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Laguna Belair Transport Service Cooperative Management Information System

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Abstract: The development of RFID systems for use in any environment has been rapidly evolving with each new development aiming to improve performance and extend the possibilities for a variety of applications (Perkins, 2017). Gathering vital data has been made easier using new technology. However, as the variety of ways to gather data increases, the demand for certain data rises in the need to generate information. In the transport cooperative context, certain mandates have been implemented regarding the need of information about members such as patronage of the coop services. In addition to that, the need to maximize resources effectively is rising in the transportation context due to the rising prices of resources needed to run vehicles. This paper presents the development of a system that allows for effective fleet management and using RFID to comply with mandates. The main objective of the study is to develop a system that would enable management to make decisions regarding the cooperative's operations, resolve compliance issues, and improve overall user experience. Laguna Belair Transport Service Cooperative (LBATSC) provides shuttle services to Laguna Bel Air 1, 2, and 3 residents and transients as well as other people with business in the area. Its main problem is the difficulty of making informed managerial decisions due to different data sources, large volume of data, unavailability of member's data on ridership, among others. The system is able to facilitate remittance processing, shuttle management and member information management. Technologies used are Django for the back end and React.js and Ant.Design for the front end. The methodology used was Agile Methodology. The users agree that the system is aligned with existing business rules and has addressed the problems of managing the shuttle operations.

Key Words: fleet management, management information system, RFID, transport cooperative

1. INTRODUCTION

There have been many innovations in the field of Information Technology (IT) in recent years. Some of these include cloud computing, virtualization, artificial intelligence, social computing, big data, 3D printing, virtual reality, and mobile computing. Technologies such as artificial intelligence, Internet of Things (IoT), augmented reality, smart objects, and blockchain will continue to develop and become more accessible to the general public (Panetta,

2017; Samit, 2017). The goal of most of the upcoming IT trends is to connect more people and more objects to each other to lessen the duration of transactions. There are many other technologies associated with IoT, some of which are radio frequency identification (RFID) technology, Internet protocol (IP), Wireless Fidelity (Wi-Fi), Bluetooth, wireless sensor networks (WSN), and data analytics (Madakam, Ramaswamy, & Tripathi, 2015; Lee & Lee, 2015; Ahmed et al., 2017). IoT is one of the important drivers of emerging technologies in the transportation sector. The focus of this study is on the fleet management and the application of RFID technology in the transportation sector. In the Philippines, there are now many transportation service organizations that implement RFID technology to improve customer experience, and examples of these are the Metro Rail Transit (MRT), the Light Rail Transit (LRT), and Point-to-Point (P2P) buses in Metro Manila (Corrales, 2015; Sabillo, 2016). There is an opportunity to use the same technology in smaller transportation service organizations, especially in transportation service cooperatives, which is also affected by the Public Utility Vehicle Modernization Program. Using RFID technology will allow the recording of riders' information and will also help address opportunities like determining optimal travel routes, rider demographics, improved customer experience, and preventive maintenance schedules.

The target domain of the study is the Laguna Belair Transport Service Cooperative (LBATSC) in Sta. Rosa, Laguna. The cooperative is currently composed of 60 members. Being s transport service cooperative, there are several regulating bodies that it needs to coordinate with such as Cooperative Development Agency (CDA), the Office of Transportation Cooperatives (OTC), the Land Transportation Franchising and Regulatory Board (LTFRB), the Land Transportation Office (LTO), and the Bureau of Internal Revenue (BIR). These different agencies require certain information and reports from the cooperative. For example, CDA requires the cooperative to keep track of ridership so that in the eventuality that these non-members who are homeowners will join the cooperative, their patronage can be computed. Currently, the LBATSC is not able to track ridership. Since it provides shuttle service for the subdivision, passengers can include also construction workers, outsiders, household helpers, baby sitters and their ward, students, etc. The drivers simply get the fare and issue the ticket. Asking the rider or the driver to record information will cause delay and is not an ideal solution due to high turnover of drivers and various types of riders.

The operation of the shuttle service entails driver scheduling, vehicle maintenance, the actual transport of riders, and monitoring the sales performance of the service. The cooperative owns nine (9) shuttles, two of which are electronic jeeps and employs 15 drivers. The supervisors prepare the driver and shuttle schedule, and this is approved by the operations manager. There are two shifts (morning and afternoon shifts and for each shift, there are different schedules for specific shuttles). If there are breakdowns or accidents, the back up shuttle is deployed and the incident is recorded so that the mechanic, if ever, can schedule the repair/maintenance. The drivers remit the payments at the end of their shift and this is verified by the supervisors. The Board of Directors (BOD) meet every two weeks to discuss the fleet management. It is very

important for them to keep track of the fuel consumption, shuttle condition, fuel prices and trends and patterns of ridership on certain shifts and days and determine peak hours to reduce costs and improve its services to the community so they require certain reports. The clerk has to retrieve information from different data sources such as excel sheets, logbooks, folders, driver's remittance slip, etc. which makes it tedious. By the time there is a board meeting, information is not readily available or incomplete due to difficulty of coming up with consolidated/desired reports. Based on these, the proponents identified the main problem which is the difficulty in making informed managerial decisions due large volume of data, different data sources, inability to capture data about ridership, and inconsistency in gathering and recording data. The objective of the study is to develop a transport shuttle service management information system for its fleet management that can facilitate remittance management, monitor the usage and maintenance of shuttles, monitor inventory levels of supplies, track member activities and generate reports about remittances, shuttle performance, and member activity, among others. The scope of the study will be on the shuttle operations and carwash business.

2. METHODOLOGY

The methodology that was used in developing the system is the agile methodology (please refer to Figure 1 for the methodology diagram). The phases are as follows: Project Selection and Approval, Project Initiation, Construction Iterations, and Product Release.

The researchers initially went through the first two stages, where they interviewed key personnel and observed the daily operations of the Laguna Belair Transport Service Cooperative. Additionally, the researchers also consulted with AF Payments, Inc., which is the company that introduced the use of the Beep card in the Philippines, in order to assess the viability of implementing a similar solution within a smaller-size organization. AF Payments provided the CSV template and the tapping device. For the template, the card number and transactions are the only information that will be uploaded in the system. The member's personal information will be added/updated by the member upon logging into the system. The personal information will be based on the legal requirements mandated by the agencies.

During the construction stage, the researchers used the Django web framework, React.js, Ant.design, and Chart.js to develop the front-end and the back-end of the system. There were several iterations because the system was built in increments, so that the developers can easily adapt to changing requirements and system testing can be done in a regular manner, which enables them to identify defects earlier and subsequently, lessen the risk and probability of rework. System testing comprised of unit and integration testing.

The product release phase was mainly concerned with user acceptance testing and system turnover. User acceptance testing involves having the actual users (e.g. office clerk, mechanic, supervisor, drivers, and members of the cooperative) use the system to get their feedback. Furthermore, the researchers developed a technical manual and a user manual for should additional help be needed.

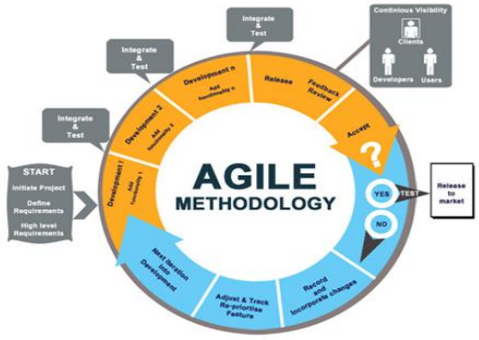

Figure 1: Agile Methodology

3. RESULTS AND DISCUSSION

Based on the interviews, the researchers found that they have difficulty in making informed managerial decisions. This is caused by several reasons, namely: difficulty in preparing reports, as a result of difficulty in locating the files that contain the data necessary for those reports, there are no records of the inventory levels of the supplies used for shuttle repairs, and there are also no records of members' patronage of the cooperative's services. The proposed solution is a Management Information System (MIS) with RFID technology to capture ridership information which is the beep card number and transactions. Please refer to Figure 2 for the conceptual framework diagram which includes the modules, users and technologies used. The main modules are: (1) Remittance Module that allows the operations manager and supervisor to create and update driver and shuttle assignment, deploy shuttles and issue / replenish ticket and monitor remittances; the Beep card information is also included in this module wherein the staff uploads the CSV file which contains the beep card number and transactions for a specific period; (2) Members Module that includes member information (such as name, address, beep card number, etc.) based on legal purpose which the member can add/edit upon logging into the system, it also allows members and BOD to track shares and patronage of cooperative's services, etc.; 3) Maintenance Module that allows the Operations Manager and Mechanic to record/update/monitor preventive and corrective maintenance information and the inventory module allows the operations manager to order supplies before they are depleted and choose suppliers; and 4) Reports module that generates different reports related to the fleet management operations that the BOD needs to make decisions, recommend changes in the operation, and validate government reports. The users are the BOD (Reports and Members Modules), Operations Manager (all modules), Clerk (Remittance and Report Modules, Supervisor (Remittance and Members Modules, Mechanic (Maintenance and Members Modules, Drivers (Members and Remittance Modules and Members (Members Module). During user acceptance testing, the researchers interviewed at least one user of each type. The testers are operations manager who is a regular member; mechanic who is also an associate member; clerk and supervisor (who is also an associate member). Most of the users were in agreement that the system is reflective of the existing business process and even enhances it somehow. Out of all the modules, the members module was the highest-rated. The associate and regular members appreciated it because they considered it very helpful in terms of tracking member patronage, which they need to do in order to comply with the Cooperative Development Authority's mandates. Members also like the fact that they can keep track of the number of shares they own and of the transactions related to their patronage of the cooperative's services. The module that needs the most improvement is the remittance module, but this is mostly due to the driver's experience (UX) concerns rather than processing issues. The assessments of the maintenance and inventory modules were positive; the users of said module (i.e, operations manager, clerk and mechanic) found them helpful in terms of managing the status of the shuttles that are used for the cooperative's shuttle service and of monitoring the inventory levels of the supplies that are needed for shuttle repairs (please refer to Figure 3 for the screenshot of the shuttle information page). The clerk and the mechanic also found the purchasing aspect of the inventory module helpful since the system is able to suggest which vendors to buy supplies from (please refer to Figure 4 for the screenshot of the purchasing page). The operations manager (who was a former BOD) also found that the reports showing peak days and routes of the shuttle service are very helpful in improving it. Refer to Figure 5 for the sample report.

The development cost of the system amounts to 2,000 pesos because all of the software that were used during development were free and open-source, and no new hardware was acquired. Installation cost was computed to be equivalent to 50,030 pesos, most of which is related to the purchase of Beep readers for the cooperative's shuttles. In addition, the

cooperative already owns several laptop computers that the system can be installed so there is no need to buy new ones. The system provides annual benefits of 108,441 pesos, which means the cooperative's operational costs will be lowered if they use the system. The system's payback period, which is the length of time until the cooperative regains the money used to finance its development, is 6 months.

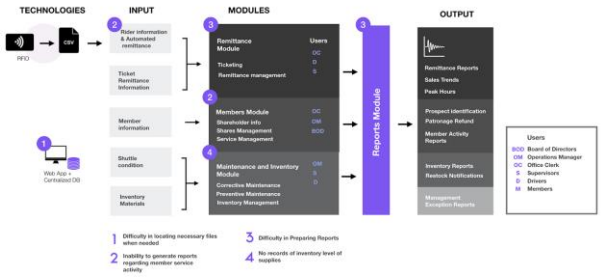

Figure 2: Conceptual Framework

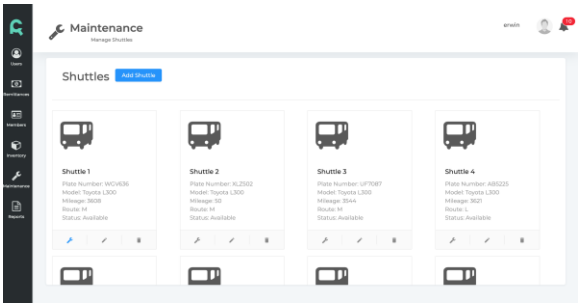

Figure 3: Screenshot of Shuttle Information Page

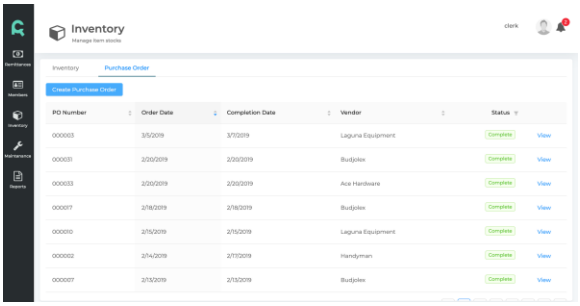

Figure 4: Screenshot of Purchasing Page

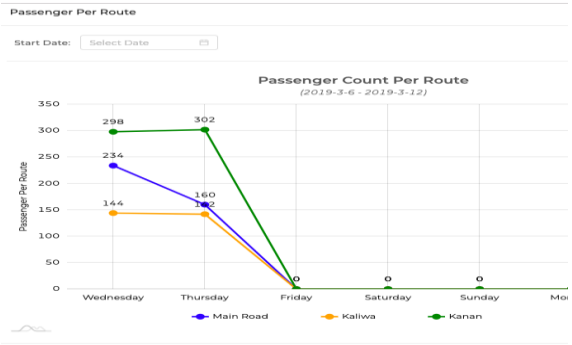

Figure 5: Passenger Count per Route Report

4. CONCLUSIONS

The proposed Management Information System helps the client organization to manage its fleet effectively. The system facilitates the processing of driver remittances and provides the ability to easily track the usage and maintenance of shuttles, the inventory levels of supplies used in shuttle repairs, and the members' patronage of the cooperative's services.

Recent mandates by cooperative regulatory bodies have forced cooperatives to search for ways to comply with these mandates. One such mandate is to track the members' patronage of their services. This system does not only address compliance issues but also provides an opportunity for the cooperative to determine their members' patronage of its services, which will help them monitor members who are not active based on the recorded transactions. If the non-member decides to become a member and he/she submits an application that includes the card number, the data can be retrieved through the system.

Currently, most of their record-keeping is done manually, with a lot of data entry in different mediums such as paper and computer. Since the data entry they do does not only refer to simple copying of data, but also includes computations, it is hard to assure integrity because it is vulnerable to human error.

In conclusion, the system was able to solve the cooperative's problems of difficulty in preparing reports and generating member service activity reports because of its reports module that gets data from the remittance, maintenance/inventory, and members modules. The maintenance/inventory module also addresses the cooperative's problem in tracking the inventory levels of their supplies. Since the remittance, maintenance/inventory, and member data are all stored in a centralized database, it is easier for the cooperative's users to find the data that they need. They do not need to fill up various, separate forms and logbooks that will also have to undergo proper filing and storage (in different places if they cannot be stored in one location anymore due to capacity issues) and then look for them should they need to get some information out of them. Additionally, members of the cooperative will also be able to track the number of shares they own and to review the transactions that they have made with the cooperative's services.

The cooperative already has the infrastructure in place to accommodate the use of the proposed system plus they have two eJeeps now. However, they will have to negotiate AF Payments, Inc. or other providers about the acquisition of card readers and how the data that is recorded are handed over to the cooperative considering the Data Privacy Act of the Philippines. In addition, the users will need to be trained on how to use the system and incorporate it into their current workflow/setup. An android application can be developed to make it easier for the drivers to submit their remittance.

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