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NEXTWAY: OPEN SOURCE LAST MILE DELIVERY SYSTEM FOR MSMEs

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This paper prepared by **ALDRIN A. NAVARRO** with the title: **"NEXTWAY: OPEN SOURCE LAST MILE DELIVERY SYSTEM FOR MSMEs"** is hereby accepted by the Faculty of Information and Communication Studies, U.P. Open University, in partial fulfillment of the requirements for the degree Course.

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Biographical Sketch

Aldrin Navarro is a multifaceted Software Engineer with over 9 years of professional IT experience. His experience on all stages of software development along with his special interest on human-computer interaction helped him mold an understanding of connecting with and delivering solutions to his clients.

Aldrin earned his B.S. Computer Science degree at the University of the Philippines Cebu in 2015. While at the university, he also worked as a student research assistant for the then Department of Computer Science. In 2014, Aldrin presented the department's research "Supporting the Health System on Dengue using an Agent-based Epidemic Model" and along with the poster "An agent-based epidemic model for dengue simulation in the Philippines" which won the best conference poster. The research team is composed of two university professors Prof. Kurt Junshean Espinosa, and Dr. Florian Miksch, a visiting professor from TU Wien, Institute for Analysis and Scientific Computing, Vienna, Austria, and a fellow research student assistant Katrina Casera. Aldrin gained significant academic research skills as well as a once in a lifetime opportunity to work with a highly dedicated team in advancing epidemic modeling in the local scene.

Aldrin is a Software Engineer and Tech Lead at Newlogic (2019 – present); Software Developer at Channelfix LLC (2014 – 2019); IT Consultant at Regal Group (2018); Web Developer at Enhance Visa (2016); and a Software Developer Intern at Crowd Metric Solutions, Inc (2014).

Aldrin's professional growth also includes completing Google IT Automation with Python Specialization Professional Certificate and earning the certifications AWS Certified Cloud Practitioner, Microsoft Certified Azure Fundamentals, and TryHackMe Junior Penetration Tester.

Acknowledgment

I would like to acknowledge and give my warmest thanks to Dr. Roberto B. Figueroa, Jr and Prof. Mari Anjeli Crisanto for the guidance and patience that made this work possible. Their guidance and encouragement carried me through finally completing this project.

I would also like to thank Ms. Juraphiel Gadiano Ubas, LPT for proofreading my manuscript and providing valuable insights to improve readability.

I would also like to give special thanks to my family — to my parents Alma and Delfin, my sisters Aireil and Abigail, and to Danson and Drixiandra — for their unwavering support and understanding, inspiring me to take up the challenge and complete one of my important milestones in life. Your prayers helped me get out of the rut and maintain peace of mind.

I am eternally grateful to my wife Josel B. Paquit-Navarro, LPT for the constant support and encouragement from day 1. Offering the time to read, and review the non-technical aspects of this project, and for extending the patience.

Finally, to God, for imparting to me the courage, wisdom, and patience to get me through all the sacrifice and hard work necessary for this endeavor. Jehovah Jireh. All of this, I offer to you.

Dedication

To my family. To Josel.
Thank you for unconditional support.

To Prof Kurt Junshean Espinosa,
for inspiring me to push the boundaries.
Rest in peace.

To the wise men that came before us and to God.
For all these things require the help of God and fortune.

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ABSTRACT

As the industry of micro, small and medium enterprises (MSMEs) in the Philippines grew over the years and contributed much to the economy, opportunities and challenges to the last mile delivery came along with the demand. No business-to-customer (B2C) transactions are complete without product fulfillment. Last mile delivery is the last leg of moving goods from hubs to customers in the supply chain. Such services existed in the Philippines as third-party logistics (3PL) solutions. While MSMEs may simply tap into these 3PLs, this study has proposed and demonstrated that open-source solutions could integrate into their existing logistics and delivery teams.

The Nextway project has developed cost-effective and reliable solutions to aid small companies, drivers, and customers. Considering the economic aspect of MSMEs, a significant capital expense was found unnecessary for adopting their last mile delivery solution. Various literature has proven that a last mile delivery system is a considerable asset and investment a business in the scale of MSME could acquire. In particular, the pilot implementation of this study for the client has solved the challenges of digitization of data, receiving orders and tracking physical packages into warehouses, designation of delivery personnel, tracking of the loaded packages into the vehicle, and providing meaningful information to drivers. The Nextway backend has utilized the open-source Odoo community edition as a provider of the enterprise resource planning (ERP) aspect of the business.

The pilot implementation of the developed system also highlighted the importance of using Metodología para la selección de sistemas ERP (MSSE) or System Selection Methodology for careful system selection. In addition, the Enterprise System Experience Cycle was selected as the overall guiding methodology and adoption assessment. This study has contributed to the research and practical use of the provided system designs for both on-premises and cloud service provider deployments, whichever future potential adopters need. Along with those were suggestions for future work, such as a cloud-edge continuum approach to further provide reliable services to the drivers and customers in rural areas with limited network connectivity.

Chapter I

INTRODUCTION

A. Statement of the Problem

Micro, small, and medium scale enterprises (MSMEs) digital solutions on the last mile delivery aspect of the business must evolve for their operations to cope with their growth. The apparent growth of MSMEs in terms of the number of establishments — 12.94% in 2021 and the number of employment — 1.50% in 2021, reflects the need to further improve productivity with the aid of Enterprise Resource Planning (ERP) management solutions. Often these ERP solutions are costly, sparsely integrated, and proprietary.

These reasons leave MSMEs slim-to-none options for obtaining and maintaining their last mile delivery solution. The alternative is to outsource with third-party logistics (3PL). Not only is the business now dependent on 3PLs, but it cannot justify adapting the delivery to its existing fleet of vehicles and driver personnel. Also, the businesses cannot capitalize on current and potential customer relationships established through their sales strategies and the upselling capabilities of their supposed staff of drivers.

B. Background and Objectives of the Project

For socio-economic and private trade operations, the company's name remains anonymous. Specific to this study, the main beneficiary was a single driver whose influence convinced other drivers to use the mobile application as part of the pilot run. This company and the driver representative provided the study with an accurate

representation of DTI's categorization of an MSME. A small food-and-beverage manufacturer in Cebu offers products such as Nata de Coco, Orange, Grapes, and other flavored juice drinks. On the same day these products were manufactured, they were delivered directly to the customers — small sari-sari stores, convenience stores, and other distributors. While most of the customers were located in Cebu Metropolitan (Talisay City, Cebu City, Mandaue City), there were also patrons from far towns such as Naga City, Consolacion, and a few municipalities of southern Cebu reaching as far as the municipality of Pinamungajan. As a family-owned venture, the proprietor has 1-2 trucks of their own and has contracted additional 2-3 vehicles and drivers to complement the fleet.

Each truck was assigned separate areas on a single day. The total number of juice packs can reach 1650-3000 packs per truck based on the load capacity. As the products are season-dependent, these trucks may need to cut short on their routes and return to the warehouse early once the supply runs out. Replenishment of the stocks may take up to the next day, but that was only sufficient to supply the next batch of delivery that was already scheduled. So the customers scheduled today but couldn't be accommodated will have to be rescheduled for the same slot the following week.

The driver representative kept his log of the stocks dispatched for the day in a journal and recorded the number of customers served, the backorder requests, the difference in the number of packs demanded vs. delivered, and the new clients made during the trip. A copy of the journal has been added in the references section. There were major improvements to be made in the management. Still, it was on the logistics or the last-mile level that encountered the problem of meeting the demand with the supply. In addition to the lack of customer relations management, the gaps in

transparency and efficiency of sales invoicing and potential improvements to fleet management, vehicle servicing, and routes planning.

Given all these pain points, the project preferred the following as objectives:

1. Practical adoption of Odoo as an ERP system to the company's business processes. Specifically in digitizing orders, contacts, fleet and drivers data, and order tracking. Modules for customization are to be provided.
2. Establish system designs for a last-mile delivery for MSMEs
3. Implement a mobile application for the logistics team to use in the field, adhering to the system designs
4. Propose a system design that can further improve reliability on a cloud-edge continuum operations

C. Significance and Scope of the Project

While there exist tools that both large enterprises and third-party logistics companies use, this study directly contributes to micro, small, and medium-sized enterprises. In addition to the community of researchers and IT practitioners interested in addressing ERP adoption into logistics in the context of MSMEs.

The scope of the project is defined below.

1. Distinct system designs for on-premise, online, and cloud-edge systems for a last-mile delivery system in the context of MSMEs
2. Up and running Odoo environment for the administration and sales team, and customers getting the PDF of the invoice as well as view the status of the delivery

3. Mobile application tailored to the delivery team to aid in accepting job order assignments, dropping off packages, and logging collection of payments

D. Documentation of Existence and Seriousness of the Problem

The company currently lacks a centralized system for inventory, sales, order dispatch, and customer relations. Each member of the departments mentioned above has their way of managing and collecting data.

The dispatch process was practically non-existent. Packs of products were handed over to the drivers. They were left to manage the distribution of the stocks to the customer. There was no established way of determining whether the vehicle's supply was sufficient for the day’s trip. The primary driver representative, as previously described, kept a journal for manual sales and expense entries. Not every driver did the same, and the journals looked different from the next. The integrity of the reports was unreliable. Some vehicles returned empty, while some had a surplus of packs loaded, causing unnecessary backorders and inefficient product dispatch. As for sales, most packs did not match the desired juice flavors of the customers and often resorted to swapping what was available. So the production did not meet the demand. The cumbersome process resulted in a disarray of sales reports, unaccounted profit and expenses, and potential loss of customers.

This study has recognized the need for a centralized system to establish transparency and data integrity and to achieve parity in the supply chain, and the importance of the growing customer demand. A centralized data stream and information presentation would also benefit organizational stakeholders by aiding decision-making.

Chapter II

REVIEW OF EXISTING ALTERNATIVES

Since the client did not have a pre-existing solution, the study has systematically matched existing solutions to address the following quantifiable needs: digitization of data into a centralized system, managing inventory, adding products for dispatch, assigning orders to delivery teams, and improving outreach to customers. Below is the comparison table for some of the last mile delivery solutions considered.

	Tookan	Onro	Shipox	Onfleet	Lalamove	Transportify	Shippo	QuadX GoGo Xpress	Odoo
Functional									
Digitization of data	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Inventory	For drivers only	No	No	No	No	No	No	No	Yes
Product transfers	No	Yes	Yes	No	Yes	Yes	Yes	No	Yes
Driver assignments	Yes	Yes	Yes	Yes	Yes	Yes	No. Based on carrier partners.	Yes	Yes
Customer relations management (CRM)	No. Separate product.	Yes	Yes	Driver app only	Driver app. Business plan.	Yes	No	No	Yes
Technical									
Adaptability to the structure of the company	No	Yes	Yes	No	No	Yes. Business plan.	No	No	Yes
Database	Yes	Yes	Yes	Yes	No	No	No	No	Yes
User documentation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Technical documentation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Language, API, and programming tools for integration	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Security	PCI, HIPAA, state and federal security laws	Not publicly available	User is solely responsible for laws and regulations based on jurisdiction	Shares customer information with third-party service providers	Shares personal data with other users: drivers and third parties are under a confidentiality obligation. Do not sell data.	Does not disclose personal data to any third party with exceptions.	GDPR compliance. Data Processing Addendum. Law enforcement request. Shares information but not PII.	Mentions Data Privacy Act of 2012 (DPA). Not sharing data with other parties without the customer's prior consent.	No sharing of data between clients. PCI compliant. Secure by design (OWASP Top Vuln)
Backup	N/A	Request basis	N/A	N/A	N/A	N/A	N/A	N/A	Yes
Cloud deployment	SaaS	SaaS	SaaS	SaaS	SaaS	SaaS	SaaS	SaaS	SaaS / User Deployed
Local deployment	No	No	No	No	No	No	No	No	Yes
Web client	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mobile client	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Provider									
Maturity	Since 2011	Since 2019	N/A	Since 2015	Since 2013	Since 2016	Since 2013	Since 2019	Since 2005
Service									
User training	Tookan Academy & Blogs	Resources page	Yes	Yes	Yes	Yes	Yes	Yes	Yes

License	Proprietary, Whitelabel	Proprietary, Whitelabel	Proprietary	Proprietary	Proprietary	Proprietary	Proprietary	Proprietary	Community Edition (LGPLv3) / Odoo Enterprise
Customer support	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Odoo Community and Odoo Enterprise
Updates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic									
Capital cost	Subscription-based	Subscription-based	Pay as you go. No pricing table.	Subscription-based.	Service charge for personal. Business plan.	Business plan.	Subscription-based	Service charge	CE (deployment dependent) / Enterprise subscription-based
Operational cost	None. SaaS.	None. SaaS.	None. SaaS.	None. SaaS.	Business plan.	Business plan.	Premier plan.	None. SaaS.	CE (deployment dependent) / Enterprise subscription-based

Table 1. Comparison of Last Mile Delivery Solutions

The data was gathered through each respective website, privacy policy page, terms and conditions, and live chat to sales. These criteria were adapted from the study “A comparative analysis of the ERP tools, Odoo and Openbravo, for business management” (Gómez-Llanez, Diaz-Leal, & Angarita-Sanguino, 2020). This study used the same methodology Metodología para la selección de sistemas ERP (MSSE) or System Selection Methodology for the careful selection of ERP systems with an emphasis on the business need of a last mile delivery.

From these resources, Odoo provided the most flexibility in terms of functional, technical, provider, service, and economic aspects. This project, Nextway, has taken advantage of this by using Odoo as the main backend solution, in which features and custom modules can be built on top of the ERP solution to suit the client’s needs. This project includes the Nextway API, which exposed only related services, and the Nextway Delivery mobile application, which consumes the API.

Chapter III

PROJECT DETAILS

A. Overview

An ERP system is unique in that different modules represent a component of a business — accounting, sales, and customer relations, among other things. Thus it is important to define a scope in which the last-mile delivery system is directly affected. At its core, Odoo already offers what the last-mile delivery system needs. The inventory, sales, and contacts.

As described in the previous sections, “Review of Existing Alternatives” and “Theoretical Framework,” this project focused on the research and development of system designs that scale based on deployment, the custom modules required specific for the client (auto-dispatch), the mobile application for the delivery, and the API that glues all these together.

The system has three main actors — the system or admin user that belongs to the sales or administration department, the customers, and the delivery drivers. To better understand the problem and establish the design scope, please refer to the following as the process flowchart.

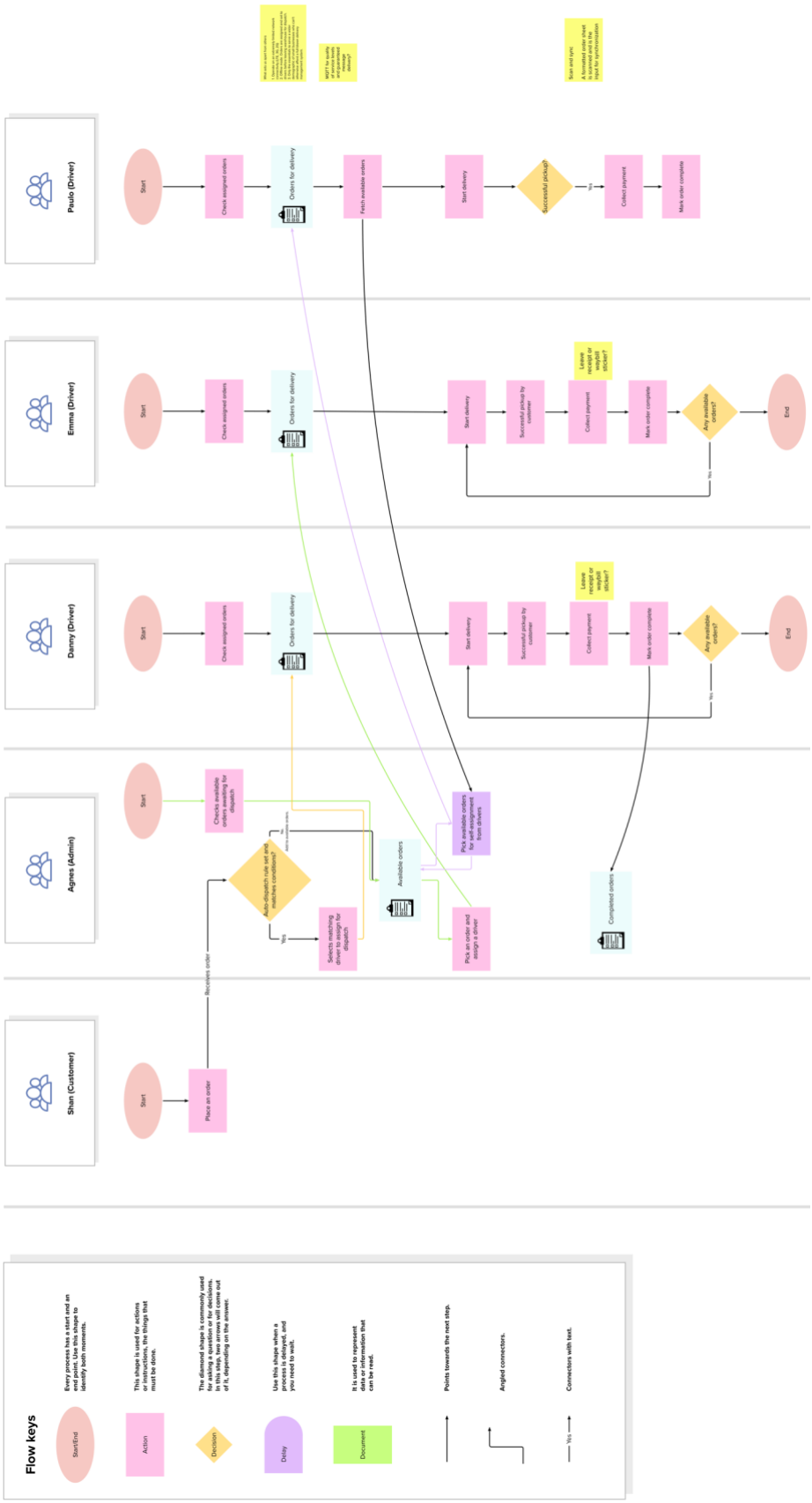


Figure 1. Process flow chart of the last-mile delivery system

B. Theoretical Framework

Developing a last mile delivery solution with integration to Odoo in mind presented many challenges. The study entitled *"Challenges of Cloud-ERP Adoptions in SMEs"* (Haddara, Gøthesen, & Langseth, 2022) has reviewed cloud-ERP adoptions and implementations in SMEs and classified four phases as well as the major impediments brought out by similar literature. This project considered their findings closely and adopted the Enterprise System Experience Cycle.

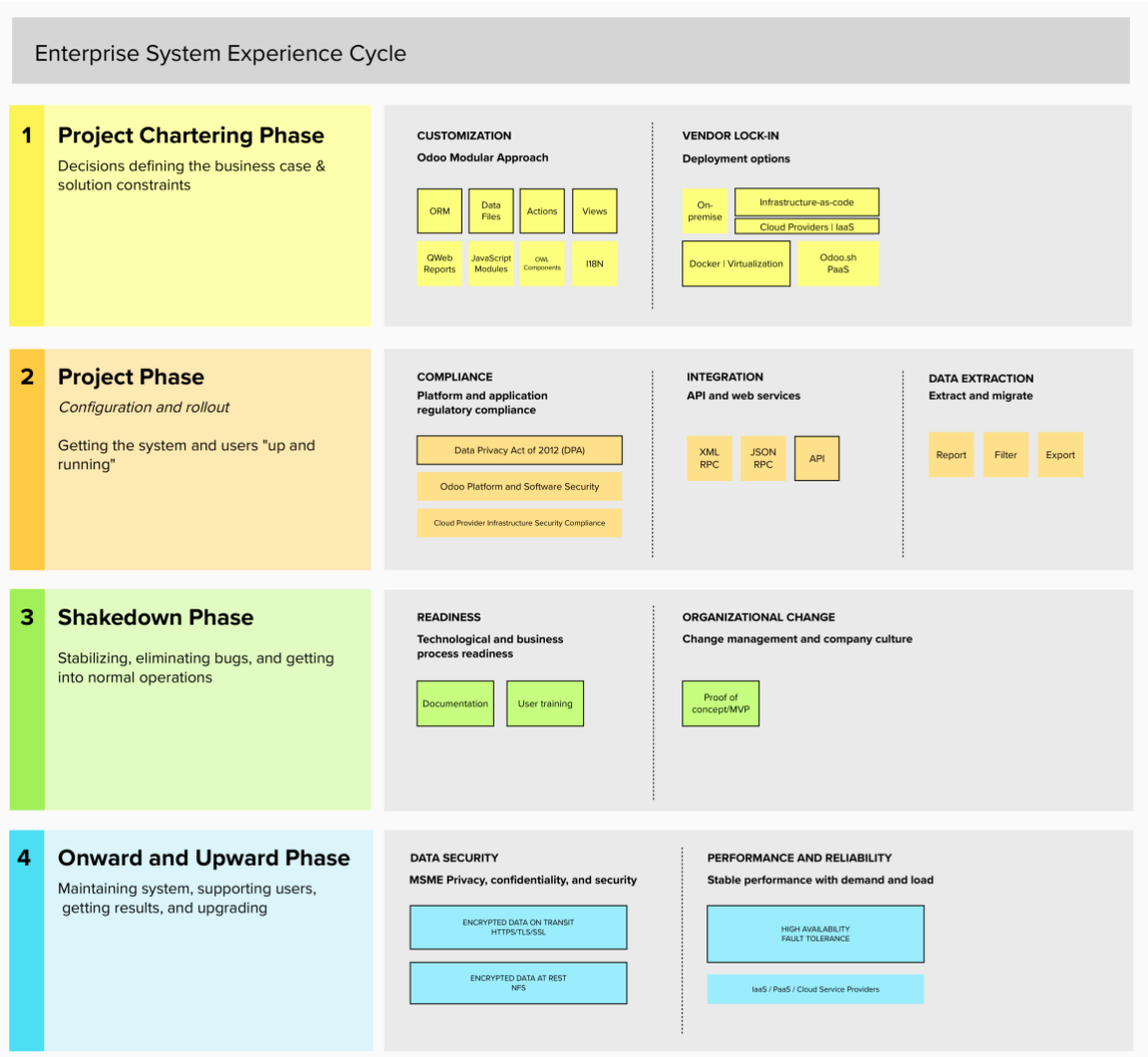


Figure 2. Theoretical Framework. Enterprise System Experience Cycle.

The Enterprise System Experience Cycle was adopted as the theoretical framework to cover and go beyond the client's needs. This framework served as a guide to realize the scope or areas that were already considered barriers. This study explored the opportunities based on past literature and research on ERP adoption in large enterprises (LEs) and small and medium-sized enterprises (SMEs). In particular, this study covered the scope of micro-sized enterprises as the main clientele.

In the figure above, each one of the phases, Project Chartering Phase, Project Phase, Shakedown Phase, and Onward and Upward Phase, enumerated major barriers — the ones in all-capitalized letters. The proposed conceptual solution is also listed below them. Finally, actionable solutions were also enumerated as components of the whole proposal, emphasized by the solid borders as directly integral to the actual implementation.

***Project Chartering Phase*.** Customization and vendor lock-in was the main challenge areas. The modular approach of Odoo served very well in developing ERP solutions. A module can be as simple as sole data essential for business operations. Data can be in CSV or XML form. Module integration as a first-class citizen for data representation in ORM supported inheritance to base models, composition through method overrides, and the powerful dynamic templating of XML and Odoo's OWL frontend framework. Extending a Kanban, tree, or form view was possible and did not impose constraints on custom views, reports, and widgets. These modules can then be packaged and distributed. The Odoo Community Organisation (OCA) developed modules and maintained an app store for the community and individual contributors. There were also a lot of free and paid modules in the Odoo app store from the community and third-party organizations.

Odoo's domain separation of the runtime environment, file store, and database made it possible for deployment on either bare metal, Docker, or virtual machines, infrastructure as a service (IaaS) offerings of cloud providers, and the platform as a service (PaaS) Odoo.sh managed by Odoo SA. These options have offered great flexibility in terms of the technical and economic aspects of the organization.

Project Phase. Compliance was a major challenge of adoption because all business is subject to law and regulation. This impediment emphasized the importance of the project to acknowledge and proactively advocate for user rights and privacy and protect the business reputation simultaneously. Nextway has adhered to and followed best practices and industry standards.

Integration was a major advantage of Odoo, and it has support for XML RPC and JSON RPC. Nextway took it a step further and implemented a REST API using FastAPI that enabled client integration without others getting bogged down in Odoo's implementation details.

Data extraction was an important functional aspect as the client already has a few sparsely structured data. Odoo made it easy to bulk import data, generate reports, apply filters, and export data.

Shakedown Phase. Technological and business process readiness and organizational change were perhaps the most challenging impediments to tackle. These areas involved not only processes but also people. Nextway influenced these areas by the provided user and technical guides and ultimately showcased the proof of concept to better nudge the organization into adopting ERP into their last mile operations.

Onward and Upward Phase. For MSMEs, privacy, confidentiality, and security (data security) were critical aspects of the business—the proposed system aimed to be secure by design. The system capitalized on the architecture solutions for high availability and fault tolerance, which gained stability on an appropriate workload.

C. Technologies Used

Component	Technology
User Interface	Flutter
Programming Languages/Frameworks	Python, Bash, Dart, FastAPI, Flutter
DevOps	Terraform, Cloudwatch
Services	AWS ECS, AWS Fargate, AWS EFS, AWS ALB
Middleware	REST, JWT, Odoo CE (ERP), Docker
DB	PostgreSQL, AWS RDS
Hardware/Network	Cloudflare, AWS VPC and Security Groups, Client Devices (Android)

Table 2. Technology stack

The technology stack was carefully chosen to balance the industry's best practices and minimum barriers to entry. At the core, the system's composition consists of computing, storage, database, networking, and security resources. These tools adhered to some or a combination of the resources in one way or another. Thus, each one can easily be swapped out into their respective alternatives.

D. System Design

In this section, the designs will be discussed:

- System features
- Data models
- System design

a. System Features

Nextway provided a straightforward API design for a last mile delivery system. This design served as the core of the system features that were implemented. RESTful conventions were used to describe the API endpoints listed below.

Order related APIs

API	Detail
POST /orders/{order_id}/accept	Accept order job. Only for unassigned orders.
POST /orders/{order_id}/drop-off	Drop off the job. Driver arrives at the delivery address, drop-off packages, collects payment, and marks the order as complete.
POST /orders/{order_id}/cancel-job	Unassign the job. Only possible for orders assigned to the requestor.
GET /orders/	List orders.

Table 3. Order related APIs

Statistics related APIs

API	Detail
GET /users/stats/	Get user statistics.

Table 4. Statistics related APIs

User related APIs

API	Detail
POST /token/	Login for an access token.
GET /users/me/	Get user profile details.

Table 5. User related APIs

For the custom ERP module auto-dispatch, the basic feature implemented primarily included the ability to add rules to match the driver location with the order delivery address.

b. Database Design

To understand the data models, the data access patterns were defined. The following queries were supported.

Query 1: View detailed information about a job order.

Query 2: Find available job orders.

Query 3: Accept a job order.

Query 4: Drop off and collect the payment for a job order.

Query 5: Cancel a job order.

Query 6: Get detailed user information.

Query 7: Get detailed usage statistics.

Query 8: Auto-assign drivers based on pre-defined dispatch rules.

From these queries, the study extracted the models from inventory, sales, and contacts and then made the models for dispatch rules to be developed on the Nextway custom module for dispatch.

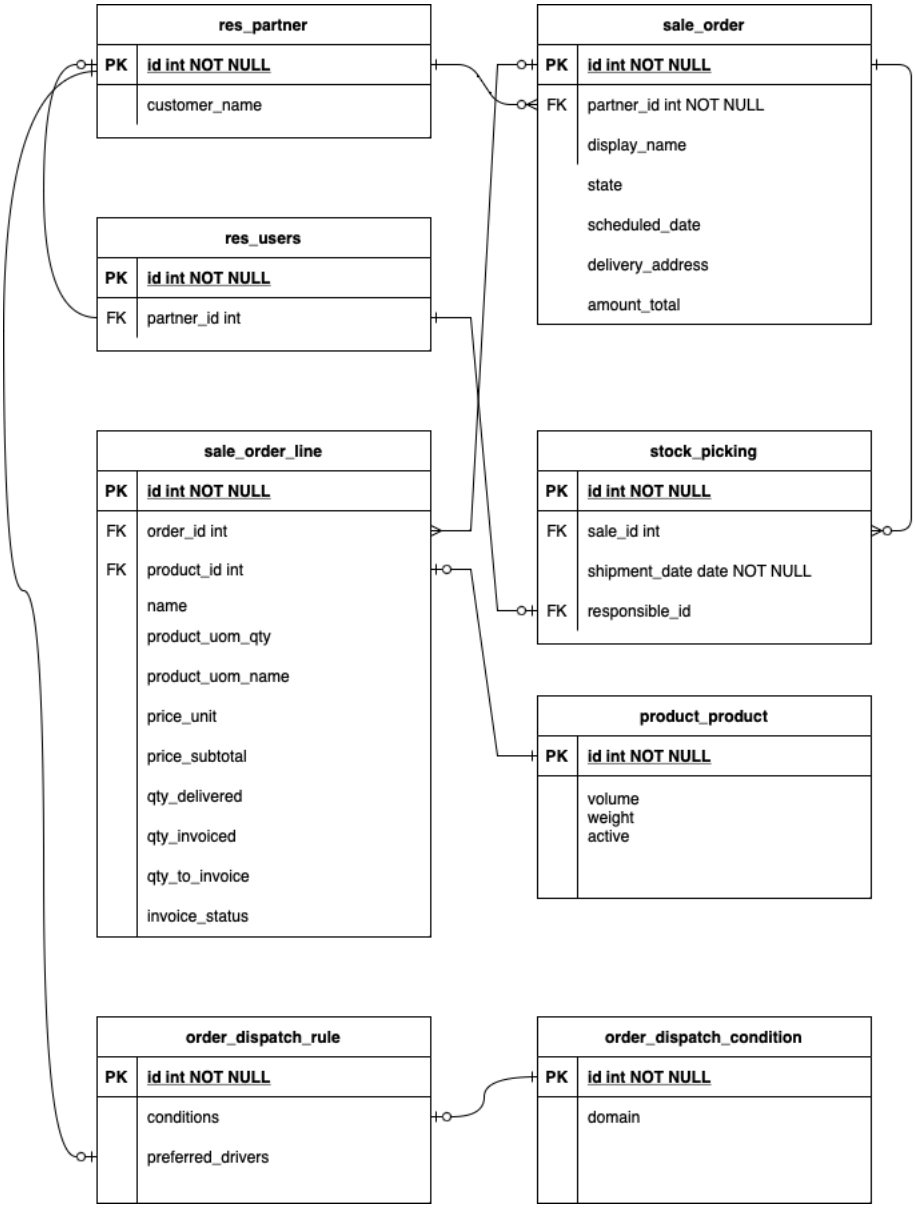


Figure 3. Database schema

c. System Design

This study has proposed two system designs representing the scale adopters plan to use for deployment. The system has applied the online system design. The other one is the on-premises system design. Both system designs are described below.

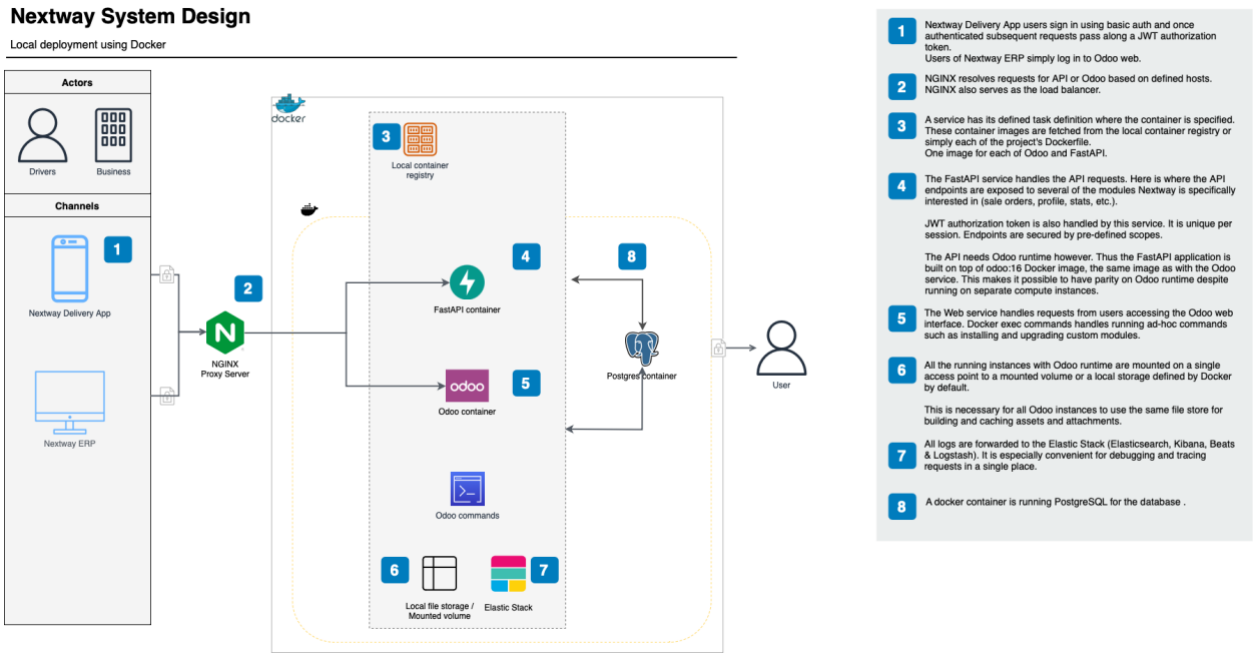


Figure 4. System design for local deployment using Docker

A simplistic take on the local deployment can be seen above. Rather than building each software component from the source, running the containers on Docker took away much of the overhead. Container deployment enabled the isolation of the lightweight containers that ran on a shared operating system. This setup also has an advantage in scaling, which can be taken up a notch with Kubernetes container orchestration.

This system design only works if the client is within the same network as the server. This server could be a single PC which, in the economic aspect, requires

capital expense. This setup differs from the previously described process flow because data synchronization happens only on-site.

1. Management assigns orders to the drivers
2. Drivers fetch job orders while on the warehouse network
3. Drivers go on with their routes. Using the application in offline mode.
4. Once they are back, orders can then be completed from the application

This workflow is less than ideal, but it does serve its purpose, especially for intermittent networks in the dispatched areas like in remote, far-flung mountain barangays. In later chapters, this system's improvement was discussed so that data is closer to the clients (edge networks).

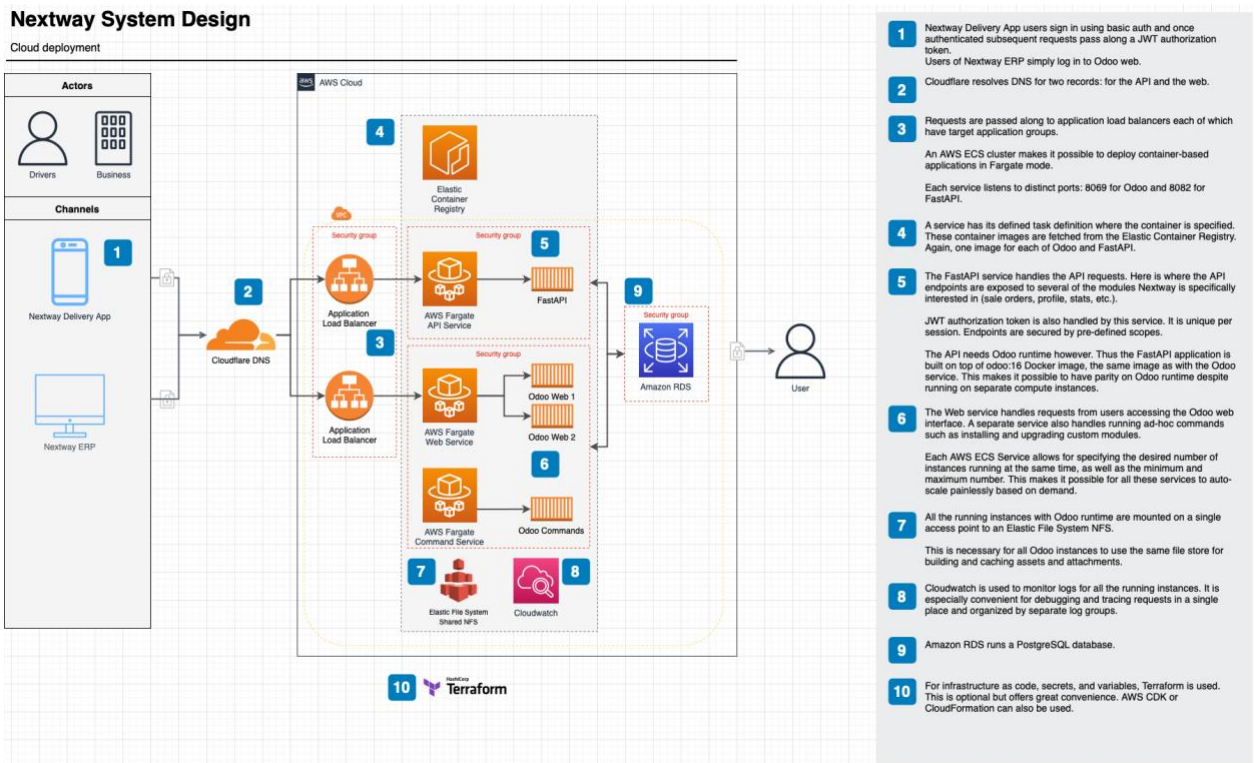


Figure 5. System design using AWS as a cloud provider

The system design above described how Nextway could be deployed on a cloud service provider such as AWS. It is important to note that this is just one example and that the deployment can be carried out on other cloud service providers such as Azure and Google Cloud Platform. For the economic aspect, the organization did have to put up capital expenses and only pay for the operational expenditure for the resources used. The cost of the operations can be provided by using pricing calculators or the budget and billing reports once the system is up and running.

The advantage of this deployment is that it could be theoretically accessed wherever there is at least a 4G connection on mobile data or an internet connection. This feature enabled real-time synchronization across all the clients connected to the system.

One unique property of a cloud deployment is elasticity. CPU, memory, and storage resources can be increased to adapt to a high workload. Similarly, when the system requires fewer resources can also be decreased to match that of a low workload. Elasticity is a convenience only cloud deployment can offer. It would take extra resources, budget, and a long time to acquire to simulate the same behavior on a local deployment.

This study has provided the context of the scope, high-level design, and system designs adapted in the economic sense and scalability.

E. Implementation

Scrum was selected for this project as the main product development methodology. A more flexible form of the Agile framework. It is a methodology fit to the composition of the project with the researcher as a sole individual contributor. This methodology could also be applied to teams with more members. Within the Scrum, multiple sprints took place. A sprint is when planning, implementation, review, and retrospectives are done before starting another sprint. The feedback loop mechanism allowed the project to stay on track with the user's needs without spending too much time on unnecessary features. The appendix section provided a Gantt Chart that was followed.

a. Design studies

For the minimum viable product, the client demanded and signed off only for the basic features to be included in the ERP and mobile app. The initial feature set request had a listing, assigned job orders, and customer contact details. The following is a low-fidelity design wireframe of the proposed mobile app.

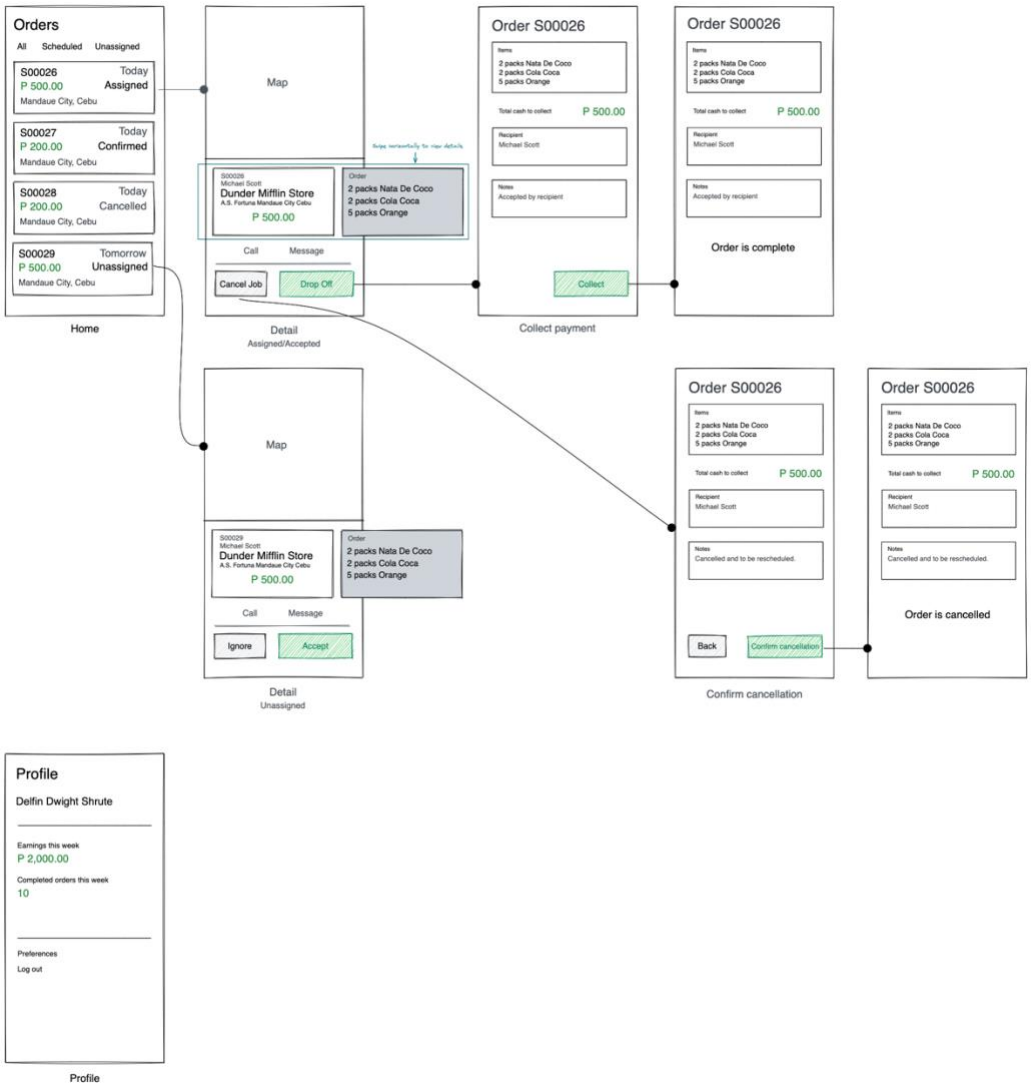


Figure 6. Low-fidelity design wireframe of the Nextway delivery app

The feature to auto-assign drivers based on dispatch rules also needs to have a placement in the ERP UI should the user choose to invoke the assignment ad-hoc.

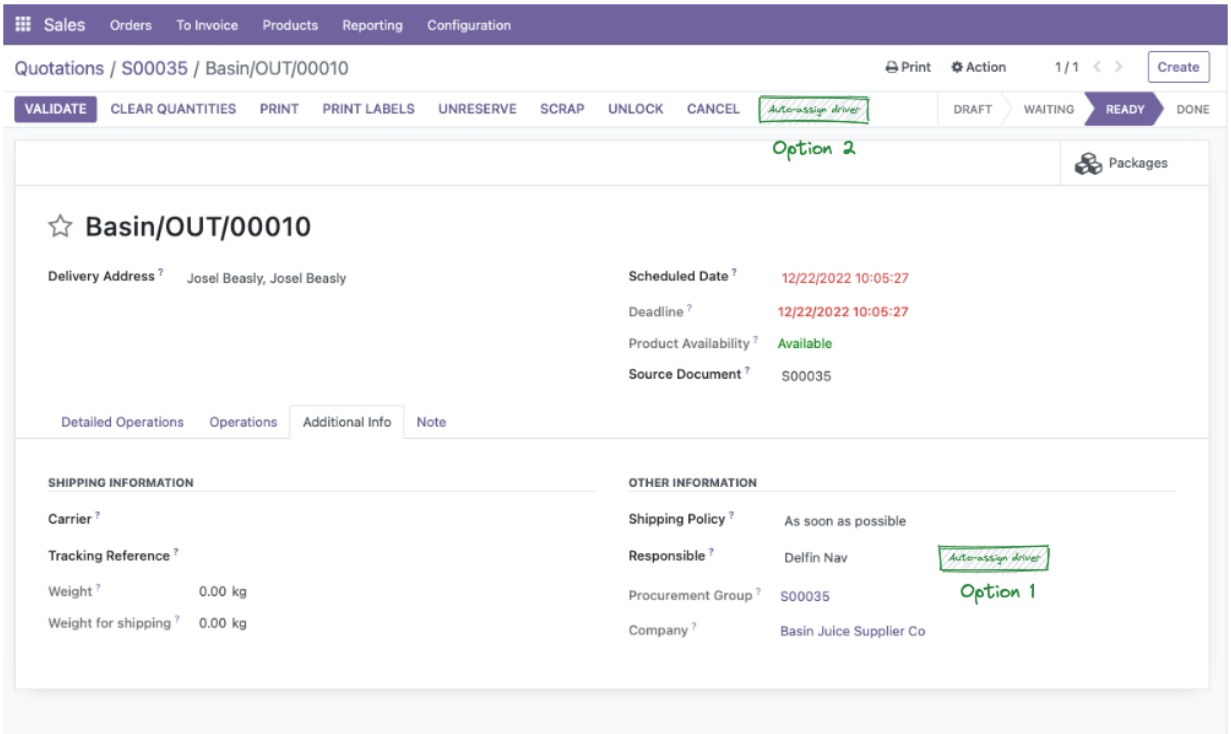


Figure 7. Auto-assign driver button on the delivery detail page

Two options were considered here. Either put the call-to-action button beside the “Responsible” (the driver field) or the header section along with the other action buttons. One advantage of the header placement is that the salesperson doesn’t have to drill down on the “Additional Info” tab. In the later section of the production of prototypes, the user interface for adding the dispatch rules will be discussed.

b. Review of existing systems

The main clientele of this study, a delivery driver, has established a system for organizing his daily work. Below is a simplified workflow gathered from personal correspondence.

1. Split the days of the week by customer areas of proximity. For simplicity, assume it’s a Monday, and the delivery reaches Toledo City, Cebu City, and Talisay City, mostly mountain barangays.
2. **Verification of orders.** In the morning, the driver calls the customers to verify orders. This step is necessary so he would know the load of the cargo.
3. **Receiving.** Then the driver goes to the warehouse. Checks the stocks, and the rest of the delivery personnel load the orders enough for today. Probably include extra from backorders or as initial sales made on the way for potential new customers.
4. **Dispatching.** It is pre-defined already which trucks go on which route. However, changes may happen depending on the demand and the year's season.
5. **Drop-off and collection.** Once the drivers reach the customers’ store, the orders are dropped-off and verified by the customer only by checking the actual stocks physically. Once everything checks out, the payment is collected. The driver continues with his trip to the next customer on the route.
6. **Reporting.** Everything gets logged into a physical notebook owned and managed by the driver—the customer contacts, store location, quantity of orders, total payment amount, and expenses. The collected payment is then handed over to the business owner.

The appendix included a photo of the single journal entry for the day made by the driver.

The following are the main issues of the current business process:

1. **Manufacturing cannot keep up with the demand.** With reports only made available at the end of the day, the information on which products are in high demand for the season and therefore need more production effort takes a lot of guesswork.
2. **Inaccurate reports.** Often orders are mixed with products that the customer does not request just to keep up with the number of packs ordered. This problem causes confusion and inaccurate reports and sale orders.
3. **No standard operating procedure.** As each driver is considered autonomous, each driver has their way of record keeping. This flaw causes a mismatch in received, dispatched, and dropped-off products. This further causes manufacturing to delay products in high demand and overproduce products in less need.

   Not to mention the human aspect of dishonesty, where expenses can be bloated and result in loss of profits reported.
4. **Lack of transparency.** Major areas in the business lack transparency — fleet management and servicing, orders, sales, and manufacturing. Vehicles that need to be serviced causes interruptions to the deliveries. This scenario is inevitable for any physical asset. The ability to predict which vehicles require servicing, how much the repairs will cost, how long repairs will take when a substitution is needed, or when a reschedule is necessary for the orders that customers need to be notified ahead of time. Are orders at par with the sales made? Is manufacturing aligned with the season's demand, or is stuck in catching up on backorders?

These factors matter most in decision-making. Without data transparency to base decisions, improving business operations is futile.

c. Literature review

The case study published by Tridip Thrizu, a Senior Product Designer at Grab, entitled “Designing a food delivery app for motorbike drivers – a UX case study” on September 2, 2018, has been influential in formulating the process workflow in developing Nextway Driver App. It outlined a scenario challenge of Grab food delivery service in the Philippines and designed a driver app for motorbike drivers.

Thrizu started to outline the process, starting with understanding the task, defining the audience, and understanding the context from the user’s perspective. He then formulated a storyboard, identifying problems from the storyboard’s UI/UX. From all these, he then applied the exploration and exploitation technique, which simply means to explore or exploit information and acknowledge tradeoffs to address seemingly unknown situations.

The information is organized then by an information architecture diagram. Thrizu explains that the information architecture enables him to have *“*(Thrizu, 2019) (Thrizu, 2019) (Thrizu, 2019)*”* (Thrizu, 2019).

With all this preparatory work, Thrizu made wireframes and the prototype of the lightweight app.

d. Production of prototypes

To get a sense of end-to-end navigation and the overall UI/UX, a low-fidelity design prototype was designed in FlutterFlow. Following the same philosophy described in the previous section.

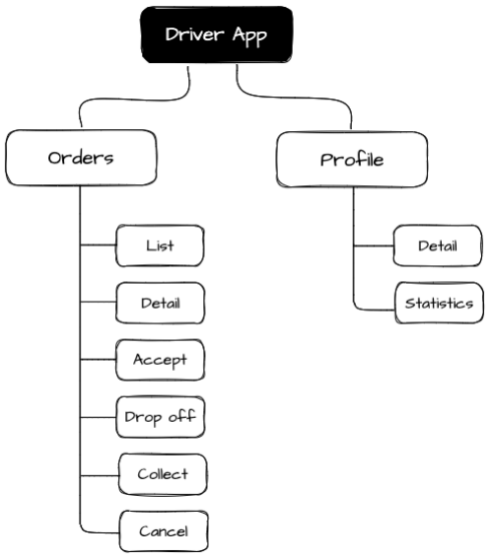


Figure 8. The information architecture of the Nextway App

Below are some of the screens made during the prototype phase.

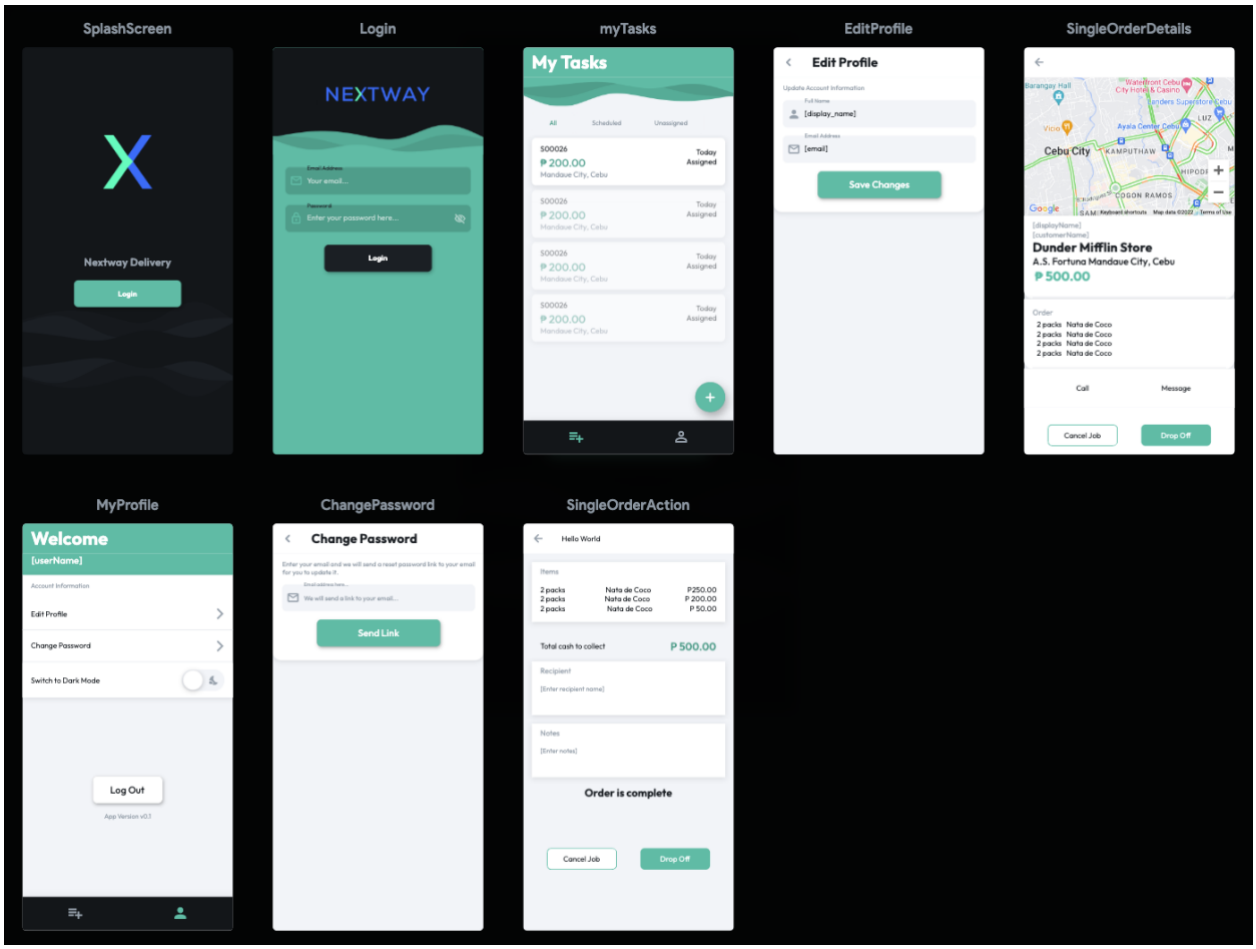


Figure 9. Nextway Driver App initial UI Prototype

For the ERP, the following shows the implemented flow and setup of the dispatch rules.

First is the listing of dispatch rules. This can be viewed under Configuration > Dispatch Rules for both Sales and Inventory modules.

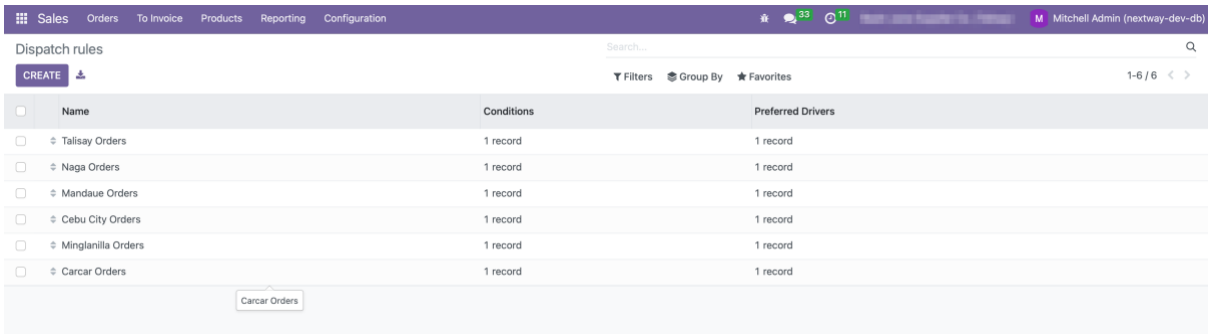


Figure 10. List of dispatch rules

Then the details of a dispatch rule. Here, a system user sets the conditions and preferred drivers.

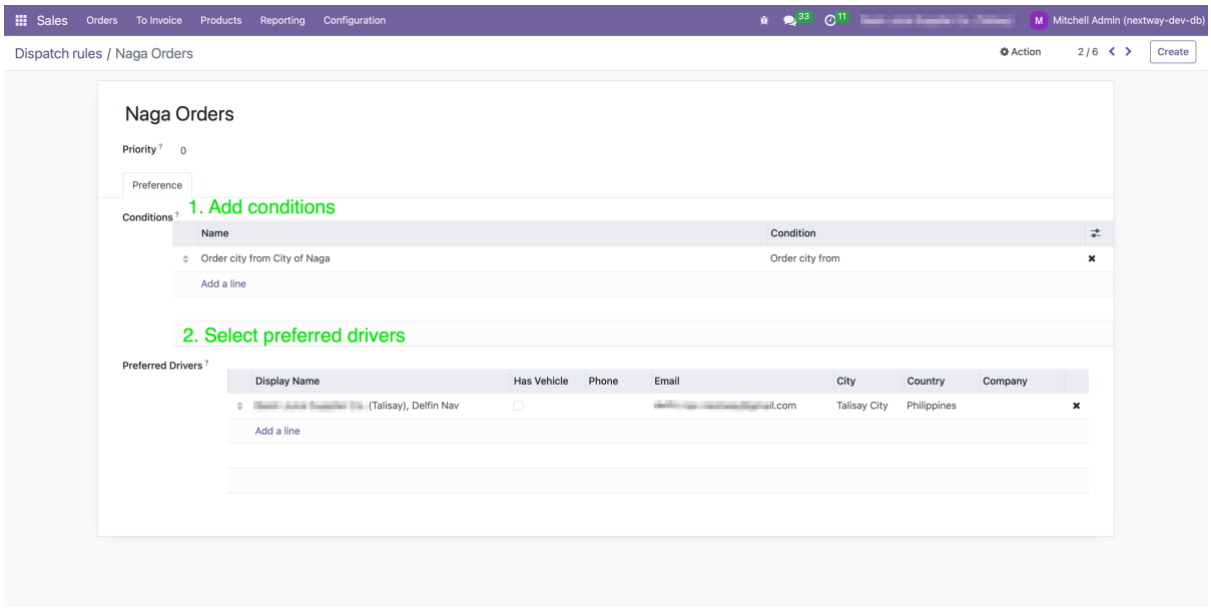


Figure 11. Dispatch rule detail view

The conditions section is where the user may select the applicable conditions. They can be added as a single condition or multiple conditions. The conditions are then applied with the **SET UNION** logic, which means any condition that returns true based on a “premise” would signal a match.

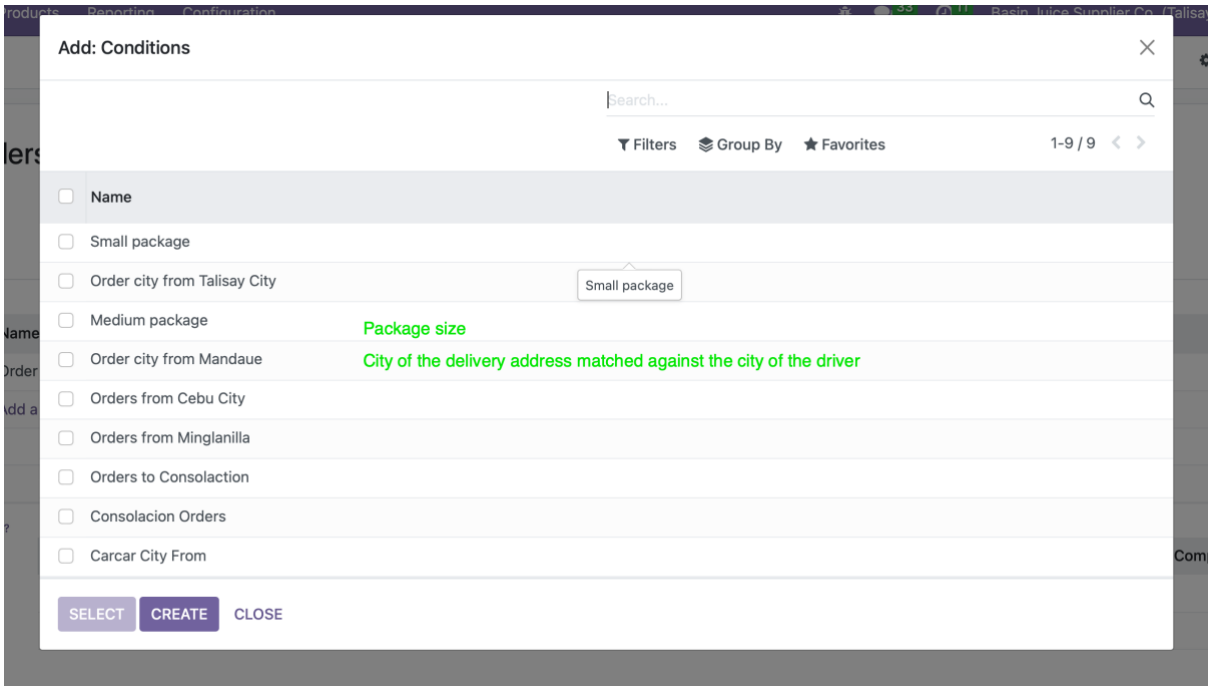


Figure 12. Selection of conditions

A simple “If this, then that” example would be — once an order is made, if there are orders to be delivered to Talisay City, then pick from the preferred drivers.

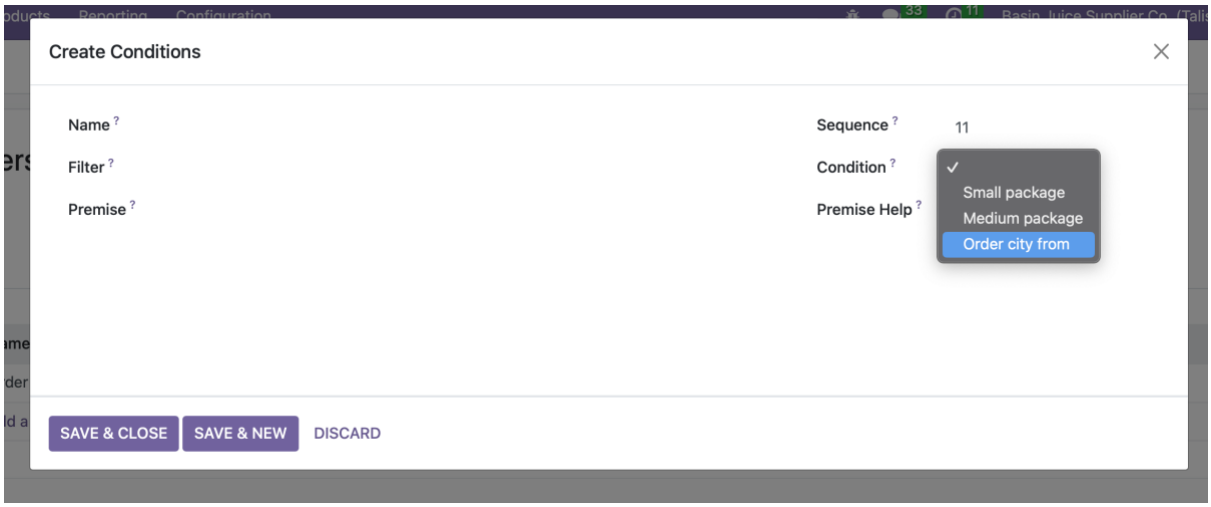


Figure 13. Creating a condition

Limitations to the current implementation

Currently, the system applies random selection when multiple drivers are added to the preferred list. For enhancements, the system has considered weight-based heuristics as a flexible option.

Also, the system only implemented two base conditions: matching based on the delivery address and package sizes. Later implementations may include more conditions at the client's request.

These limitations were added to the project roadmap, where actionable feature requests were queued for prioritization. The appendix section contained the link to the project documentation.

e. Tryouts of prototypes with users

The initial draft of the UI prototype was shared with the client. What the prototype lacked and unnecessary features for the MVP have been immediately clear.

Turn-by-turn navigation. This feature request from the client stemmed from the fact that even though the Google Maps static marker view provides context for the customer's location, turn-by-turn navigation would also provide information such as current traffic situation and roadblocks ahead. One technical challenge the researcher has found is the additional dependency. Google Maps as a dependency was chosen for the economic aspect as it serves map data for free.
The researcher added Waze as the navigation provider. This way, a web view can be used with basic navigation features, including the roadblocks reported in real time by Waze users. This way, even clients with no Waze app can still use the navigation features.

Statistics. There should be a way to easily see the total number of job orders assigned to the user within a set period. This statistic could be weekly or monthly. The client also requested the number of orders completed, and the profit gained based on the same statistic. This feature was initially implemented in Nextway API, then in the Nextway mobile application.

Customer contacts. The client's existing workflow involves contacting customers ahead of time to confirm orders. A such workflow was integrated into the app. The researcher added deep-linking to SMS and Phone apps as supported by Android while also advocating the customer’s private data by showing the privacy policy implemented and followed by Nextway in the app.

Re-prioritization. From the client’s feedback, personalization is important but not urgent. Credential administration and personalization can be done in the ERP and thus can be considered not a priority.

Prototypes were developed rapidly. For the Flutter application, UI changes were made in FlutterFlow, and the backend was directly developed using Android Studio and Visual Studio Code. A rolling-release model was adopted for the API component and custom Odoo modules. A rolling release meant that developments were rolled out immediately after tests were performed successfully.

The implemented MVP for the mobile application included the following screens.

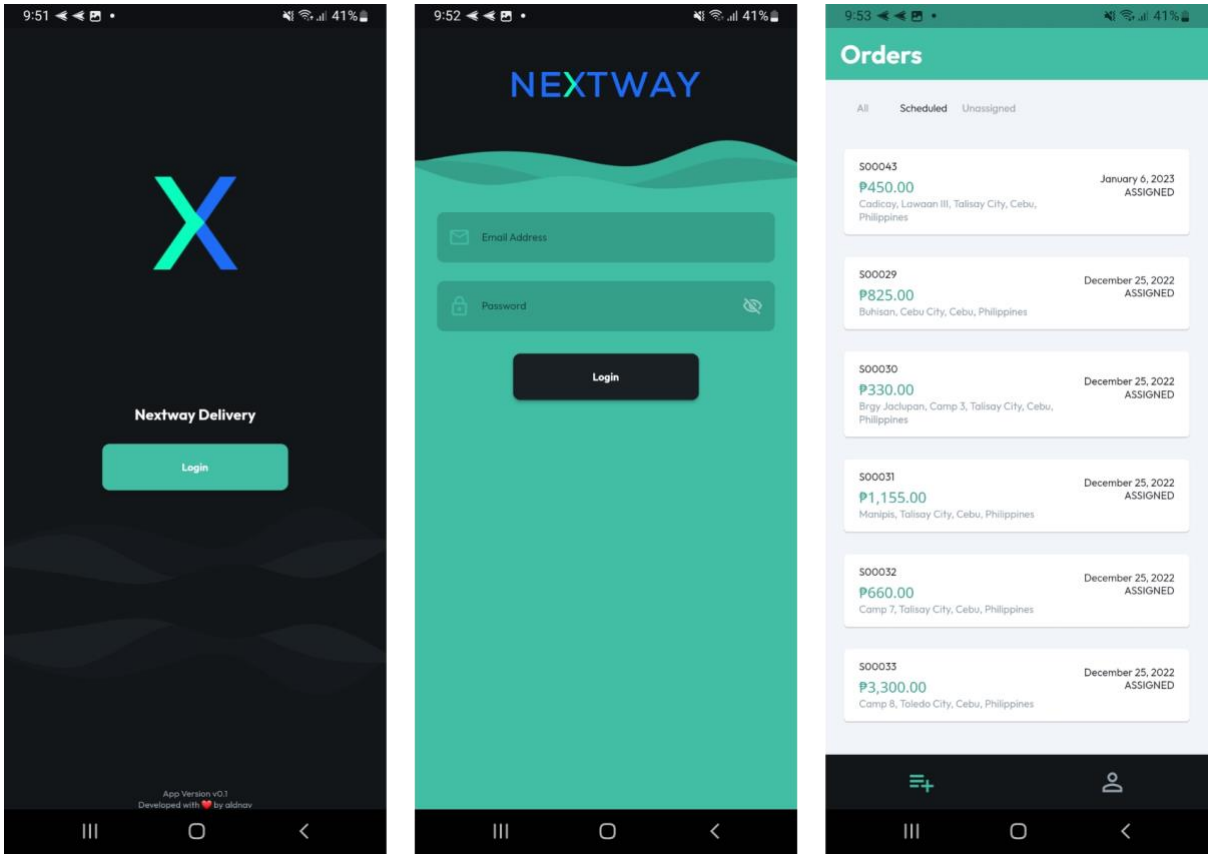


Figure 14. Login and home screen

Once logged in, the driver will be shown scheduled job orders. The unassigned tab and all job orders tab are also shown.

The driver can simply tap on one item to see the order details. Here, the customer details, the order lines, the menu options for Waze directions, and contacting the customer were also displayed. The instructions to complete the delivery are described next.

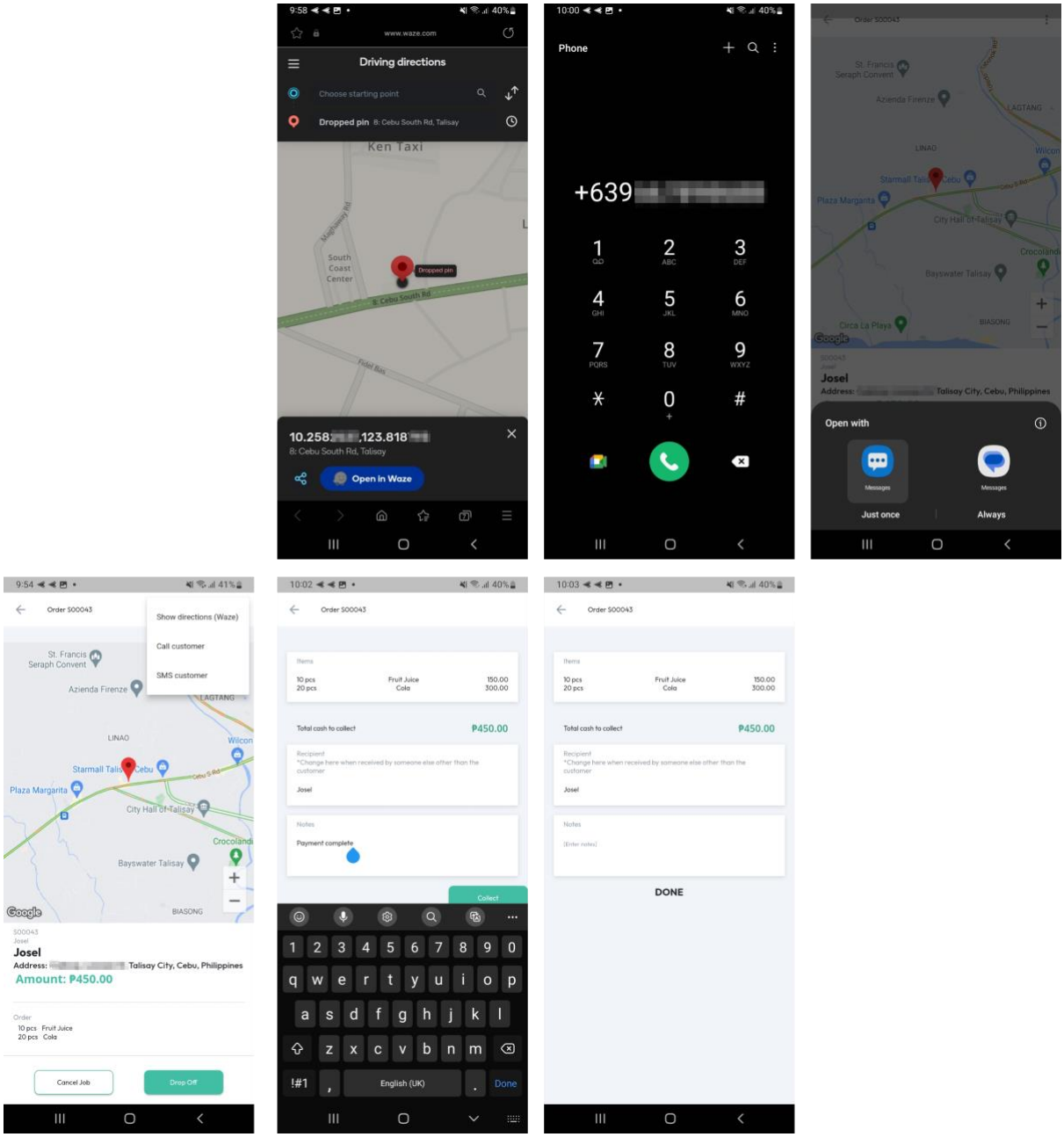


Figure 15. Drop off, collection, Waze integration, and customer contact

The driver taps on “Drop off” once he arrives at the delivery address. He reviews the orders, collects the payment, and fills in the recipient (pre-filled with the customer’s name by default) and additional notes before finally tapping the “Collect” button.

The app sends a request using the Nextway API to mark the delivery as done. After a few moments, the app receives a response confirming that the action was successful. Finally, the screen in the app updates indicating “DONE” to the order.

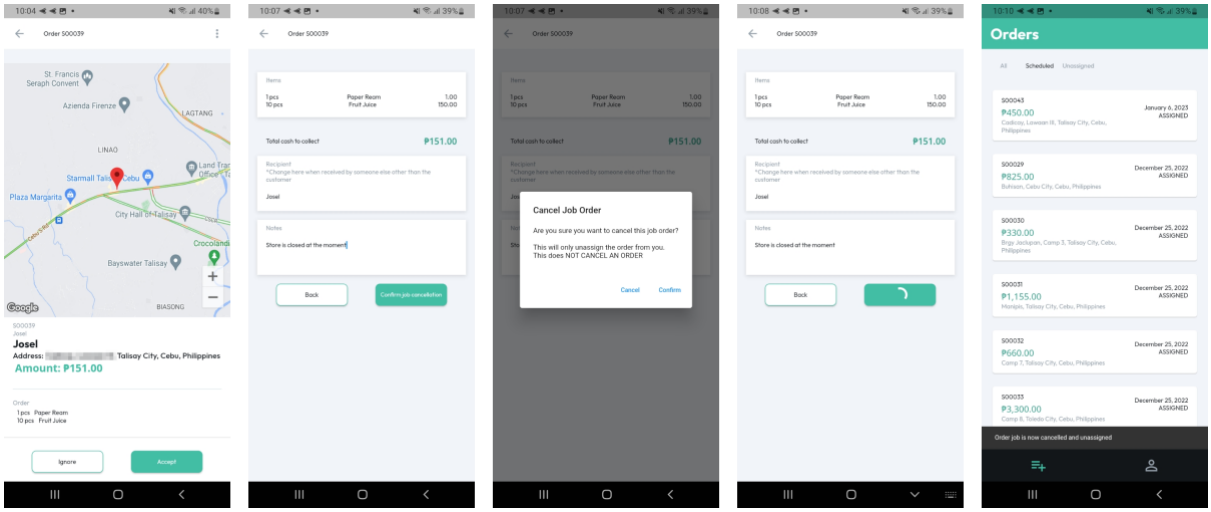


Figure 16. Cancelling a job order

To cancel a job order, the driver can simply tap on the item, tap the cancel job order button, fill in some notes, and confirm the cancellation. The confirmation from the alert dialog is an important step to ensure that the driver understands the action. Once a job order is canceled, it is listed in the unassigned tab.

Unassigned job orders are orders that any driver can self-assign by simply tapping on the “Accept” button.

The next figure shows the profile screen. In this screen, user details were displayed along with the statistics of the job orders related to the driver.

For enhanced accessibility, a “Switch to Dark Mode” button was implemented. Using this, the driver can switch to light or dark mode, and the theme changes accordingly.

The driver can also log out from the profile screen.

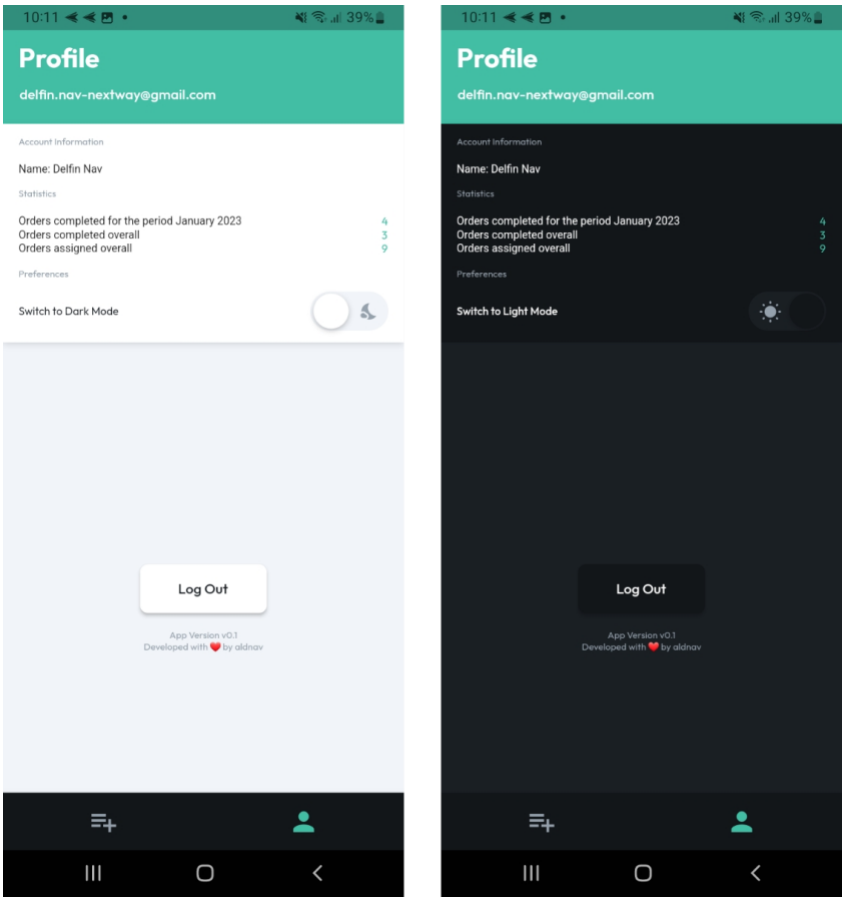


Figure 17. Profile screen

All of the development work, as well as the revisions, can be tracked on the project's GitHub organization (link in the appendices chapter).

The project's main deliverables are the mobile application, API, and modules.

The mobile application has been published in a closed-testing release at the Google Play Store.

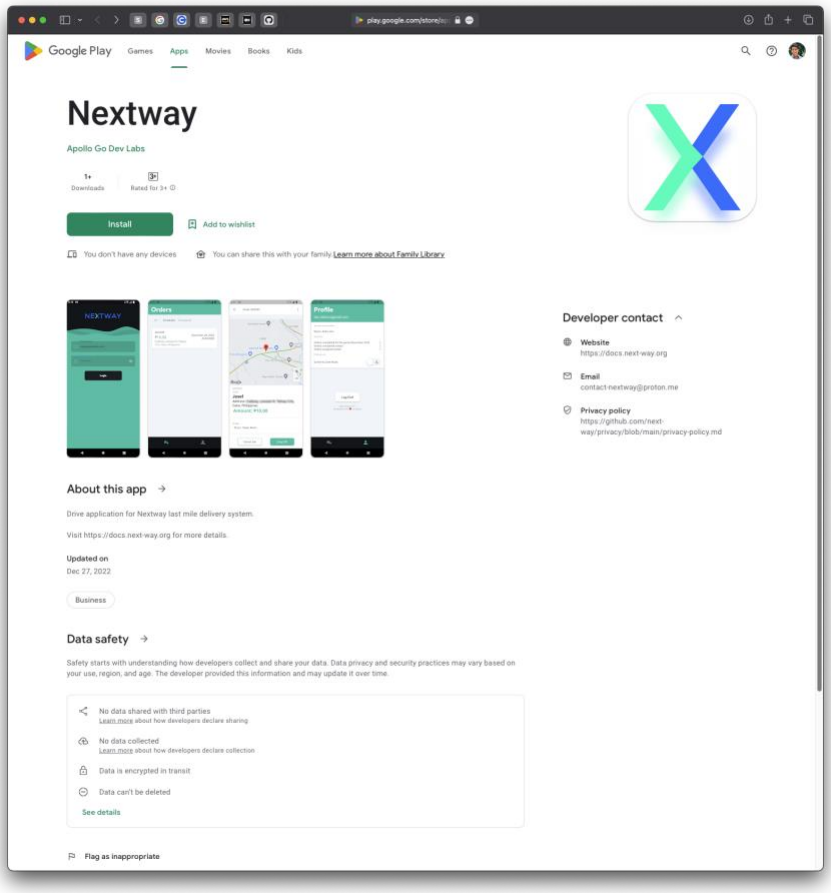


Figure 18. Nextway mobile app on Google Play Store

A staging environment for the API is up at https://api-stage42.next-way.org/docs.

And the staging environment for the ERP is up at https://stage42.next-way.org

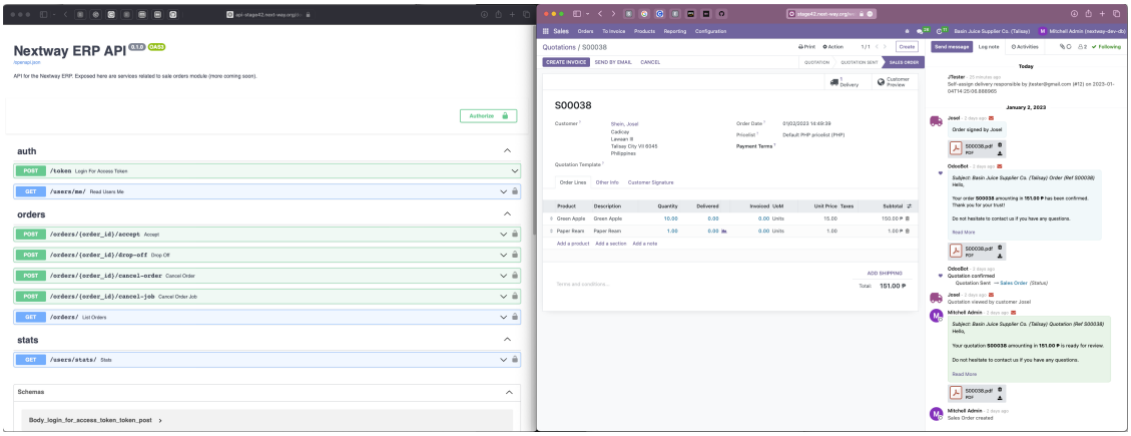


Figure 19. Nextway ERP API and Odoo ERP showing sales order

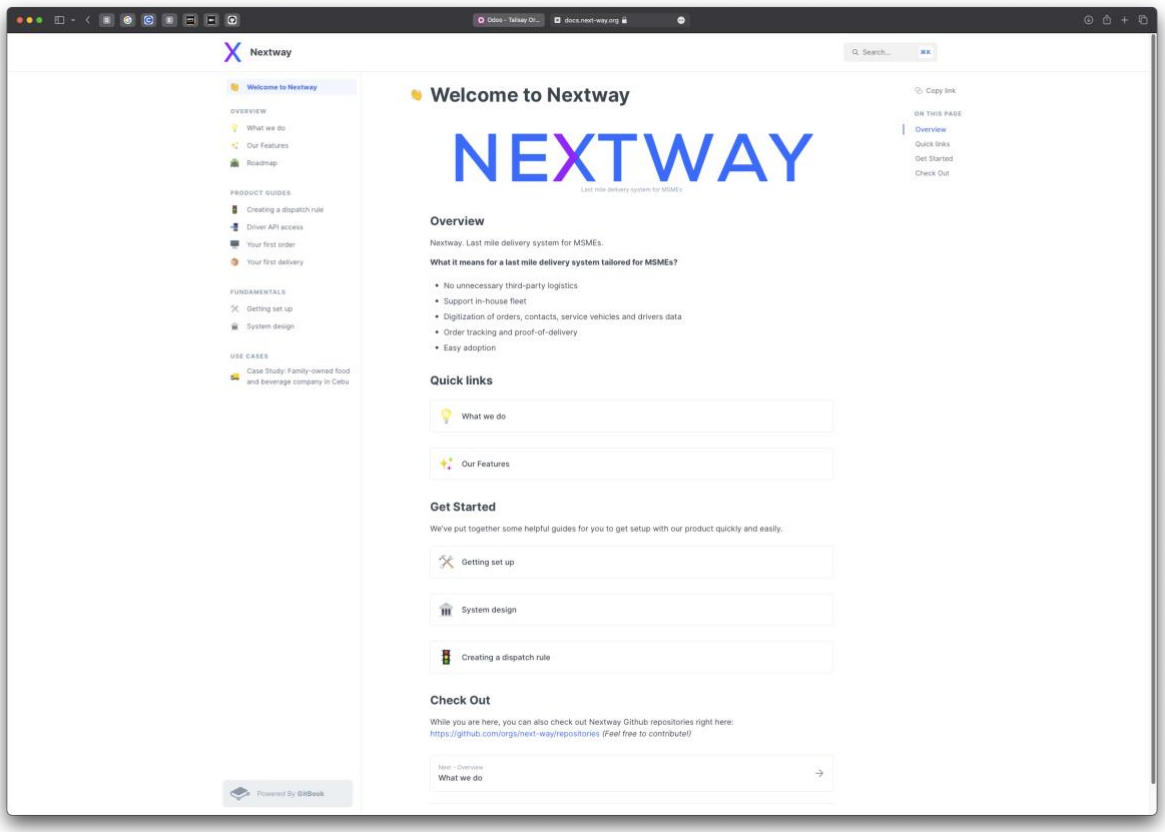


Figure 20. Project online documentation

The Nextway project published public documentation on the website (https://docs.next-way.org).

f. Development of assessment instruments and analysis of assessment data

For this study, the critical success factor was the easy adoption of the paper-based journal entry system into an app-based job order system. Training, hardware and software, project management, and top management support were the top factors that define the quality benefits of implementing ERP systems in SMEs (Deshmukh, Thampi, & Kalamkar, 2015).

In this study, the system design, the ERP, and the mobile application directly affected the software factor. The study considered the importance of measuring success through intuitiveness, ease of use, and functionality of whether or not it helped the users accomplish their tasks.

Usability testing provided organic feedback to improve the system further. From multiple references, the study summarized the advantages of implementing such a methodology for this study (Usability.gov Assistant Secretary for Public Affairs, 2013) (Maze, 2022) (LambdaTest, 2022) (UXCAM, 2019):

1. Early detection of usability issues and bugs
2. Identify required changes for performance improvement
3. Fresh insights and perspectives directly from the users
4. Evaluate user satisfaction

This study performed an unmoderated usability testing method. Participants completed a set of tasks called missions that reflected the use cases. From the testing, the completion metrics, error metrics, and user satisfaction metrics were used for the analysis of assessment data.

Chapter IV

PROJECT ASSESSMENT

A. User Testing

This study applied “The Lean Usability Test Plan” from a toolkit developed by Dr. David Travis. He proposed a usability test plan dashboard that summarized the contents of multi-page test documents into a single page.

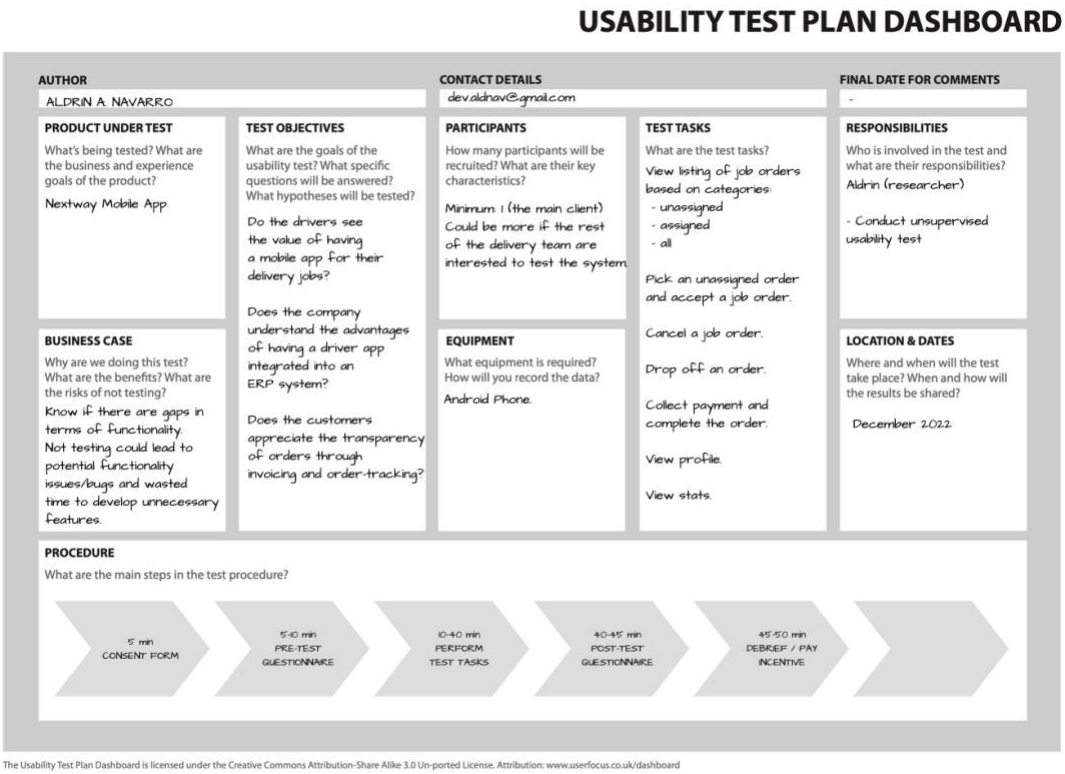


Figure 21. Usability test plan dashboard adapted for Nextway Mobile App

The app was tested in the field on December 10-23, 2022, and January 2-3, 2023, with timing aligned with the company drivers’ availability. There were 5 participants—the driver team. 1 participant had not been able to install the app due to incompatibility. The researcher loaned the participant another test device.

Setup

Each participant was given user credentials. Orders were set up ahead of time in the ERP, with some orders pre-assigned to them using the auto-dispatch module, while a few of the orders were left unassigned. The reason behind this is to demonstrate the self-assignment feature of the app. These order numbers were unique, and the driver assignment was one-to-one. A user acceptance test form has been prepared for them to complete the test missions on test data. The complete UAT form was added in the appendix section. The procedure of the test was described in the previous figure.

Issues and bugs

Unable to tap on the collect button. The collect button was not visible on a Huawei Nova 2 Lite phone. This unexpected behavior is a bug on the view itself when the layout overflows on the vertical space. The zoom level of the phone's display can be set to a smaller value to mitigate the issue. Other devices did not encounter the same issue. Regardless, the problem has been fixed but couldn't be tested on time by the participant.

Unable to install/compatibility issue. On a Vivo Y91c, the app shows in the Google Play Store, but the participant couldn't install it.

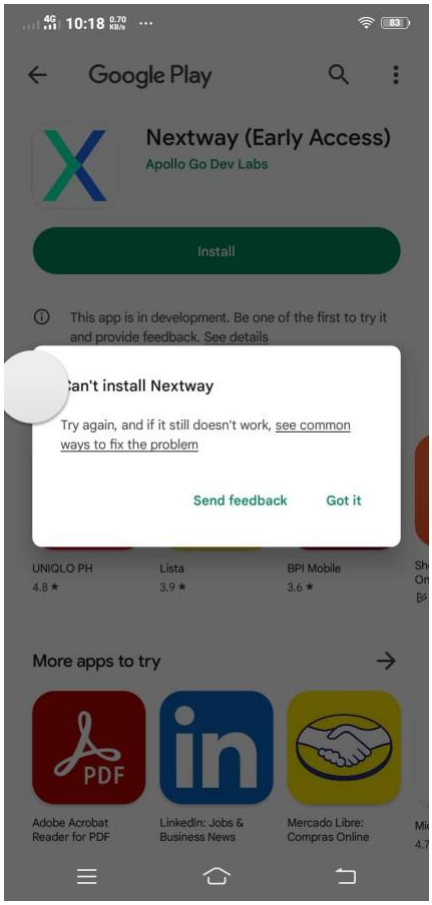


Figure 22. Unable to install on Vivo Y91c

The researcher suspected that the app bundle uploaded in the release wasn't compatible with the client's phone. The build command `flutter build appbundle --target=lib/main_staging.dart --flavor production --target-platform=android-arm64` is used during the first application to the Google Play Store. This issue can be easily addressed by using `--split-per-abi` flag and an update to the release.

B. Testing Results

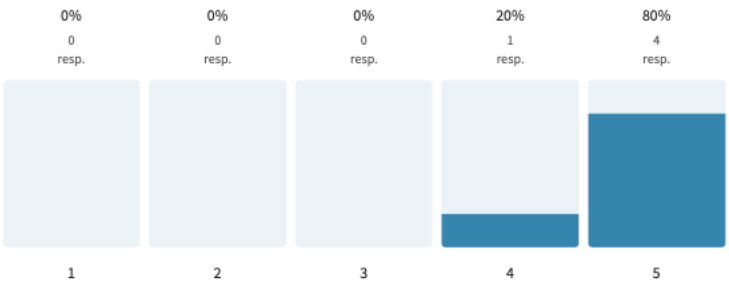
The test took 18:26 minutes to complete on average, based on Typeform result statistics. Below is the summary of the UAT response.

How would you rate the app in terms of ease of listing job orders?

Hide question

5 out of 5 answered

4.8 Average rating

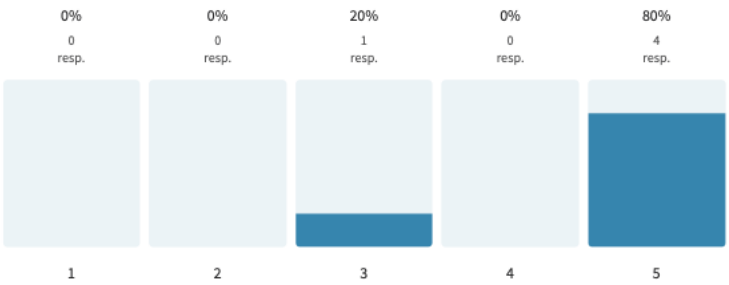


How would you rate the app in terms of ease of accepting job orders?

Hide question

5 out of 5 answered

4.6 Average rating

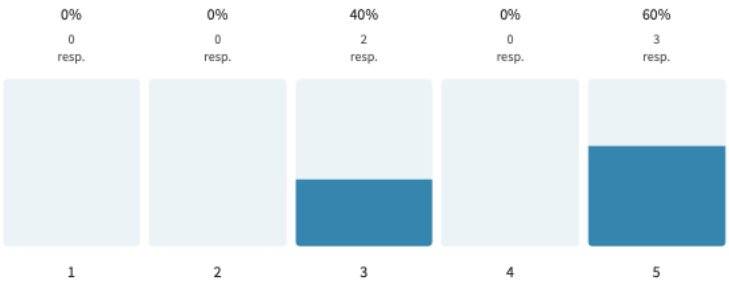


How would you rate the app in terms of ease of dropping off and collecting payment for the job orders?

Hide question

5 out of 5 answered

4.2 Average rating

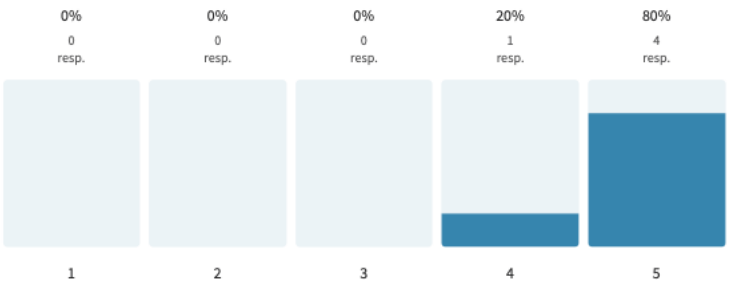


How would you rate the app in terms of ease of viewing user profile and statistics?

Hide question

5 out of 5 answered

4.8 Average rating



How would you rate the system on its usability?

Hide question

5 out of 5 answered

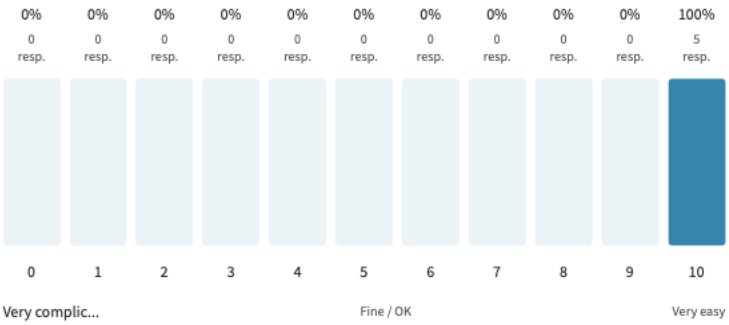
5.0 Average rating

How easy did you find this system to use?

Hide question

5 out of 5 answered

10.0 Average rating

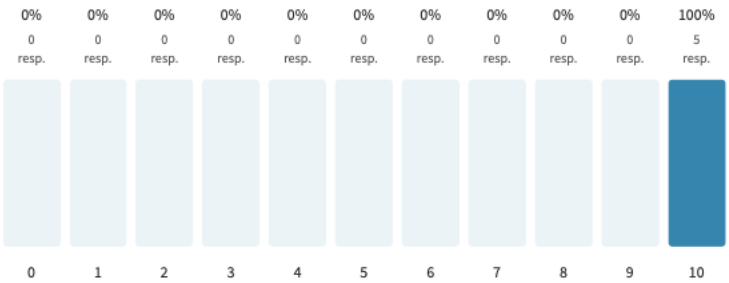


How easy was it to navigate the system and find what you needed?

Hide question

5 out of 5 answered

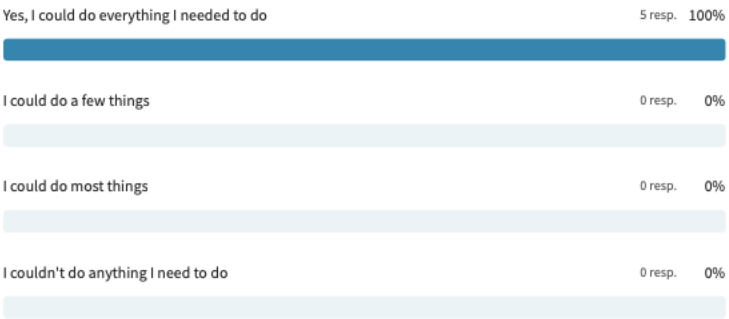
10.0 Average rating

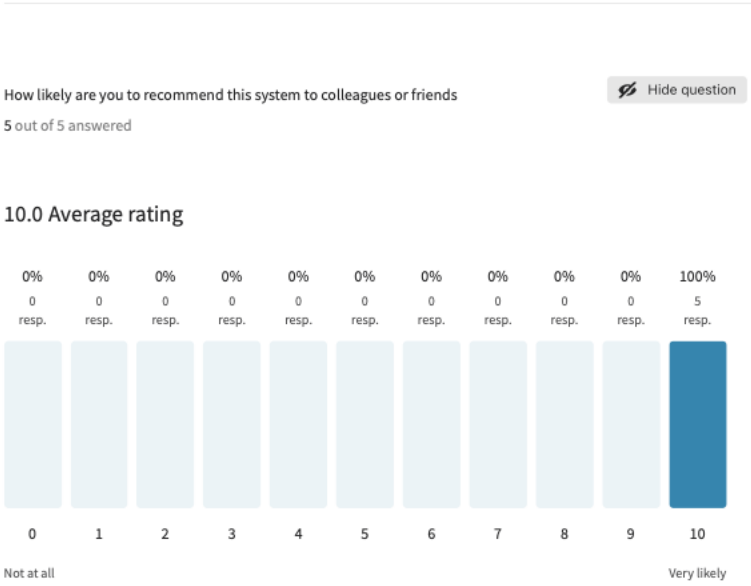


Were you able to complete the tasks you needed to using this app?

Hide question

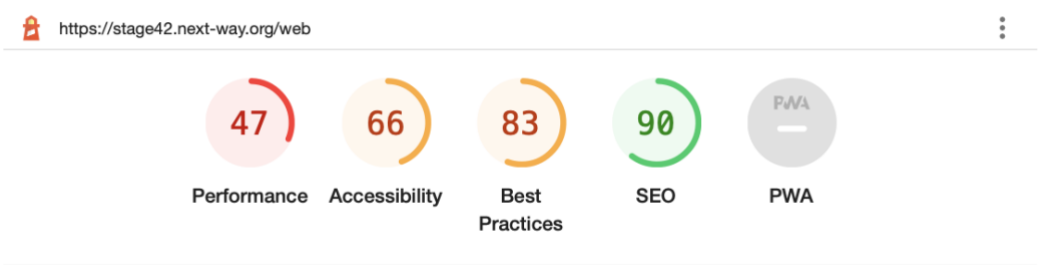
5 out of 5 answered





C. Web Content Accessibility Guidelines (WCAG) Tests

The researcher also ran accessibility tests using Google Lighthouse. This tool also provides performance, progressive web apps, and SEO audits.



The test was run against the dispatch rules page. The full test report is provided in the appendix. Going forward, Nextway can improve performance, accessibility, and best practices audits. At the time of writing, it is not definitive which parts are specific to Nextway or Odoo version 16. The progress for these improvements will be documented on the public documentation roadmap page.

Google Lighthouse tool runs accessibility tests that cover a subset of the requirements defined in Web Content Accessibility Guidelines (WCAG) (Google's lighthouse accessibility tests are helpful, but not perfect, 2021). Future improvements may consider using more accessibility testing tools.

Chapter V

DISCUSSIONS

The testing results provided meaningful insights. The participants had virtually no experience using other delivery apps catered towards their last-mile delivery system since it was their first time adopting it. Testing also revealed trivial cases, such as app incompatibility, which could be addressed in later releases. The functionality of the app also reflects the user's expectations. The results show that the app enabled the users to do everything they needed. Perhaps one aspect this study has gained but falls short of evaluating is user behavior while using the app. Being first-time adopters, using a mobile application for their supposed manual journal entries seems very useful.

Maintenance Plan

Potentially, it would be beneficial to capitalize on the user behavior aspect as well. The positive response to the usability brought suggestions from other users, such as photos or signatures on drop-off and collection. These suggestions were discussed by the researcher and the initial client and put on the roadmap for future releases.

The system is currently proactively in field testing and hand-over phase for the minimum viable product. The release cycle has been planned to be at most bi-weekly or once a month since the closed testing release has proved to be successful.

As for the custom ERP modules, the auto-dispatch will be rehashed to be more straightforward. As the administration side of the client is out-of-scope for the current study, most of the perspective will come from the initial client with the experience of the manual journal entry.

The system design will also evolve as the user need change. For example, a storage service can be considered an alternative to the shared file system. It will depend on the throughput or overhead when accepting user uploads. Load testing will have to be done to determine acceptable limits and tradeoffs that may affect performance.

For performance, caching may be a good consideration for system design improvement. Now, requests made when the user pulls down on the job orders list go directly to the ERP server. The API may apply rate-limiting to ease the server load, and the app would just have to adapt to the most recent cached response, depending on the action. Actions in the app, such as payment collection, accepting job orders, and canceling job order assignments, are good candidates for signaling a cache bust, guaranteeing a new request to be made to the server, and getting a reliable response.

Chapter VI

CONCLUSION

A last-mile delivery system is beneficial not only to large enterprises but also to MSMEs. As described in the theoretical framework, this demographic is challenging because of economic concerns and customization and vendor lock-in, compliance with data privacy rights and regulations, system integration, and data extraction. The case study involving the main client of a small family-run food and beverage company in Cebu, Philippines, also has unique challenges. The client already has an existing fleet of delivery vehicles and an outside contract with independent drivers and vehicle owners. While the study does not concern the overall organizational structure of their businesses, the scope could be impactful enough to the actual drivers themselves.

The Nextway last-mile delivery system eliminated the need for manual journal entry and self-management of customer contacts. The system also implemented location-based operations such as turn-by-turn using open-source solutions such as Odoo ERP and third-party integration to Google Maps and Waze. Customization has been made possible by developing Nextway provided modules for auto-dispatch rules, and more modules will be developed in the future. Nextway provided an API tailored to the user operations and performed them on Odoo. The API, in turn, has proven effective in delivering the integration to the services needed by the Nextway Driver mobile application. The Nextway project has provided system designs for on-premises and an example deployment architecture to AWS that could easily be swapped with alternative Infrastructure-as-a-Service offerings.

The Nextway last-mile delivery system has delivered a minimum viable product to the client. With the results, the project can move forward to developing features that the wider open-source community can find beneficial.

Chapter VII

FUTURE WORK

The Nextway last-mile delivery system can be the basis for mainstream deployment models, on-premises, and cloud service providers. Taking a step further, adopters and other interested parties may consider the possibility of implementing a cloud-to-edge approach.

The cloud-to-edge approach means taking the data closer to the client, and synchronization happens on networks that operate in challenging areas, such as remote mountain barangays where at least 3G communication is available.

Cloud-to-edge is a very different approach from what the Nextway project has proposed. Possibly the system may consider using Message Queue Telemetry Transport or MQTT, which is common on the Internet of Things (IoT). The benefit of such technology includes but is not limited to lightweight messaging protocol and efficient network resource usage. The MQTT system's capabilities will also depend on the service provider, so adopters will have to weigh the advantages and disadvantages of each and if it is even feasible to run such a system on an economic aspect, advocating still to MSMEs.

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MISCELLANEOUS

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Onro. https://onro.io

Shipox. https://shipox.com

Onfleet. https://onfleet.com/

Lalamove. https://www.lalamove.com/en-sg/all-vehicle-pricing-detail

Transportify. https://www.transportify.com.ph/information/

Shippo. https://goshippo.com/pricing/

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The 1-page usability test plan. Userfocus.
http://www.userfocus.co.uk/articles/usability_test_plan_dashboard.html
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APPENDICES

Deliverables and Milestones

1. The project pitch is available at https://drive.google.com/file/d/1juroCaL2mXYXrrWcvsva0dhoFucHYypv/view?usp=share_link
2. API is hosted at https://api-stage42.next-way.org/, and documentation can be viewed at https://api-stage42.next-way.org/docs or https://api-stage42.next-way.org/redocs
3. The staging server is deployed at https://stage42.next-way.org/
4. A project GitHub organization can be viewed at https://github.com/next-way with repositories to the related sub-projects
5. Read the project documentation as well as the roadmap at https://docs.next-way.org

Resources

Historical Data on the Philippine MSME Sector (2006-2021). Personal data request to Bureau of Small and Medium Enterprise Development Department of Trade and Industry for the subject “MSMEs Statistics over the Span of 10 Years”. Request made on October 28, 2022, via e-mail. Response received on the same day.

Year	Number of Establishments										
	MICRO	% change	SMALL	% change	MEDIUM	% change	Total MSMEs	% change	LARGE	% change	TOTAL Establishments
2021	978,612	15.11%	93,230	-4.99%	4,437	-5.92%	1,076,279	12.94%	4,531	-2.58%	1,080,810
2020	850,127	-4.59%	98,126	-1.81%	4,716	-0.95%	952,969	-4.30%	4,651	-2.39%	957,620
2019	891,044	0.43%	99,936	-5.88%	4,761	-2.74%	995,741	-0.26%	4,765	-0.08%	1,000,506
2018	887,272	7.10%	106,175	20.09%	4,895	27.84%	998,342	8.44%	4,769	17.93%	1,003,111
2017	828,436	0.93%	88,412	1.68%	3,829	-4.70%	920,677	0.98%	4,044	2.17%	924,721
2016	820,795	1.76%	86,955	0.68%	4,018	4.01%	911,768	1.66%	3,958	-2.87%	915,726
2015	806,609	-5.30%	86,367	-1.05%	3,863	-0.59%	896,839	-4.89%	4,075	0.30%	900,914
2014	851,756	0.58%	87,283	0.60%	3,886	3.68%	942,925	0.60%	4,063	5.61%	946,988
2013	846,817	0.24%	86,762	-5.72%	3,748	-8.47%	937,327	-0.38%	3,847	-4.09%	941,174
2012	844,764	13.66%	92,027	31.05%	4,095	24.58%	940,886	15.20%	4,011	14.73%	944,897
2011	743,250	4.70%	70,222	13.30%	3,287	17.98%	816,759	5.43%	3,496	15.65%	820,255
2010	709,899	-0.13%	61,979	-2.44%	2,786	-7.32%	774,664	-0.35%	3,023	-1.85%	777,687
2009	710,822	1.97%	63,529	8.98%	3,006	-1.99%	777,357	2.49%	3,080	3.60%	780,437
2008	697,077	-3.20%	58,292	0.16%	3,067	5.07%	758,436	-2.91%	2,973	11.43%	761,409
2007	720,084	-0.01%	58,198	1.32%	2,919	2.82%	781,201	0.09%	2,668	2.77%	783,869
2006	720,191		57,439		2,839		780,469		2,596		783,065

Year	Number of Employment										
	MICRO	% change	SMALL	% change	MEDIUM	% change	Total MSMEs	% change	LARGE	% change	TOTAL Establishments
2021	2,741,741	8.68%	2,118,519	-4.30%	601,471	-6.68%	5,461,731	1.50%	2,983,847	-6.93%	8,445,578
2020	2,522,662	-4.12%	2,213,654	-0.65%	644,499	-1.06%	5,380,815	-2.36%	3,206,011	-3.30%	8,586,826
2019	2,631,165	0.80%	2,228,204	-8.87%	651,391	-1.14%	5,510,760	-3.56%	3,315,575	-0.40%	8,826,335
2018	2,610,221	10.15%	2,445,111	20.78%	658,930	24.79%	5,714,262	16.09%	3,328,801	14.40%	9,043,063
2017	2,369,748	1.01%	2,024,470	2.18%	528,033	-4.32%	4,922,251	0.88%	2,909,838	2.76%	7,832,089
2016	2,345,992	2.64%	1,981,316	0.65%	551,871	3.97%	4,879,179	1.97%	2,831,729	-5.03%	7,710,908
2015	2,285,634	-3.67%	1,968,452	-0.92%	530,784	-0.29%	4,784,870	-2.19%	2,981,819	2.91%	7,766,689
2014	2,372,678	1.98%	1,986,823	2.79%	532,335	4.16%	4,891,836	2.54%	2,897,421	6.56%	7,789,257
2013	2,326,509	0.42%	1,932,857	-6.22%	511,079	-7.60%	4,770,445	-3.25%	2,719,166	2.27%	7,489,611
2012	2,316,664	30.27%	2,061,090	25.49%	553,097	22.49%	4,930,851	27.33%	2,658,740	7.50%	7,589,591
2011	1,778,353	2.85%	1,642,492	15.86%	451,561	16.94%	3,872,406	9.61%	2,473,336	15.77%	6,345,742
2010	1,729,100	-0.11%	1,417,672	-2.16%	386,163	-7.07%	3,532,935	-1.74%	2,136,362	2.01%	5,669,297
2009	1,731,082	4.07%	1,449,033	10.27%	415,526	-0.61%	3,595,641	5.89%	2,094,298	-2.55%	5,689,939
2008	1,663,382	0.09%	1,314,065	1.25%	418,058	5.55%	3,395,505	1.18%	2,149,085	17.30%	5,544,590
2007	1,661,884	-0.36%	1,297,792	1.47%	396,066	3.95%	3,355,742	0.84%	1,832,051	10.56%	5,187,793
2006	1,667,824		1,279,018		381,013		3,327,855		1,657,028		4,984,883

Below is a single journal entry of the manual system.

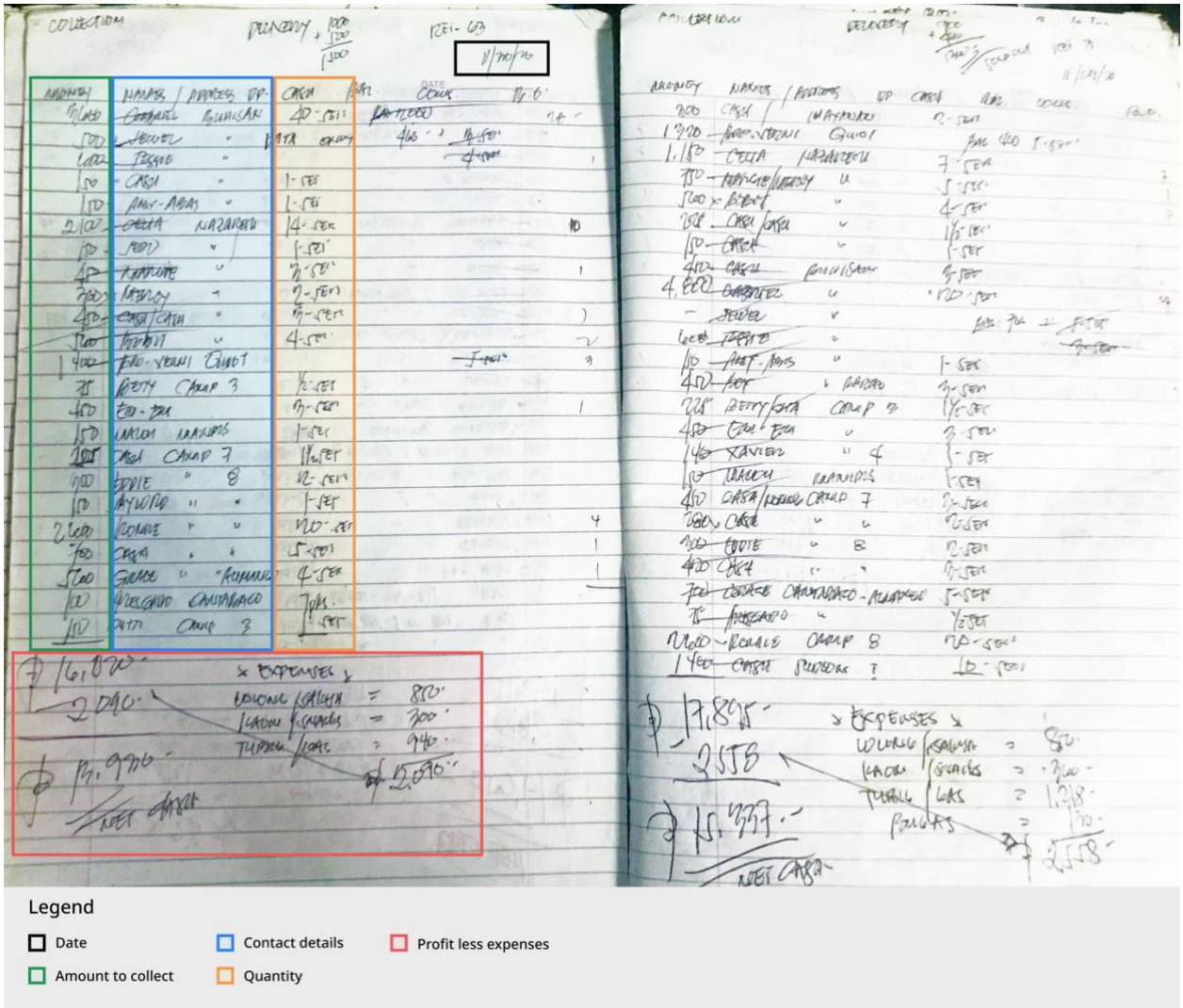


Figure 23. Journal entry from the client's journal

The Gantt Chat consisted of three sprints (phases): (1) Proof of concept, (2) Enhancements, (3) Pilot.

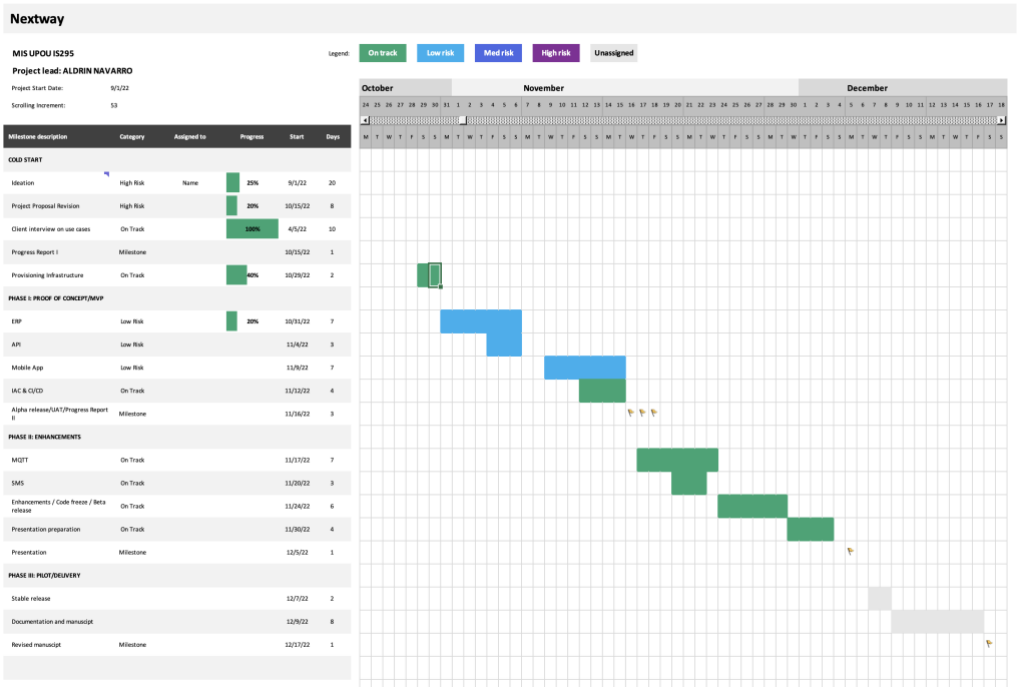


Figure 24. Project Gantt Chart

Nextway UAT Form

Introduction

Ask for respondent consent following Republic Act 10173 – Data Privacy Act of 2012.

A copy of the privacy policy is available on the Nextway GitHub project.

If the respondent declines, end the test politely.

Pre-test questionnaire

1. Do you have experience using a mobile application for delivery drivers?
2. Which mobile application for delivery drivers have you used?
3. Collectively, for how many years have you used (answer to test 2)?

Test tasks

1. How would you rate the ease of installing Nextway Driver mobile application?
    a. Easy installation
    b. Cannot install on my device
    c. Not easy at all
    d. Straightforward
2. When 1 = a, can you please provide the mobile phone make and model?
3. Otherwise, can you tell us why you think the installation of Nextway Driver mobile application is?
4. Were you able to log in to the Nextway Driver mobile application?
5. Listing of job orders. Was the Nextway Driver mobile application able to list scheduled job orders?
    a. Yes

b. No

c. It says the list is empty

6. Listing of job orders. Were you able to locate unscheduled / available job orders from the Nextway Driver mobile application?

    a. Yes

    b. No

    c. Yes, and the app says it’s empty

7. Accepting job orders. Locate the unassigned / free job orders. Tap on one of the orders. Input the job order number below.
8. Accepting job orders. Tap Accept button. Did Nextway Driver mobile app able to assign the job order to you?
9. If no, did the app prompt an error / try again message?
10. Accepting job orders. Tap “Back”. Locate the scheduled job order tab. Was the app able to show job order in the list?
11. Accepting job orders. While on the scheduled job order tab, pull down to refresh the list. Was the app able to show job order in the list now?
12. Completing job orders. While on the scheduled job order tab, tap the job order. Were you able to view the customer’s location pinned on the map?
13. Completing job orders. While on the job order, were you able to view the customer’s details?
14. Completing job orders. While on the job order, please input the customer’s name.
15. Completing job orders. While on the job order, please input the total amount of the order.
16. Completing job orders. While on the job order, how many order lines are there?

17. Completing job orders. While on the job order, were you able to see options for the following actions? Show directions (Waze), Call customer, SMS customer.
18. Completing job orders. While on the job order, tap “Show directions (Waze)” option. Were you able to view the directions?
19. Completing job orders. While on the job order, you couldn’t view the directions via Waze app. Was there any error? Please input any error message below.
20. Completing job orders. While on the job order, tap the “Call customer” option. Were you able to view the customer’s number on a dialer app?
21. Completing job orders. While on the job order, the “Call customer” option had a problem. Can you please describe what happened?
22. Completing job orders. While on the job order, tap the “SMS customer” option. Were you redirected to the SMS app with the customer’s number?
23. Completing job orders. While on the job order, the “SMS customer” option did not redirect to the SMS app with the customer’s number. Can you please describe what happened?
24. Completing job orders. While on the job order, tap on the “Drop Off” button and wait for a few seconds. Was Nextway Driver mobile application successful in dropping off the order?
25. Completing job orders. While on the job order, the “Drop Off” button didn’t work. Can you describe what happened? Was there an error message prompted?
26. Completing job orders. While on the job order, the dropping off of a job order works! Now, please tap on the Notes section and input some data. After that

tap the “Collect” button. Was Nextway Driver app successful in marking the job order as “Done”?

27. Completing job orders. While on the job order, the dropping off of a job order works! But the “Collect” action did not. Was Nextway Driver app able to show you an error message? Can you please describe what happened?
28. Cancelling job orders. Tap on a scheduled job order. If there aren’t any. Please tap on the unassigned tab and accept any job order. Please input the job order number below.
29. Cancelling job orders. Tap on “Cancel Job”. Was the Nextway Driver mobile application able to show an alert dialog?
30. Cancelling job orders. Nextway Driver mobile application was not able to show an alert dialog. Was the app able to show any error message instead? Please describe what happened.
31. Cancelling job orders. Proceed on cancelling the job order. Was Nextway Driver mobile application able to cancel and unassign the job order from you?
32. Cancelling job orders. Proceed on cancelling the job order, the Nextway Driver mobile application was not able to cancel and unassign the job order from you. Can you please describe what happened? Did the app prompt any error message?
33. Cancelling job orders. Were you able to see the job order back to the Unassigned tab?
34. Viewing user profile. From the app, were you able to locate the profile screen?
35. Viewing user profile. Please view the user profile. Tap on the selection below if you see any of them in the profile screen.
    a. Username

b. Name

c. Orders completed for the period

d. Orders completed overall

e. Orders assigned overall

f. Switch for the dark mode layout

g. A cat walking around the screen

h. Log out button

36. Viewing user profile. Please view the user profile. From the list below, can you please select which ones did not work?

a. Username

b. Name

c. Orders completed for the period

d. Orders completed overall

e. Orders assigned overall

f. Switch for the dark mode layout

g. A cat walking around the screen

h. Log out button

Post-test questionnaire

1. How would you rate the app in terms of ease of installing job orders? 5 Very easy, 4 Easy, 3 Can improve, 2 Not easy, 1 Did not work at all
2. Please describe what made you decide on the rating
3. How would you rate the app in terms of ease of accepting job orders? 5 Very easy, 4 Easy, 3 Can improve, 2 Not easy, 1 Did not work at all
4. Please describe what made you decide on the rating

5. How would you rate the app in terms of ease of dropping off and collecting payment for the job orders?

   5 Very easy, 4 Easy, 3 Can improve, 2 Not easy, 1 Did not work at all

6. Please describe what made you decide on the rating
7. How would you rate the app in terms of ease of viewing user profile and statistics?

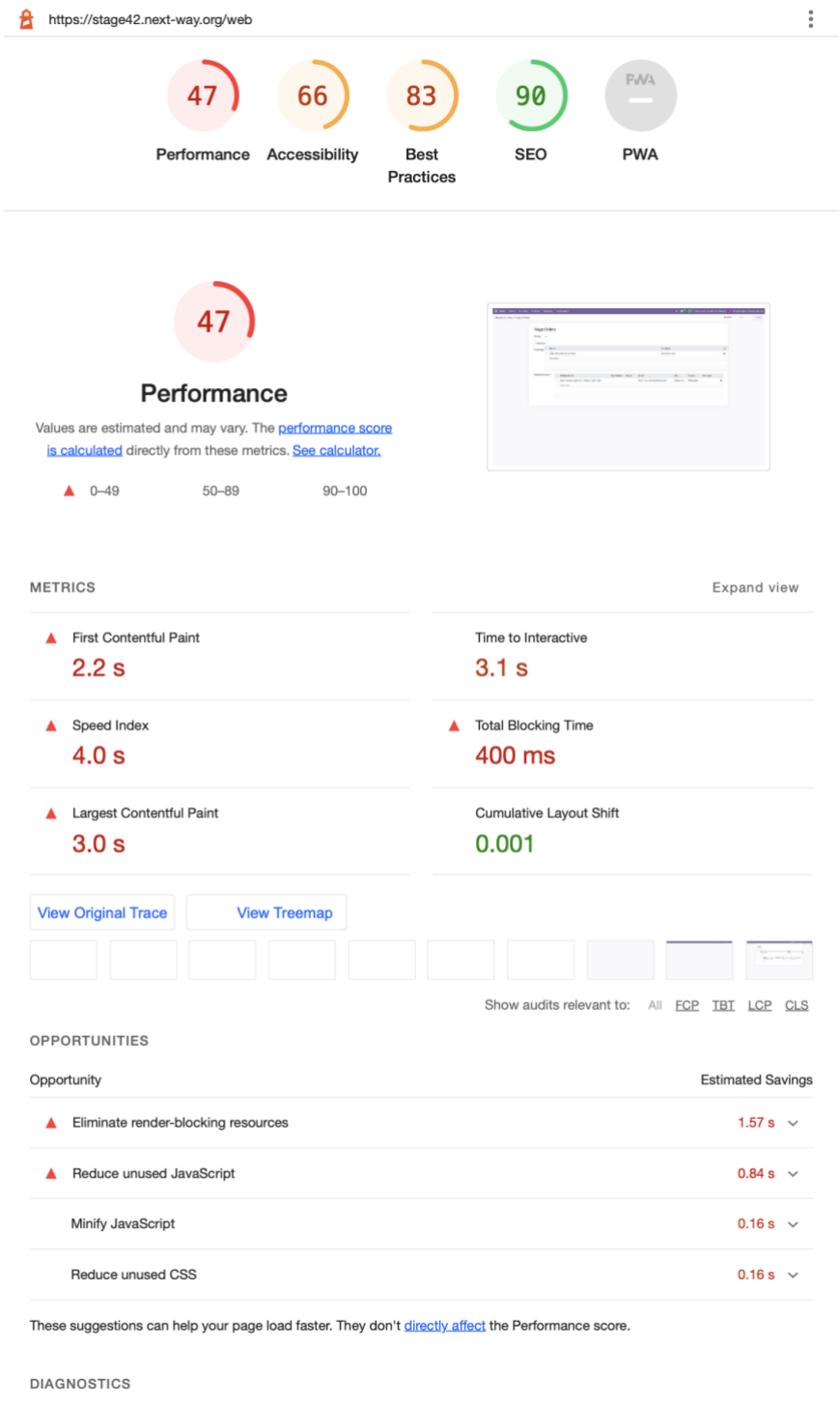
   5 Very easy, 4 Easy, 3 Can improve, 2 Not easy, 1 Did not work at all

8. How would you rate the system on its usability? 1 – 5. Higher is better.
9. How easy did you find this system to use? 0 – 10. Very complicated – Very easy.
10. How easy was it to navigate the system and find what you needed? 0 – 10. Very difficult – Very straightforward
11. Were you able to complete the tasks you needed to do using this app?
    a. Yes, I could do everything I needed to do
    b. I could do most things
    c. I could do a few things
    d. I couldn't do anything I needed to do
12. How likely are you to recommend this system to colleagues or friends?

    0 – 10. Higher is better.

The complete responses of the UAT for the MVP can be found in the public documentation on the website (https://docs.next-way.org)

Google Lighthouse report



- ▲ Does not use passive listeners to improve scrolling performance
- ▲ Image elements do not have explicit `width` and `height`
- ○ Avoid chaining critical requests — 6 chains found
- ○ User Timing marks and measures — 3 user timings
- ○ Keep request counts low and transfer sizes small — 35 requests • 2,054 KiB
- ○ Largest Contentful Paint element — 1 element found
- ○ Avoid large layout shifts — 5 elements found
- ○ Avoid long main-thread tasks — 5 long tasks found

More information about the performance of your application. These numbers don't directly affect the Performance score.

PASSED AUDITS (28) Show

Accessibility

These checks highlight opportunities to improve the accessibility of your web app. Only a subset of accessibility issues can be automatically detected so manual testing is also encouraged.

ARIA

- ▲ Elements with an ARIA `[role]` that require children to contain a specific `[role]` are missing some or all of those required children.
- ▲ `[role]`s are not contained by their required parent element

These are opportunities to improve the usage of ARIA in your application which may enhance the experience for users of assistive technology, like a screen reader.

NAMES AND LABELS

- ▲ Buttons do not have an accessible name
- ▲ Form elements do not have associated labels

These are opportunities to improve the semantics of the controls in your application. This may enhance the experience for users of assistive technology, like a screen reader.

BEST PRACTICES

- ▲ `[user-scalable="no"]` is used in the `<meta name="viewport">` element or the `[maximum-scale]` attribute is less than 5.

These items highlight common accessibility best practices.

CONTRAST

▲ Background and foreground colors do not have a sufficient contrast ratio.

These are opportunities to improve the legibility of your content.

INTERNATIONALIZATION AND LOCALIZATION

▲ `<html>` element does not have a `[lang]` attribute

These are opportunities to improve the interpretation of your content by users in different locales.

ADDITIONAL ITEMS TO MANUALLY CHECK (10) Show

These items address areas which an automated testing tool cannot cover. Learn more in our guide on conducting an accessibility review.

PASSED AUDITS (18) Show

NOT APPLICABLE (19) Show

Best Practices

TRUST AND SAFETY

▲ Includes front-end JavaScript libraries with known security vulnerabilities — 9 vulnerabilities detected

○ Ensure CSP is effective against XSS attacks

GENERAL

▲ Browser errors were logged to the console

○ Detected JavaScript libraries

▲ Missing source maps for large first-party JavaScript

PASSED AUDITS (10) Show

NOT APPLICABLE (1) Show

SEO

These checks ensure that your page is following basic search engine optimization advice. There are many additional factors Lighthouse does not score here that may affect your search ranking, including performance on Core Web Vitals. Learn more.

CONTENT BEST PRACTICES

- ▲ Document does not have a meta description

Format your HTML in a way that enables crawlers to better understand your app's content.

ADDITIONAL ITEMS TO MANUALLY CHECK (1) — Show

Run these additional validators on your site to check additional SEO best practices.

PASSED AUDITS (9) — Show

NOT APPLICABLE (4) — Show

PWA

These checks validate the aspects of a Progressive Web App. Learn more.

INSTALLABLE

- ▲ Web app manifest or service worker do not meet the installability requirements — 1 reason

PWA OPTIMIZED

- ▲ Does not register a service worker that controls page and `start_url`
- ▲ Is not configured for a custom splash screen Failures: No manifest was fetched.
- ▲ Does not set a theme color for the address bar. Failures: No manifest was fetched.
- ○ Content is sized correctly for the viewport
  - Has a `<meta name="viewport">` tag with `width` or `initial-scale`
  - Provides a valid `apple-touch-icon`
- ▲ Manifest doesn't have a maskable icon No manifest was fetched

ADDITIONAL ITEMS TO MANUALLY CHECK (3) — Show

These checks are required by the baseline PWA Checklist but are not automatically checked by Lighthouse. They do not affect your score but it's important that you verify them manually.

Captured at Jan 8, 2023, 5:16 PM GMT+8	Emulated Desktop with Lighthouse 9.6.6	Single page load
Initial page load	Custom throttling	Using Chromium 108.0.0.0 with devtools

Generated by **Lighthouse** 9.6.6 | File an issue