

# Development of a Utility Vehicle Express System Framework Using Design Thinking Process for the Province of Albay

Emmanuel Isaiah Z. Detera<sup>1</sup>, Ibrahim F. Hanbal<sup>2</sup>

<sup>1</sup> Divine Word College of Legazpi, , Legazpi City, Philippines

<sup>2</sup> University of the Cordilleras, Baguio City, Philippines

**Abstract** – Utility vehicle express or locally known as UV Express is a key mode of transportation in Albay, Philippines, offers cost-effective connectivity between urban and suburban areas. Composed of vans operating point-to-point from terminals, it serves routes connecting Legazpi with surrounding municipalities like Tabaco, Ligao, and Polangui. Its affordability and efficiency cater to students and workers, supporting both educational and economic activities. However, challenges such as overcrowding, long waits, and inconsistent scheduling persist, highlighting the need for service improvements. This study aims to address these issues through design thinking process that includes identifying the issues and tracing its root causes through 5 Why Analysis. A proposed framework is developed to modernize UV Express operations by replacing manual processes with digital solutions like a Booking System, GPS tracking, and passenger feedback integrated into a mobile app. This initiative enhances operational efficiency, aligns services with evolving transportation trends, and fosters competitiveness. Moreover, it prepares UV Express for further advancements, including usability assessments through pilot testing of the mobile application in Albay.

**Keywords** – UV express, design thinking process, framework, 5 why analysis, transportation.

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**Corresponding author:** Emmanuel Isaiah Z. Detera,  
Divine Word College of Legazpi, , Legazpi City, Philippines  
**Email:** [emmisaiah25@gmail.com](mailto:emmisaiah25@gmail.com)

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## 1. Introduction

Transportation serves as a vital link connecting people to essential services and in areas with insufficient public transportation infrastructure, particularly in urban and suburban communities, accessibility challenges emerge, restricting the mobility of the population [1].

Overcoming these challenges through the improvement of urban and suburban transportation not only addresses the immediate issue of inconvenience but also generates a positive economic impact. By enhancing accessibility to education and workplaces, improved transportation contributes to increased convenience, subsequently fostering economic growth and productivity [2][3]. In essence, investing in upgraded transportation infrastructure not only facilitates easier access to critical services but also plays a crucial role in nurturing economic opportunities and overall community development.

The Philippines, situated in Southeast Asia, is classified as a developing country where a significant portion of the population relies on public transportation as a daily means of commuting. Recognizing the vital role of transportation, the country prioritizes the enhancement of the quality of life for its people through initiatives in the transportation sector [4]. Key areas of focus include vehicle modernization, aimed at upgrading the public transport fleet to more efficient and environmentally friendly vehicles. Additionally, the nation emphasizes measures to improve road safety, addressing concerns related to accidents and ensuring secure transportation experiences, and infrastructure through digitalization. Sustainable investments in the transportation sector further underscore the commitment to fostering long-term improvements in accessibility, efficiency, and overall well-being for the population [5].

Albay, located in the Bicol Region of Luzon, Philippines, is a province characterized by its diverse landscape and vibrant communities.

Composed of municipalities and cities, the province is strategically divided into three distinct areas, with the urban hub of Legazpi City serving as the central point. Connectivity within Albay is facilitated primarily through road transportation accommodating bus, jeepneys, and UV Express vehicles [6]. This transportation infrastructure plays a vital role in linking the various municipalities and cities, ensuring the seamless movement of people and goods across the province.

UV Express is one of the main modes of transport in Albay, operated by cooperatives, which are groups of UV Express operators and drivers. It operates on a point-to-point basis, making it faster than jeepneys and buses. However, due to its widespread usage among the people, it faces operational challenges such as long waiting times and overcrowding [7]. In contrast to the ongoing modernization of other public transport services, the main problem is the lack of acceptance of modern practices by UV Express. To respond to these shortcomings in modern practices, this study aims to create a system framework that can be used to digitize the current processes of the UV Express by identifying the issues and tracing its root causes from the current manual processes. The proposed framework can improve the overall commuting experience of the passengers through a modern information technology solution [8]. Moreover, the framework intends to efficiently offer convenience to commuters who use UV Express, reducing their waiting time and travel time to terminals.

## 2. Literature Review

In this literature review, the inclusions and effects of various technological advancements in the transport industry will be looked into. The transformative potential of such technologies to improve user convenience, operational efficiency as well as business viability for UV Express framework will be discussed. An analysis that covers all this information is considered essential for identifying trends, obstacles, and opportunities that may exist which is purposeful in guiding the proposed framework.

### 2.1. Location Tracking with GPS and GIS

Location tracking is crucial in modern transportation systems, enhancing navigation, efficiency, and safety. GPS and GIS allows for real-time mapping and analysis, enabling applications ranging from navigation and asset management to environmental studies. This technology not only aids in route optimization and fleet management but also enhances passenger experience by offering accurate

and timely information and further provides location data for future travel optimization [9] [10].

A developed application called Unibus app in Sarawak, Malaysia, is a revolutionary tool leveraging GPS technology to enhance public transport ridership. This innovative application goes beyond traditional transportation services, prioritising customer loyalty, satisfaction, accessibility, comfort, safety, and security. By providing public transport users with precise and real-time information, the Unibus app ensures that commuters are well-informed about their journeys, promoting a sense of confidence and reliability in the public transportation system. The app further enables users to effortlessly search for nearby transportation options, streamlining the commuting experience and contributing to improved overall satisfaction. With its commitment to accessibility, comfort, and safety, the Unibus app not only serves as a valuable resource for commuters but also acts as a catalyst for the advancement of public transportation in Sarawak, fostering a more seamless and user-friendly urban mobility experience [11]. A study on public transportation in Makassar city, Indonesia implemented Location-Based Service via Web Application. Due to its dense population and considered as one of the largest cities in Indonesia. The study enhanced the public transport lines for commuters and tourists moving from different locations, pointing out the routes and transportation to be used as well as the cost enhancing the travel experience of commuters [12].

### 2.2. Transport Network Vehicle Services (TNVS)

Transport Network Services have dominated the urban transport sector for its convenient process of transporting people and goods with simple processes by the use of mobile applications. It revolutionised traditional processes providing increased convenience for users in accessing transportation services. There is significant potential for these applications to establish viable business models, driven by the essential nature of transportation and the evolving preferences of users who prioritise time efficiency and convenience [13].

TNVS experiences a rising demand in the Philippines as consumers heavily base their attitudes on the anticipated benefits and delivery of services by TNVS providers. The alignment of service delivery with expectations tends to generate favourable consumer attitudes. Nevertheless, it is noted that there is not a significant relationship between consumer attitudes and overall satisfaction with TNVS, suggesting that satisfaction might be influenced by factors beyond initial expectations [14].

Additionally, a study focused on the Grab Mobile Application in Kedah, Malaysia [15] found that users generally had a positive experience, appreciating the application's user-friendly interface and convenience for transportation needs. However, the study also revealed a divergence in user sentiments, with some expressing negativity towards additional fare charges, emphasising the varied perspectives users have regarding the balance between application usability, convenience, and associated costs. In the driver's perspective, the economy plays a crucial role in influencing the adaptation of drivers to TNVS. While TNVS competes with traditional public transportation modes, its appeal lies in the ease of finding passengers. Despite this convenience, fluctuations in income within the TNVS model sometimes led to financial losses for drivers, highlighting the complex and dynamic nature of the driver's economic experience within this service [16].

### **2.3. Reservation and Booking Systems**

Reservation and booking systems have significantly transformed the transportation sector by enhancing convenience and efficiency for commuters. Allowing passengers to book their transportation online ensures availability, reduces waiting times, and provides a more reliable travel experience [17].

For instance, a study in Romania explored modernising an existing system to support both road and rail transportation through a mobile application. This update, achieved using Unified Modeling Language (UML), aimed to improve user experience by enabling seamless access and mobility [18]. Similarly, a study on the UV Express implemented a reservation mobile application [5][19] that allows users to book seats in advance and track their travel in real-time. While this system offers benefits, such as reserving seats and tracking estimated arrival times, it has encountered challenges. The traditional first-come-first-serve approach at UV Express terminals can create bottlenecks, delaying departures and affecting walk-in passengers. Despite these issues, the studies highlight the potential for improvement in urban transportation systems. The advancements in information technology have introduced new trends that disrupt traditional transportation methods, opening opportunities for more efficient and customer-focused solutions.

### **2.4. Online Digital Payments**

The adoption of mobile payment technology is recognized as a crucial driver of socioeconomic development globally, with countries like Australia,

Bangladesh, Canada, China, France, India, Indonesia, Malaysia, Norway, Pakistan, Peru, the Philippines, Spain, and Thailand actively engaging in discussions about its role in the banking industry. Despite widespread discourse on the topic, the adoption of mobile payments is influenced by a variety of factors, including technological advancements, individual preferences, and environmental considerations, highlighting the complexity of support for this transformative financial technology [20].

In the Philippines, there is a notable surge in the growth of digital wallets, indicating a significant shift towards digital financial solutions. One notable catalyst towards the shift to digital payment and banking is COVID-19 pandemic. People prefer digital payments due to its safety and convenience particularly on transportation payments which eliminates physical contact by using cash [21]. The concurrent rise of digital banking aligns with evolving consumer needs, prompting further adjustments to enhance operating models within the financial sector [22]. Notably, government initiatives aimed at improving and supporting digital banks contribute to the broader momentum of digitalization in the country's financial landscape [23]. By having digital payments in the transport industry, it will give significant convenience particularly on transport booking, and it ensures the security and correct tracking of fund remittance compared to the traditional way.

## **3. Methodology**

In this study, the design thinking process was utilised to solve problems by understanding people's needs and coming up with creative solutions [24]. However, the phases included will be limited to the first three phases which are empathise, define, and ideation due to the limitation of the study to only design a framework for the UV Express. For the empathise phase, the researcher conducted a survey for the passengers in the terminal to identify the issues that are experienced. Moreover, observation in the terminal will be done to witness the current operation in the UV Express terminal. Furthermore, an interview with the cooperatives will be done to also identify their issues regarding operation, and validate the issues identified in the passenger survey. In the define phase, the gathered issues from the passengers, cooperatives, and the observation of the current operation will be synthesised to conduct a 5 why analysis to identify the root causes to directly address the issues. By this approach, the study can ideate the framework that will be done to enhance the operation of the UV Express.

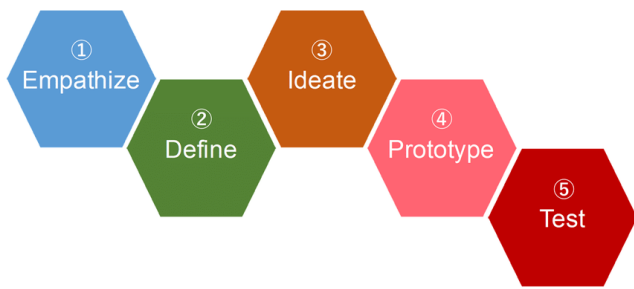


Figure 1. Design thinking process [25]

#### 4. Results and Discussion

This section discusses the results of the conducted analysis on the problems encountered in the UV Express, and the factors that may affect the creation of the framework through the design thinking process.

##### 4.1. Problems Experience in UV Express

Table 1 shows the identified issues of UV Express commuters from 29 random participants from the Legazpi city UV Express Terminal. The data shows that 86.2% of the participants experienced "Long waiting times", 82.8% experienced "Overcrowding" (in the terminal), 62.1% experienced "Uncertainty of UVs" (Availability of UVs), 58.6% experienced "Traffic Congestion", 48.3% experienced "Irregular Departure Time", 41.4% experienced "Unclear Queuing", 34.5% experienced "Fare disputes", and 31% experienced "Unreliable Information" (for Incoming UVs to ride). The following issues have been related and can be categorised such as the "Unreliable Information and Uncertainty of UVs" which points out to the availability of UVs. Overcrowding and long waiting times can also be categorised into one because it only points out to the large influx of people in the terminal.

Table 1. Issues identified in Legazpi City UV Express

Issue	Count	Percentage
Long Waiting Times	25	86.2%
Overcrowding	24	82.8%
Uncertainty of UVs	18	62.1%
Traffic Congestion	17	58.6%
Irregular Departure Time	14	48.3%
Unclear Queuing	12	41.4%
Fare Disputes	10	34.5%
Unreliable Information	9	31%

##### 4.2. Current Operational Process of UV Express

The operational process of the UV Express primarily the loading of passengers in the terminal, and how the passengers' rate or send feedback to the UV Express which provides the study of insights on the daily operation of the UV Express as observed in the terminal which will show the points where the UV Express can improve and focus. Loading of passengers of UV Express in the terminal. It starts with the UV Express queues at the terminal and waits for passengers. The passengers are loaded on a first-come-first-serve basis where the UVs will depart once the seats are full, and the dispatcher has collected all fees from the passengers. To send feedback, the passengers can call or send SMS through the mobile number of the operator printed on the side of UVs. Aside from the operator, there is also a mobile number of the LTFRB, the regulatory agency of the Philippine Government in land transportation [26] where passengers can send complaints. This method is seldom used by passengers and has been the method of most PUVs for sending feedback for decades in which some printed phone numbers on the side of the UVs are no longer available and are not updated which can lead to unattended complaints of passengers.

##### 4.3. 5 Why Analysis Results

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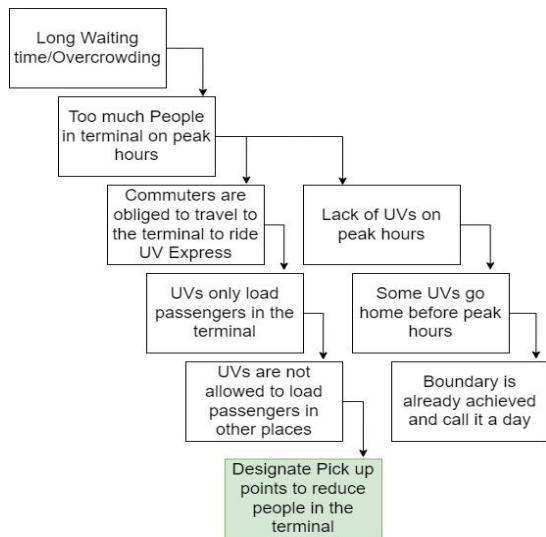


Figure 2. 5 why analysis on long waiting time/overcrowding

The issue of “Irregular Departure Time” was also split into two branches as illustrated in Fig. 3. The first branch is due to “Off season or school breaks”. During school breaks, the demand for UV Express is low due to most of its users being students. The said issue cannot be resolved because it is beyond the control of the cooperatives and authorities. The second branch of the issue is due to technical issues from UVs. Since some of UV Express vehicles are old, and need regular maintenance which leads to a root cause of “Insufficient allocation of resources and schedule for maintenance” which can likely be resolved for having a “Scheduled checking for maintenance in UVs”.

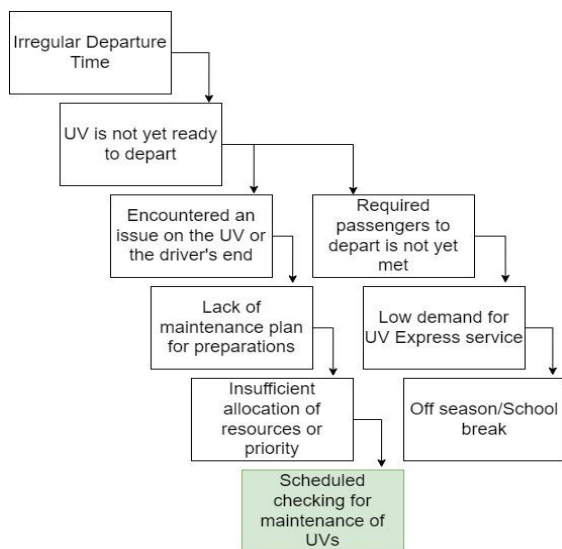


Figure 3. 5 why analysis on irregular departure time

In Fig. 4, the “Traffic congestion” issue was due to the high volume of vehicles on the road especially during peak hours or season. This issue was due to “Lack of road planning and prioritisation” which is an issue that can be solved only by the government, and beyond control of the cooperative.

Furthermore, the issue of “Unclear queuing” was due to “Poor communication or training” of the UV Express in the terminal. Which can be solved by having “Proper communication and training from cooperatives”.

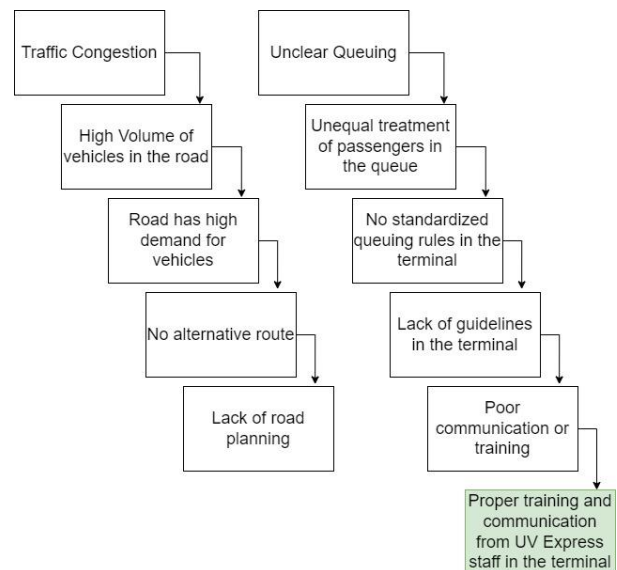


Figure 4. 5 why analysis on traffic congestion and unclear queuing

The issue in “Fare disputes” is due to “Insufficient resources for monitoring” which can be resolved by having “Proper monitoring of unfair treatment/fare disputes” as shown in Fig. 5. However, this issue also is based on feedback from passengers which the cooperatives are unaware of. Lastly, the “Uncertainty of UV availability” where passengers still need to go to the UV terminal and wait in line and knowing afterwards that there are no more UVs that will be coming to the terminal. This issue is due to no way of knowing the availability of the UVs except from the UV staff in the terminal that has communication with the UV drivers which can be resolved by “Tracking UV location/availability”.

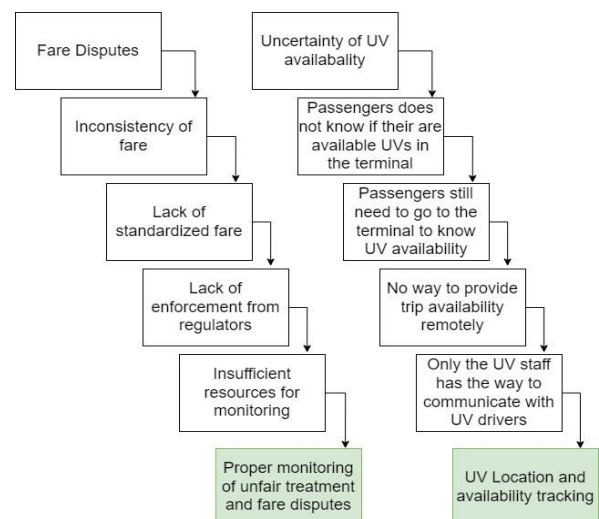


Figure 5. 5 why analysis on fare disputes and uncertainty of UV availability

**4.4. Factors that Influenced the Development of the Framework**

The UV Express operates in a point-to-point way of transportation unlike other PUVs like jeepneys, and buses that stop at certain locations to unload and load passengers which makes the UV Express a fast transport mode compared to them. With this current process the development of a framework can be challenging since the framework is likely to consider having designated pick-up points along the route of UV Express to allow loading of passengers. However, according to Bitcoop, a UV Express cooperative, they are already considering having pick up points in Albay which they have already sent request letters from the Local Government Unit (LGU) along with other transport cooperatives regarding this matter. It is said that they have seen the large volume of inbound traffic of passengers going to the terminal for UV Express, and the passengers are obliged to travel via jeepneys or tricycles just to go to the terminal which also adds up in the road congestion. Furthermore, they already felt the effects of the jeepney phaseout which reduces the volume of jeepneys that the commuters can ride going to the terminal due to its budget friendly fare compared to the tricycle especially from places that are distant from the terminal.

**4.5. Proposed UV Express Framework**

The UV Express drivers' role in the proposed framework is to enable the seat booking mechanism of the UV for passengers to book in the mobile application. The mobile application for drivers and operators is merged because most drivers are also

operators in the UV Express. The operators will be managing their own UVs and employing drivers to ensure that all details are available and transparent for passengers to see, which provides a sense of security and trust. Moreover, the operators can track the location of their owned UVs and view reviews and feedback.

The passengers will book for UV seats once the driver has enabled it where the passenger can set a pickup location which is along the route of the UV to its destination which will cut the travel time of passengers to the terminal that are already in a nearby pick up point reducing time, effort, and travel cost. They will pay the seat booking through digital payments then will be picked up by the UV in the pick-up point which will reduce fare disputes and will be able to provide feedback regarding their experience from the trip to regulate and determine areas in the UV Express that need improvement.

The cooperatives' role is primarily in monitoring booking transactions which will give the cooperative transparency to transaction data of the deployed UVs on the road. Furthermore, they can view feedback, and complaints which will help the cooperatives know lapses, and improvements which they can take care to enhance passenger experience.

The GPS and GIS is responsible for enabling the on-route booking process which ensures that the passengers are near the pick-up points along route to the UVs destination. It is also utilised on the tracking of the UVs and provides the estimated time of arrival to the pick-up points and to its destination. Furthermore, the digital payment refers to the payment method of the passengers that lessens the fare disputes in the UV Express.

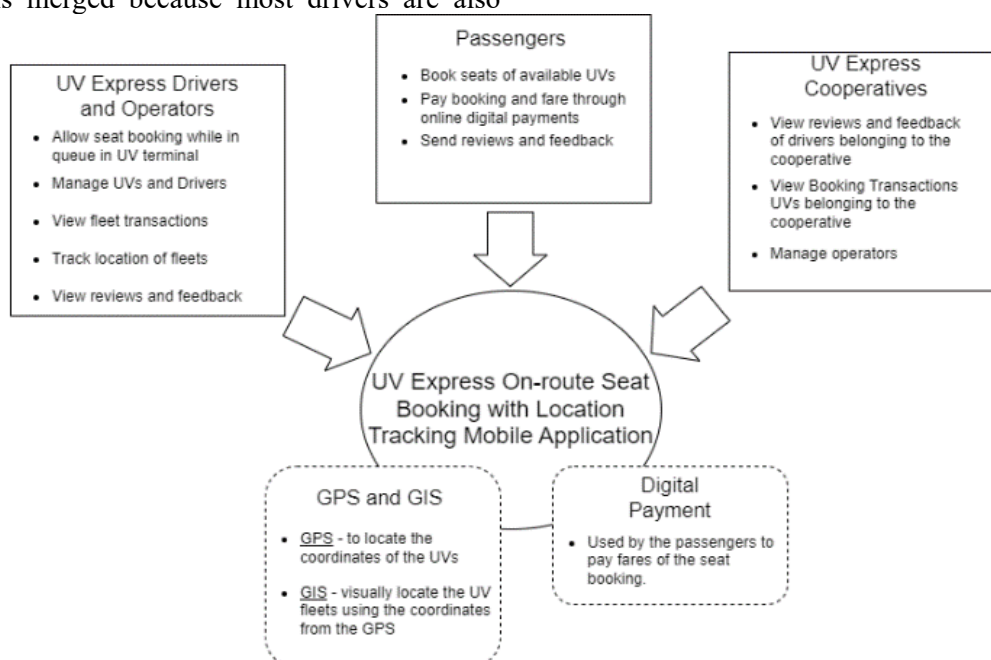


Figure 6. Proposed framework for UV Express in Albay

With the identified problems and its root causes, the proposed framework was developed in accordance with the UV Express' current operation, and policies. The proposed framework will help the UV Express provide a modernised approach to enhance its operations by having three mobile applications primarily for drivers and operators, and the cooperative with the specific features of having an on-route seat booking, digital payments, location tracking, and passenger reviews and feedback with the help of GPS and GIS, and payment gateways.

## 5. Conclusions and Recommendations

In this section, the researcher discusses the conclusions and recommendations based on the findings of the research.

The 5 why analysis identified various root causes affecting the user experience of UV Express passengers. The researcher concludes that improvements can be made to reduce passenger inconvenience at the terminal. However, factors such as the point-to-point scheme of UV Express, which conflicts with designated passenger pick-ups, may affect these improvements. But some UV Express cooperatives suggest that the LGU consider implementing designated pick-up points which will give consideration of the proposed framework to be implemented.

With the findings of the analysis, the researcher proposed a framework through design thinking process for UV Express operations in Albay, addressing identified passenger and management problems. This framework aims to reduce long waiting times, provide accessible schedules, and gather feedback through a mobile application integrating GPS, GIS, and payment gateways. Additionally, the researcher also found that terminal seat reservations could increase waiting times and inefficiency, disadvantaged walk-in passengers. To prevent such disadvantage, the researcher recommends developing an on-route seat booking and location tracking mobile application for UV Express. Moreover, this should be implemented with pilot testing to assess usability and efficiency of the proposed framework.

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