly at the lower echelons of the hierarchy. These insights are invaluable to practitioners, and the paper concludes by summarizing key takeaways and suggesting future research directions in this domain [22].

The integration of GIS methods and AHP multicriteria decision method offers a promising approach to mitigate risks associated with establishing a new retail business in a regulated market with limited space [23]. The development and assessment of geospatial recommendations for high street retail within a major city center in Germany have been conducted, with a particular focus on evaluating their effectiveness within shopping malls [24]. Geofencing technology is

utilized to enable the automatic detection of various stages within the delivery process, enhancing efficiency and accuracy [25]. Looking at the emergence of modern technologies at this time of the pandemic, will not just resolve a challenging situation like this but augments the future possibility of a smart city, which proposes to take contactless delivery to the next level [14].

A. Project Objectives

The purpose of this project is to design a contactless product order and delivery information system equipped with analytics for market analysis and geo-mapping for location identification for the Gaisano Grand Mall of Panabo, Panabo City. The main objective is to ensure speedy and effective delivery of goods to customers in real-time, conduct market rate analysis to improve sales, optimize the 'shop-to-door' process, and promote contactless shopping as a safety measure during the ongoing pandemic.

Specifically, the objectives of this are to:

1. Design and implement a precision delivery system for the new 'shop-to-door' process that will enable customers to receive their orders within sixty (60) minutes of completing their e-shopping.
2. Design an online web-based platform that will provide transaction management and contactless ordering, processing, and delivery for customers.
3. Design a Reports module that provides comprehensive market data and sales analysis, integrating analytics and reporting capabilities to identify market preferences and forecast future supply purchases.
4. Design a component that grants the system to connect with other third-party platforms or tools through API integrations.
5. Design a website using Content Management Software to increase the company's brand credibility and visibility with the help of recommended Search Engine Optimization (SEO) industry best practices, including keyword research, backlinking, and mobile responsiveness.
6. Design a Local Contactless Parcel Service module to enhance the delivery information system by integrating new shopping processes with the third-party delivery service partners using geo-mapping technologies.

B. Scope and Limitations

The scope of this project is to design a contactless product order and delivery information system equipped with analytics for market analysis and geo-mapping for location identification for the Gaisano Grand Mall of Panabo, Panabo City. The key target of the system is to maintain customer records and preferences, facilitate online browsing and shopping through an automated 'shop-to-cart' mechanism, monitor inventory levels and company products, analyze market sales trends, and ensure a streamlined local delivery process. The platform should be accessible via desktop and mobile (mobile view) devices, and the design should adhere to company branding guidelines and maintain a user-friendly interface. Also, the API module integration should be able to exchange data in real-time between the system and the third-party platforms, enabling seamless integration and reducing manual data entry errors. Additionally, the system can generate custom reports based on the specific requirements of the company and can also display market preferences. The Reports module should include graphs, charts, and tables to facilitate data interpretation and decision-making for the improvement of market intelligence to make informed business decisions.

C. Project Stakeholders

The external interface of the project is composed of the following: The Store Manager, Assistant Store Managers (2), Visual Merchandising Manager (Brand), Department Manager (Brand), Head Cashier (Capability), Back of House Manager (Capability), Visual Merchandising Assistant

(VMM), Sales Team (DM), Cashiers (HC), Baggers (HC), Administrative Staff (BOHM), and Back of House Staff (BOHM). Figure 1 shows the hierarchy of these entities:
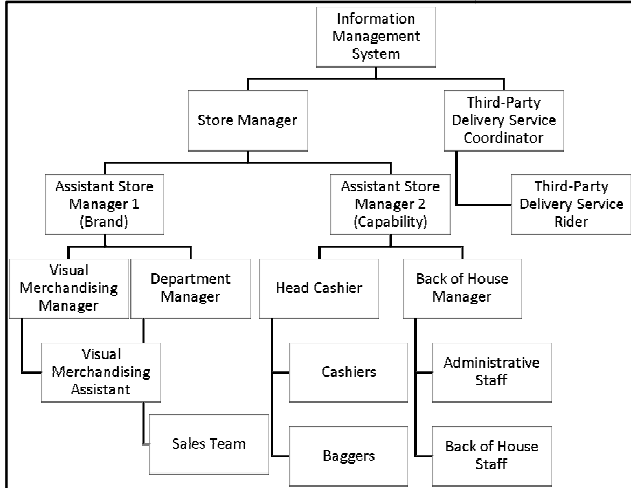

Figure 1: External Organization

The internal interface of the project is composed of the following: The Store Manager, Assistant Store Managers (2), Visual Merchandising Manager (Brand), Department Manager (Brand), Head Cashier (Capability), Back of House Manager (Capability), Visual Merchandising Assistant (VMM), Sales Team (DM), Cashiers (HC), Baggers (HC), Administrative Staff (BOHM), and Back of House Staff (BOHM). Figure 1 shows the hierarchy of these entities:
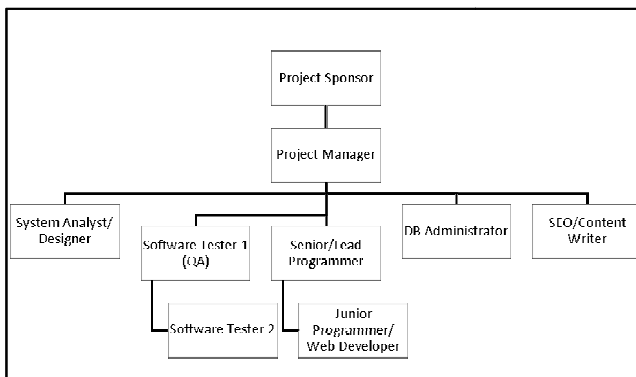

Figure 2: Internal Organization

II. MANAGERIAL PROCESS PLANS

In this section, we outline the schedule and cost projections for the proposed Information Systems. The anticipated budget has been meticulously assessed using a comprehensive costing approach, as detailed in the tables that follow. The expenses associated with each tier of the work breakdown structure are methodically computed and aggregated during each phase of the project.

A. Manpower Cost Estimates

Table 1 displays estimated manpower costs for the project, determined by the daily rate and number of man-days per role. The table highlights the estimated number of 'man-days' required for each role and the estimated daily rate of each role.

Table 1. Manpower Cost Estimates

Roles	Man-Days	Rate/Day	Costs
Project Manager	59.75	₱1,653.82 [26]	₱98,807.37
Project Sponsor	18.44	₱0.00	₱0.00
System Analyst/Designer	20.13	₱1,543.73 [27]	₱31,067.51
Software Tester 1 (QA)	30.06	₱2,155.91 [28]	₱64,812.02
Software Tester 2	14.56	₱2,155.91 [28]	₱31,395.43
Senior/Lead Programmer	32.81	₱1,776.95 [29]	₱58,306.32
Junior Programmer/Web Developer	32.31	₱1,141.18 [30]	₱36,874.44
DB Administrator	9.38	₱2,123.77 [31]	₱19,910.37
SEO/Content Writer	8.25	₱1,934.27 [32]	₱15,957.75
Store Manager	1.13	₱886.27 (Organization-based)	₱997.06
Assistant Store Manager 1	0.88	₱899.23 (Organization-based)	₱786.82
Assistant Store Manager 2	0.88	₱899.23 (Organization-based)	₱786.82
Visual Merchandising Manager	0.88	₱874.50 (Organization-based)	₱765.19
Department Manager	0.88	₱958.73 (Organization-based)	₱838.89
Head Cashier	1.13	₱794.73 (Organization-based)	₱894.07
Back of House Manager	1.13	₱934.91 (Organization-based)	₱1,051.77

Visual Merchandising Assistant	1.13	₱802.59 (Organization-based)	₱902.91
Sales Team	1.13	₱531.14 (Organization-based)	₱597.53
Cashiers	1.13	₱631.09 (Organization-based)	₱709.98
Administrative Staff	1.13	₱752.82 (Organization-based)	₱846.92
Back of House Staff	1.13	₱453.50 (Organization-based)	₱510.19
Baggers	1.13	₱652.77 (Organization-based)	₱734.37
Third-Party Delivery Service Coordinator	1.00	₱811.64 (Organization-based)	₱811.64
Third-Party Delivery Service Rider	0.25	₱663.95 (Organization-based)	₱165.99
TOTAL	**240.56**		**₱368,531.34**

B. Schedule Estimates

Table 2 provides a summary of the project timeline with the schedule estimates, organized by phase.

Table 2. Schedule Estimates

Phase	Duration (Man-Days)	Start Date	End Date
Project Proposal and Approval	7.19	05-Jun-23	14-Jun-23
Project Preparation	12.87	15-Jun-23	29-Jun-23
Project Research and Development	4.81	29-Jun-23	04-Jul-23
Project Kick-Off	6.38	04-Jul-23	05-Jul-23
Business Process Documentation	15.19	05-Jul-23	12-Jul-23
Project Configuration and Set-up	14.50	13-Jul-23	19-Jul-23
Phase Total	**60.93**	05-Jun-23	19-Jul-23
System Design	15.31	19-Jul-23	07-Aug-23
Coding and Unit Testing	51.31	08-Aug-23	06-Oct-23
Phase Total	**66.63**	19-Jul-23	06-Oct-23
Testing	38.50	09-Oct-23	15-Nov-23
Implementation	36.38	15-Nov-23	04-Dec-23
Phase Total	**74.88**	09-Oct-23	04-Dec-23

Go Live	1.00	04-Dec-23	04-Dec-23
Maintenance and Support	33.38	05-Dec-23	23-Jan-24
Project Closure	3.75	23-Jan-24	25-Jan-24
Phase Total	38.13	04-Dec-23	25-Jan-24
TOTAL	**240.56**	**05-Jun-23**	**25-Jan-24**

C. Software Cost Estimates

To provide an overview of the software expenses for the project, Table 3 summarizes the estimated cost of the required software, totaling to ₱99,614.64.

Table 3. Software Cost Estimates

Software	Quantity	Unit Cost	Total Cost
Windows 10 Pro 64-bit OS, One-time	3	₱7,990.00, one-time	₱23,970.00
Canva, Canva Pro (paid), Annual	1	₱2,000.00, annual	₱2,000.00
Figma (free, limited), Annual	1	₱2,500.00, annual	₱2,500.00
Git (free, open-source)	1	Free	Free
GitHub, GitHub Free (free, limited)	1	Free	Free
Visual Studio Code (free)	1	Free	Free
HTML	1	Free	Free
Vue (Vue.js) (open-source)	1	Free	Free
CSS	1	Free	Free
MySQL (open-source)/XAMPP	1	Free	Free
Laravel (open-source)	1	Free	Free
Inertia (Inertia.js) (open-source)	1	Free	Free
Hostinger, Cloud Startup (paid) with Domain included, Annual	1	₱5,000.00, annual	₱5,000.00
Google AdSense, Free (limited)	1	Free	Free
Google Analytics (free)	1	Free	Free
Google Search Console (free)	1	Free	Free
SEMrush, Pro (limited), Annual	1	₱66,146.64, annual	₱66,146.64
Leaflet (open-source)	1	Free	Free
OpenStreepMap (open-source)	1	Free	Free
Forecasting, Time-Series (existing library)	1	Free	Free
TOTAL COST			**₱99,614.64**

D. Hardware Cost Estimates

To develop and implement the proposed system, an extra set of computers will be needed (already existing with the same or higher specifications). Table 4 summarizes the estimated cost of the required hardware, totaling to ₱127,511.00.

Table 4. Hardware Cost Estimates

Hardware	Quantity	Unit Cost	Total Cost
Intel Core i5-10400F Processor H510M-H Motherboard (4GBx2) 8GB DDR4 Memory 1TB HDD GT730 2GB Video Card 18.5" LED Monitor Computer *(already existing with the same or higher specs)*	3	₱40,000.00 each	₱120,00.00
Xprinter Label Barcode Printer Thermal Receipt Bar Code Print 20mm-80mm Sticker Printer Bluetooth WIFI LAN USB *(already existing with the same or higher specs)*	2	₱3,000.00 each	₱6,000.00
TOTAL			**₱127,511.00**

E. Financial Viability

To ensure the project's financial sustainability, the first step is to regularly deliver shopping services to the customers and achieve the cost of executing its activities. The cost of each activity can be calculated by multiplying the total time spent by the hourly rate of the employees or any person involved.

As the proposed project involves a few departments, the following list represents the collective tasks that personnel from different departments will undertake.

The customer's journey begins with creating an account and providing their basic information. Once the account is created, the main activity is placing an order. Payment can be made electronically (via bank transfer, GCash (recommendation), etc.) before packing or in cash upon delivery. After placing the order, the staff will retrieve the items from the shelving units or racks and bring them to the cashier for barcode scanning and item packing by the bagger. It's crucial that all items scanned and packed match the customer's order. Table 5 presents the current and proposed process durations for order entry and fulfillment. By monitoring the time spent on each step, the company can identify opportunities for improvement and optimize the order fulfillment process.

Table 5. Time spent: Current vs. Proposed Processes (Order Entry and Fulfillment)

Process	Current	Proposed	Difference
Order Entry (electronic payment, item picking, and order queueing)	30 mins	15 mins	15 mins
Cashiering and Transaction Recording	10 mins	8 mins	2 mins
Packing	10 mins	8 mins	2 mins
Order Fulfillment (COD and delivery)	45 mins	10 mins	30 mins
TOTAL	**95 mins**	**41 mins**	**54 mins**

The Back of House team is responsible for managing the inventory of all items, both incoming and outgoing. When items are placed on the shelves or included in an order, they are subtracted from the current inventory. When items are received from suppliers and brought into the Back of House area, they are added to the current inventory. Table 6 displays the time spent on each of the current and proposed processes for the Back of House and inventory management.

Table 6. Time spent: Current vs. Proposed Processes (Back of House and Inventory)

Process	Current	Proposed	Difference
Inventory In	30 mins	30 mins	0 min
Inventory Out	10 mins	10 mins	0 min
TOTAL	**40 mins**	**40 mins**	**0 min**

Once a successful transaction is completed, the billing process takes place. The Head Cashier is responsible for the reporting process for billing, which goes after one of the Assistant Managers. Table 7 provides the time spent on each current and proposed process for billing.

Table 7. Time spent: Current vs. Proposed Processes (Billing)

Process	Current	Proposed	Difference
Billing (consolidation)	10 mins	8 mins	2 mins
Reports (Sales) (consolidation)	30 mins	20 mins	10 mins
TOTAL	**40 mins**	**28 mins**	**12 mins**

The current process of the organization does not include any delivery service, and customers are responsible for their own delivery arrangements, which incur their personal time and expenses. However, as a result of system integrations, a new delivery scheme has been introduced whereby third-party delivery services are engaged once the order is packed. Table 8 illustrates the time spent on each of the current and proposed processes.

Table 8. Time spent: Current vs. Proposed Processes (Delivery)

Process	Current	Proposed	Difference
Delivery (customer arrangements)	30 mins	10 mins	20 mins
TOTAL	**30 mins**	**10 mins**	**20 mins**

The calculation of the monthly savings is obtained by dividing the total annual savings of ₱645,000.00 by twelve (12), resulting in a monthly savings of ₱53,750.00. To estimate the cost and savings for the next twelve (12) months, the cumulative costs and cumulative savings are computed, which are presented in Table 9.

Table 9. Cumulative Cost vs. Cumulative Savings

Month	Cost	Savings	Cumulative Savings
February-24	₱448,730.46	₱53,750.00	₱53,750.00
March-24		₱53,750.00	₱107,500.00
April-24		₱53,750.00	₱161,250.00
May-24		₱53,750.00	₱215,000.00
June-24		₱53,750.00	₱268,750.00
July-24		₱53,750.00	₱322,500.00
August-24		₱53,750.00	₱376,250.00
September-24		₱53,750.00	₱430,000.00
October-24		₱53,750.00	*₱483,750.00*
November-24		₱53,750.00	*₱537,500.00*
December-24		₱53,750.00	*₱591,250.00*
January-25		₱53,750.00	**₱645,000.00**
TOTAL		**₱645,000.00**	

III.   QUALITY CONTROL

The quality of software can be viewed from three perspectives: functional quality, structural quality, and process quality. Functional quality refers to the ability of the system to perform the tasks it is designed for, meeting the requirements of its users. Structural quality, on the other hand, pertains to the internal structure of the codes, including its design, complexity, and maintainability. Lastly, process quality emphasizes the quality of the development process itself, taking into account the methodologies, techniques, and tools used throughout the software development lifecycle.

A. Software Development Methodology

To address the three aspects of software quality, the project will implement the V-Model approach for software development and testing, as shown in Figure 3. This approach is named as such because

of its two components: Verification and Validation, and its V-shaped structure. Each stage in the model requires the verification and validation of all deliverables. The software testing process ensures the validation of software quality. The V-Model also parallelizes the testing phase with the development phase, and the phases of verification and validation are situated on opposite sides of the "V." The coding phase links the two sides of the V-Model.
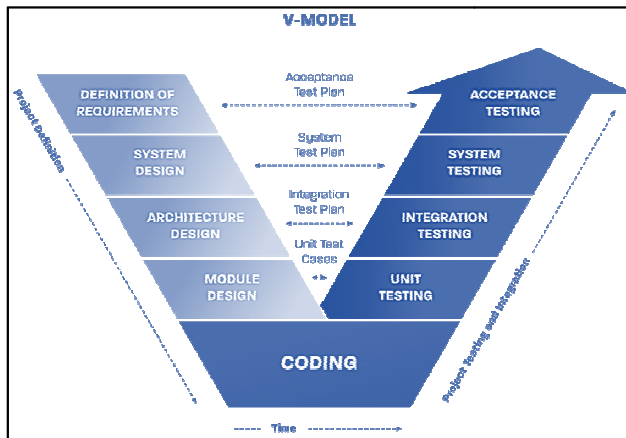

Figure 3: V-Model Software Development and Testing Methodology

B. *Risk Management Process*

According to the AS/NZS 4360:2004 standard, risk management involves applying management policies, processes, and practices in a systematic way to activities such as setting the context, identifying, analyzing, assessing, treating, monitoring, and communicating risks. Risk management is an iterative approach that can improve an organization's understanding of risks and their impacts with each cycle. Figure 4 illustrates the process for managing risks in the project.
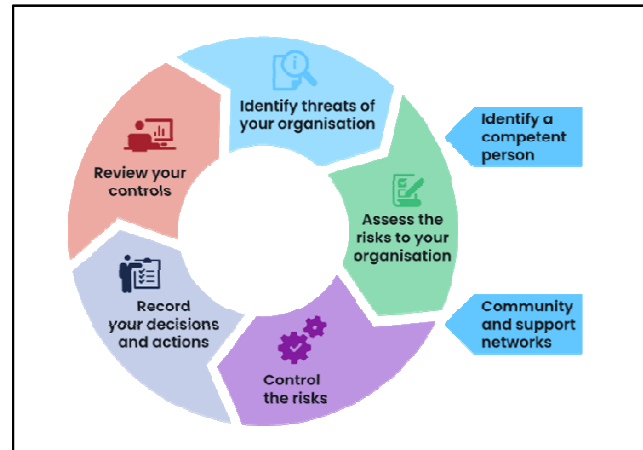
Figure 4: Risk Management Process

C. *Project Framework*

The objective of the project is to enhance the existing business processes within the organization, specifically focusing on the supermarket and department stores. This will be achieved by developing an Information System that encompasses various modules designed to address specific needs and requirements.

1. Administrator Module – This module empowers the administrator (Store Manager, Assistant Store Managers, and Managers) with the ability to efficiently handle data management, access control, and other modules within the proposed system.

2. Staff Module (recommendation) – This module is designed to grant specific access and control to the organization's staff members (administrative staff, back of house staff, bagger, cashier, sales team, and visual merchandising assistant) based on their assigned roles in coordination with the proposed processes. It ensures that each staff member has appropriate access privileges and control relevant to their respective responsibilities.

3. Delivery and Delivery Coordinator Module – This module has been specifically developed to provide access and control over customer information,

location identification, payment receiving, and remittance processes (as per the agreed MOA) to the Third-Party Delivery Services, including both the Coordinator and the Riders. Additionally, it offers advanced access privileges to enable the Coordinator to view and verify Riders accounts (identity) effectively.

4. Inventory Module (recommendation) – This module enables the management, particularly those in the back of the house, to effectively track and monitor the inventory as it flows in and out. While the organization is currently making the most of the existing inventory system, there is a need to implement a new process that will align and synchronize the existing data with the new data. This proposed approach aims to ensure accurate inventory management and enhance overall operational efficiency.

5. Payment Module (recommendation) – This module provides the organization with the capability to accept payments through various channels, including electronic transactions, cash payments, and mobile payment terminals. It is highly recommended that the organization integrates payment methods following a formal request and approval process from the issuing bank, including popular options like GCash. By incorporating these payment options, the organization can offer greater convenience and flexibility to its customers while ensuring secure and efficient payment processing.

6. Client/Customer Module – This module enables customers to engage in online shopping, access their order details and purchase history, benefit from customer loyalty rewards, and enjoy the convenience of delivery privileges. With this module, customers can easily browse and purchase products or services through the organization's online platform. They

can also track their orders, review their past purchases, and take advantage of loyalty programs that offer rewards and special benefits. Additionally, customers are granted the convenience of delivery services, ensuring their orders are promptly and securely delivered to their preferred locations.

7. Reports Module – This module facilitates the integration of preprocessed inventory and point-of-sale data into the proposed system's database. It enables the merging of these datasets, ensuring that accurate and consolidated information is available for analysis and reporting. The refined data will be utilized in the forecasting algorithm, which will provide market analytics and valuable insights. By leveraging this module, the management level will have access to data-driven decision-making tools, allowing them to make informed choices for future strategies and purchasing decisions. This integration of data and analytics will greatly benefit the organization's overall operations and enable more effective planning and resource allocation.
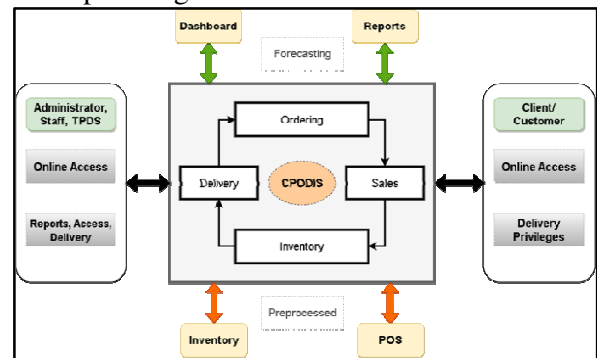

Figure 5: Project Framework

D. System Architecture

The system architecture of the proposed system is depicted in Figure 6. The system users include Customers, Admin, Staff, and Third-Party Delivery Services. The system will be web-based, allowing Customers to access it via the Internet. A dedicated

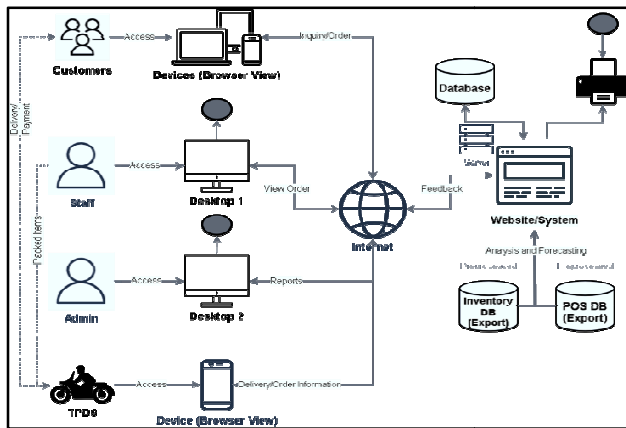server will handle all database management and web transactions.

Figure 6. System Architecture

E. Continuous Improvement

Figure 7 shows the Plan-Do-Check-Act (PDCA) framework will be implemented to facilitate ongoing improvement efforts.
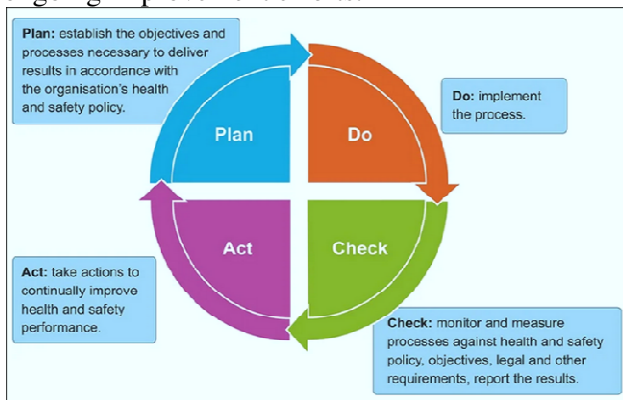

Figure 7: Continuous Improvement Process

IV.   CONCLUSIONS

In conclusion, this project aimed to design and implement a cutting-edge contactless product order and delivery information system with integrated analytics and geo-mapping capabilities, specifically tailored for the Gaisano Grand Mall of Panabo in Panabo City. Our primary objective was to revolutionize the retail experience by enabling the swift and efficient delivery of goods to customers in real-time, enhancing market rate analysis for data-driven sales improvement, optimizing the entire 'shop-to-door' process, and prioritizing contactless shopping as a crucial safety measure in the midst of the ongoing pandemic.

Through meticulous planning, innovative technology, and a dedicated team, we have successfully achieved these goals. This project represents not only a significant leap forward in retail management but also a testament to our commitment to adapt and thrive in an ever-evolving landscape. As we move forward, we envision our system making a lasting impact by not only meeting the current challenges but also serving as a model for future developments in the retail industry.

ACKNOWLEDGMENT

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