



Web-Based Motorcycle Loan Management System with credit risk and approval analysis using Data Mining Techniques

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Received Date April 18, 2023

Accepted Date: May 20, 2023

Published Date: June 06, 2023

ABSTRACT

Using information systems can dramatically improve a business's productivity and efficiency. Moreover, the ability of information systems to provide users with the information they need to complete jobs effectively can be the most significant advantage. This project development plan proposes a Web-Based Motorcycle Loan Management System with credit risk and approval analysis using Data Mining Techniques for a private motorcycle dealer who encounters challenges, particularly in the decision-making of motorcycle loans. It will facilitate the automation of business processes, including online motorcycle loan applications and payments, access to real-time data and reporting, and credit risk and approval analysis to assist the credit department in decision-making by applying data mining techniques. The project will employ the Scrum framework for software development and testing method. A total of 150.625 man-days with a total cost of P1,350,231.78 were computed to complete the proposed information system. A one-year financial viability analysis was defined to determine the proposed project's total cost and benefits. Based on the results, time spent on activities is reduced to 89.19%, indicating that the business can handle more applications every day compared to the average twenty daily applications since processing time is significantly decreased. It is recommended for future improvement of this plan to implement Augmented Reality for a better user online experience in previewing motorcycle units.

Key words : Data Mining, Information System, project development plan, motorcycle loan

1. INTRODUCTION

The Philippines is one of the countries with the largest motorcycle users in Southeast Asia [1]. Motorcycles have become in demand nowadays and a widely accepted transportation mode for many [1], [2], not just because of low gas consumption [3] but also to avoid the disastrous traffic situation in the country [1]. Based on the Motorcycle Development Program Participants Association (MDPPA)

sales report for the Sales Report of 2018 [4], approximately 21% of annual sales were achieved, with a total of 1,580,926 units sold. As it predicted a 20% increase in sales for 2019, the association anticipates that the upward trend in motorcycle sales will continue. Additionally, findings from the Philippines Census conducted in 2010 [5] showed that almost 90% of households in the country—more than 13% of which are based in Metro Manila—own at least one motorcycle.

Another reason for the rapidly rising of motorcycle users every year is that this type of transportation is more affordable than loaning a car or van [3]. However, not all people can afford to consider the product's price versus the daily needs, as well as the household's salary [6]. Consequently, in the Philippines, motorcycle dealers offer credit or loans for their items [3], [4], [7]. A study conducted in Nueva Ecija, Philippines [7], found that 4 or 8.89% of the debtor respondents acquired a motorcycle loan. Individuals can apply for 1-3 years on an installment basis for motorcycle loans without a down payment.

RUBI Grand Showroom Corporation, commonly known as RUBI, is a subsidiary entity of the LYR Group of Companies that primarily offers motorcycle units. The business has multiple locations situated in different cities and municipalities in Mindanao. Branches are in Tagum, Panabo, Polomok, and two showrooms in Davao City: Ulas and Calinan. From branded and affordable motorcycles, RUBI offers cash or loans for their items.

RUBI's current situation includes company policy on conducting a credit investigation will be done the next day after the applicant submits the requirements. The strategy often delays the approval process as moving to the subsequent phase will depend on the completion of requirements. Sometimes, ocular inspections are not performed on time due to the availability of credit field investigators, who typically examine twenty applications on average per day. Also, the remoteness of applicants' addresses is a factor in delaying the transaction. In conclusion, CIs occasionally will only fulfill their daily quota (applications to be investigated) because the

following location is distant from the currently inspected or they are not available. Unperformed assessments will be rescheduled the next day or Monday (if the next day is Sunday), adding to the following day's list and might result in rescheduling others if the same condition arises — cascading effect. Another factor for delaying the approval is the time-consuming and lengthy process for assessment. The credit investigation team reviews each requirement submitted by each applicant which can take hours. Aside from a review of the applicant's submitted requirements, RUBI is adopting a traditional credit risk model that might have a possible adverse effect on the business by raising collection costs and disrupting the consistency of cash flows. By adopting this model, there's the possibility of approving applicants that fail to meet their debt obligations. The loss may be partial or complete, where the RUBI incurs a loss of part of the loan or the entire loan extended to the customer.

Further, the current application and paying for motorcycle loans can be made by visiting their physical branches, limiting their target customers compared to their competitors who established online stores. Also, since it's a brick-and-mortar store, the hours or locations might need to be more convenient for some customers/applicants.

Lastly, another concern is the availability of information. For its applicants and customers, the only way to access accurate information is by visiting or contacting the connected branch. They must travel to the physical store or wait for the response to get information like their application details and status, list of submitted and unsubmitted requirements, and loan balances. Also, as the information is not immediately available, customers and applicants will not be updated on their latest status and might have incorrect or misleading information. For its employees, attaining information is time-consuming and costly. As the RUBI adopts a mix of manual document filing and a point-of-sale system, employees need to organize and store the document files, which can also take a lot of space, and hunting down the information when needed can take time. It can take minutes to hours to hunt down a file; the file found might have data errors that need to be corrected, and unvalidated files lead to misinformation. In some cases, the file might not be helpful as it is damaged, or worst file can't be found as it is lost or misplaced. This traditional strategy also results in a high cost for printing and acquiring supplies; paper documents are much harder to change, reduce the sharing of information in real-time, and poor and costly tracking and producing reports that include inventory and sales.

With the significant advances made in computer technology, data collection and manipulation have become more feasible than ever. Thus, the growth of data analysis and classification demand is realized. Data mining is the most popular technique utilized in this area [8]. It can process and discover meaningful correlations, trends, and patterns by sifting vast amounts of data stored in different repositories by applying pattern recognition technologies and statistical and mathematical techniques [9].

Hence, this study is motivated to produce this project proposal to explore Data Mining to provide better loan management in the motorcycle dealership industry with an automated and well-judged credit risk assessment and approval analysis.

1.1 Project Objectives

The project's objective is to develop an information management system that will focus on managing and delivering the business' services efficiently to customers through:

- assisting the company in motorcycle loan application;
- securing the application results can be done in a day only;
- guiding in conducting and fair judging on credit assessments;
- providing an online checklist of the updated list of submitted and unsubmitted requirements of the application;
- enabling employees to generate and provide access to real-time inventory and sales of motorcycle units;
- allowing customers to pay their loan balances online;
- allowing customers to view updated application details and;
- customers will be updated to their application, due of payments, and business announcement through SMS notification.

1.2 Scope and Limitations

The scope of this project is to design a Web-based Information Management System for RUBI Grand Showroom Corporation. The system focuses to shorten turnaround time (TAT) and increase process efficiency of the application from registration to receiving the unit by securing that the requirements checklist is updated and assessment results are carried out on time. The system generates accurate reports and the real-time managerial report data are available anytime, provides customers' application view with updated and accurate information, and implements an auto-generated analysis of an application's credit to aid the credit department in decision-making by performing data cleaning and applying data mining techniques specifically clustering and classification.

1.3 Project Stakeholders

The participating stakeholders are composed of two organization which are coming from external and internal groups.

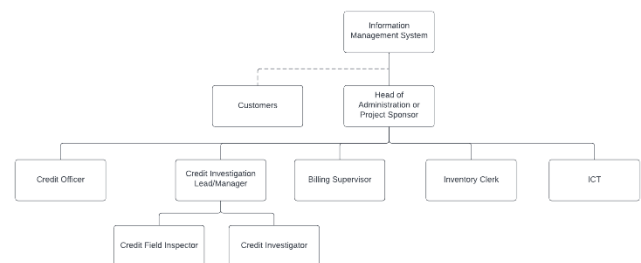


Figure 1: External Organization

Figure 1 shows the external interface of the project which is composed of the following: Head of Administration or Project Sponsor (PS), Credit officer (CO), Credit Investigation Team (CLI), Inventory Clerk (IC), Billing Supervisor (BS), and ICT. Further, the Credit Investigation Team comprises Credit Field Inspector and Credit Investigator Staff.

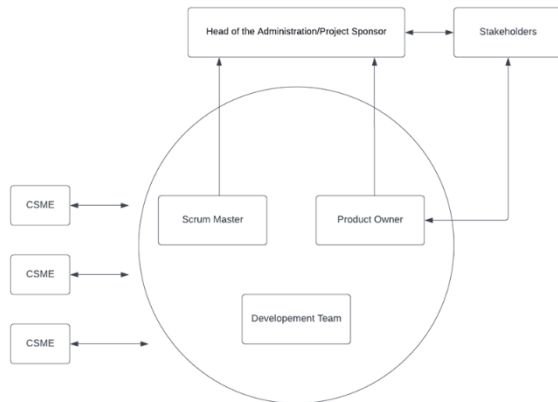


Figure 2: Internal Organization

Figure 2 shows the Internal interface of the project which is composed of the following: Product Owner (PO), Scrum Master (SM), and Development Team. The Development Team (DT) consists of Full Stack Senior, Full Stack Junior, Systems Analyst/Designer, Quality Assurance/Testers, DB Administrator, Data Mining Engineer, and Data Migration Specialist.

2. METHODOLOGY

2.1 Software Development Methodology

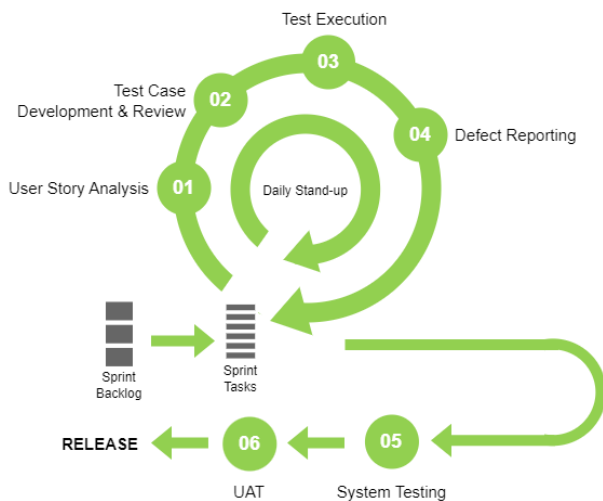


Figure 3: Agile Testing

Functional, structural, and process qualities are the aspects of software quality. Addressing these factors can only be finalized and ready for production if it has passed through validation and verification. Scrum emphasizes proactive and

reactive approaches to quality. Proactively, by promoting face-to-face interaction, developing design and coding standards, and pair programming. Reactively, Agile In this project proposal, the testing methodology has been used, and the agile software development principles are followed throughout the software testing process.

2.2 Project Framework

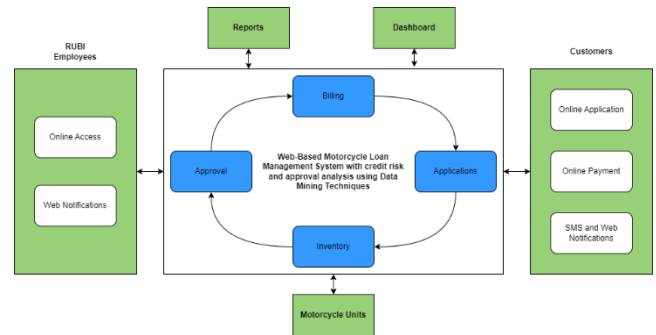


Figure 4: Project Framework

Figure 4 depicts the project framework where it expects to address the current state by developing a networked-based system that will include the following modules/backlogs:

- Admin Module – The Administrator will be able to manage data, restrict loan access, and oversee other system modules with the help of this module.
- Application Module – This module will allow the Credit Officer to manage applications from new and existing customers. It also enables the Credit Investigation and Billing departments to retrieve the applications.
- Application Analyzation Module – A sub-module of the Application Module that will allow the Credit Investigation department to conduct final assessments based on the process and analyze data of the proposed system that adopts hybrid Data Mining Techniques: clustering and classification.
- Billing Module – This module will make it possible for the billing department to carry out routine tasks. This module will be used to manage the billing data for the clients.
- Inventory Module – The inventory staff will be able to track and manage the inventory of motorbike units and their status with the help of this module.
- Customer Module - Customers can access general information online with this module. By accessing this, they can also see the status of their application.
- Reporting Module
 - Reports – With the help of this module, RUBI staff members will be able to produce the necessary standard reports for top management.
 - Dashboard – Through this feature, the organization will be able to view the data and statistical information provided for decision-making.

2.3 System Architecture

The project’s system architecture is depicted in Figure 5. Employees from various departments, head of administration, applicants, and existing customers are all system users. The customer and employees will access the system online. A web server which the project hosted will manage all database and web transactions.

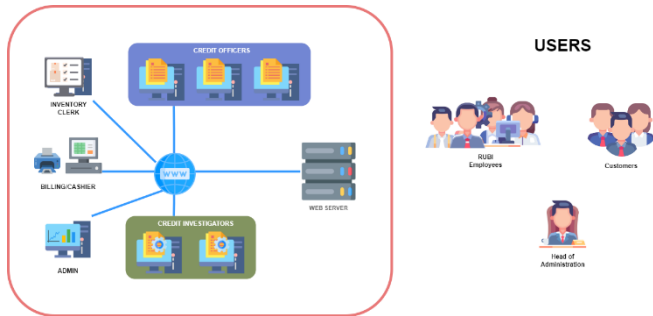


Figure 5: System Architecture

2.4 System Development

The agile Scrum methodology, which emphasizes incremental and iterative processes, is used for developing the system. Scrum is an agile framework that is rapid, adaptable, and designed to provide value to the client throughout the project's development. Scrum's main objective is to satisfy the customer's needs by promoting an environment of open communication, shared responsibility, and continuous development. Figure 6 displays the system development approach.

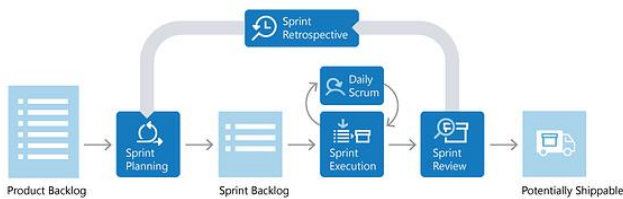


Figure 6: System Development

The development process begins with a general understanding of what must be created, developing a list of qualities (the product backlog) the product owner wishes to achieve, which turn into Sprint Backlog. Scrum events on each Sprint make it easier to adjust some elements of the process, the product, the progress, or the relationships. These include Sprint Planning, Daily Scrum, Sprint Review, and Sprint Retrospective.

2.5 Data Mining Approach

In providing credit risk and approval analysis, data mining is the approach to be used in the project. Data mining is sifting through enormous amounts of data to find knowledge and intriguing patterns. The SAS Institute's SEMMA (Sample, Explore, Modify, Model, Assess) is the adopted data mining methodology for this project.

1. Sample: RUBI's ICT Team will extract an extensive dataset, and sample data that accurately represents the entire dataset is taken out. Sampling will speed up processing and cut down on computational costs.
2. Explore: To gain a better understanding of the data, any outliers and anomalies are investigated. Data Mining Engineer visually examines the data to identify trends and groups.
3. Modify: Data manipulation operations like grouping and subgrouping are carried out while keeping the final model in mind.
4. Model: The models that describe the patterns in the data are built based on explorations and modifications. The project will use a hybrid data mining technique to produce a data model with two processing stages: clustering and classification. The clustering stage involves grouping samples into uniform clusters, eliminating isolated samples, and relabeling inconsistent samples. Samples with updated labels are fed into Support vector machines (SVMs) to create the data model during the classification step.
5. Assess: Involves evaluating the developed model's usefulness and dependability. In this step, the model is tested using actual data.

3. RESULTS AND DISCUSSION

3.1 Cost and Schedule Estimates

Table 1 illustrates the projected workforce cost based on the estimated number of man-days required for each role and its corresponding daily rate estimates.

Table 1: Manpower Cost Estimates

Position	Rate/Day	Total Mandays	Cost
Head of the Administration or Project Sponsor (PS)	-		
Project Owner (PO)	₱1,650.45	52.53	₱86,700.20
Scrum Master (SM)	₱1,389.40	34.03	₱47,283.02
Developer 1 (FSS): Full Stack Senior	₱1,705.00	109.41	₱186,537.66
Developer 2 (FSJ): Full Stack Junior	₱1,106.78	96.28	₱106,562.16
Developer 3 (SAD): Systems Analyst/Designer	₱1,080.16	95.34	₱102,986.51
Developer 4 (QAL): Quality Assurance Lead	₱1,607.23	116.84	₱187,794.78
Developer 5 (QAJ): Quality Assurance Junior	₱1,493.28	100.03	₱149,374.67
Developer 6 (DBA): Database Administrator	₱1,478.52	101.28	₱149,746.35
Developer 7 (DME): Data Mining Engineer	₱3,400.00	18.31	₱62,262.50
Developer 8 (DMS): Data Migration Specialist	₱2,300.50	10.69	₱24,586.59
TOTAL			₱1,103,834.44

Table 2 illustrates the summary of the project schedule, broken down per phase.

Table 2: Schedule Estimates

Phase	Duration (Mandays)	Start Date	End Date
Definition Phase			
Project Inception	3.1875	Mon, 10-Apr-23	Mon, 17-Apr-23
Agile Project Charter	2.8125	Wed, 19-Apr-23	Mon, 24-Apr-23
Project Plan	9.25	Tue, 25-Apr-23	Fri, 12-May-23
Project Kickoff	1.03125	Fri, 12-May-23	Mon, 15-May-23
Product Backlog & Product Roadmap	4.46875	Tue, 16-May-23	Mon, 22-May-23
Sprint 0	4.5	Tue, 23-May-23	Fri, 26-May-23
Phase Total	25.25		
Sprints			
Sprint 1: Loan Application Backlog	16	Mon, 29-May-23	Tue, 20 Jun-23
Sprint 2: Loan Application (Part 2) and credit risk and approval analysis; Customer View Backlog	16	Wed, 21 Jun-23	Thu, 13 Jul-23
Sprint 3: Administrator Backlog	16	Fri, 14 Jul-23	Fri, 04 Aug-23
Sprint 4: Online and In-store Payment & Inventory Backlog	16	Mon, 07 Aug-23	Wed, 30 Aug-23
Sprint 5: Login and Report Backlog	16	Thu, 31 Aug-23	Thu, 21 Sep-23
Sprint 6: Finalization Backlog	15.625	Fri, 22 Sep-23	Fri, 13 Oct-23
Phase Total	95.625		
Live Phase			
Go Live	2.875	Mon, 16 Oct-23	Thu, 19 Oct-23
Maintenance and Support	25	Fri, 20 Oct-23	Mon, 08 Jan-24
Project Closure	1.875	Tue, 09 Jan-24	Fri, 12 Jan-24
Phase Total	29.75		
TOTAL	150.625	Mon, 10-Apr-23	Fri, 12 Jan-24

As shown in Table 3, ₱51,944.00 is the total hardware cost estimate in which there are one computer and one printer to be purchased.

Table 3: Hardware Cost Estimates

Hardware	Quantity	Actual Cost
Windows 11 Home SL 12th Gen Core i5-12400 processor 8GB DDR4 256SSD + 1TB HDD NVIDIA GeForce GT1030 with 2GB of DDR5 (Desktop and Monitor Bundle)	1	₱43,999.00
Epson EcoTank L1210 A4 Ink Tank Printer	1	₱7,945.00
Total Cost		₱51,944.00

As shown in Table 4, ₱39,0300.00 is the total software cost estimates.

Table 4: Software Cost Estimates

Software	Quantity	Actual Cost
Visual Studio Code	4	Free
Justinmind	2	Free
Adobe Illustrator	1	₱5,230.00 (5 months)
Google Drive	5	Free
Web Hosting	1	₱2,016.90 (9 months)
Domain Name	1	₱2,500.00
Monday.com	1	₱2320.00 (5 months)
m360 SMS API	1	₱11,691.00 (9 months)
Dragon Pay	1	₱10,125.00 (3 months)
Total Cost		₱33,882.90

3.2 Project Cost Summary

Adding the Work Breakdown Cost, Technology Cost, Audit Cost, and Effort Cost, Table 6 shows the monthly budget allocation for the project.

Table 6: Project Cost Summary

Year	Month	WBS Cost	Techn ology Cost	Audi t Cost	Effor t Cost	Total Cost	Cumu lative Cost	
2023	April	₱19,805.04		₱5.00	₱1,980.50	₱26,785.55	₱26,785.55	
	May	₱131,196.04	₱56,174.10	₱5.00	₱13,119.60	₱205,489.74	₱232,275.29	
	June	₱220,566.78	₱3,029.10	₱5.00	₱22,056.68	₱250,652.55	₱482,927.84	
	July	₱200,001.23	₱3,029.10	₱5.00	₱20,000.12	₱228,030.45	₱710,958.29	
	August	₱192,899.63	₱6,404.10	₱5.00	₱19,289.96	₱223,593.69	₱934,551.99	
	September	₱189,522.74	₱6,404.10	₱5.00	₱18,952.27	₱219,879.12	₱1,154,431.10	
	October	₱103,706.05	₱6,404.10	₱5.00	₱10,370.61	₱125,480.76	₱1,279,911.86	
	November	₱30,340.69	₱1,523.10	₱5.00	₱3,034.07	₱39,897.86	₱1,319,809.72	
	December	₱11,770.43	₱1,523.10	₱5.00	₱1,177.04	₱19,470.58	₱1,339,280.30	
	2024	January	₱4,025.80	₱1,523.10	₱5.00	₱402.58	₱10,951.48	₱1,350,231.78
		TOTAL	₱1,103,834.44	₱86,013.90	₱50,000.00	₱110,383.44	₱1,350,231.78	

3.3 Financial Viability Evaluation

Identifying the financial viability of the project commences by collecting user stories that include current cost information in doing tasks of all operating departments within the motorcycle loan application. Attaining the cost for performing the activity, the total hours spent on each activity are multiplied by the employee's hourly rate. Table 7 shows the computations of the time spent for the current and proposed processes. Based on the data collected, the time spent on the activities is reduced to 89.19%.

Further, in acquiring the total annual saving for this process, compute the expenses incurred for the current process and obtain the difference from the proposed process computation. Table 8 shows the total saving with process improvement using the proposed system per year which is ₱2,144,692.00. Additionally, the new system will cost ₱352,167.20 annually.

Table 7: Time spent: Current vs Proposed Processes

Processes	Current	Proposed	Difference
Credit Department	30 mins	10 mins	20 mins
Credit Investigation	235 mins	5 mins	230 mins
Billing Department	15 mins	5 mins	10 mins
Inventory Department	90 mins	20 mins	70 mins
Total	370 mins	40 mins	330 mins

Table 8: Payback Period (Cost vs. Saving)

Process	Current	New	Savings
Credit Department	₱330,000.00	₱110,000.00	₱220,000.00
Credit Investigation	₱1,382,356.80	₱49,500.00	₱1,332,856.80
Billing and Inventory Department	₱784,502.40	₱192,667.20	₱591,835.20
Difference	₱2,496,859.20	₱352,167.20	₱2,144,692.00

To compute for the total savings per month, the annual savings (₱2,144,692.00) is divided by twelve (12) which will yield a monthly savings of ₱178,724.33. Performing a 12-month projection for the next twelve (12) months, the cumulative costs and cumulative savings are computed as shown in the Table 9.

Table 9: Cumulative Cost VS Cumulative Savings

Month-Year	Total Cost	Savings	Cumulative Savings
Jan-24	₱1,350,231.78	₱178,724.33	₱178,724.33
Feb-24		₱178,724.33	₱357,448.67
Mar-24		₱178,724.33	₱536,173.00
Apr-24		₱178,724.33	₱714,897.33
May-24		₱178,724.33	₱893,621.67
Jun-24		₱178,724.33	₱1,072,346.00
Jul-24		₱178,724.33	₱1,251,070.33
Aug-24		₱178,724.33	₱1,429,794.67
Sep-24		₱178,724.33	₱1,608,519.00
Oct-24		₱178,724.33	₱1,787,243.33
Nov-24		₱178,724.33	₱1,965,967.67
Dec-24		₱178,724.33	₱2,144,692.00
Jan-25		₱178,724.33	₱2,323,416.33

Furthermore, the total cost will be regained after eight months (in August 2024) from implementation. During this time, at the cost of ₱1,350,231.78, the cumulative savings will be ₱1,429,794.67. Computing the ROI or return on investment is subtracting the cumulative savings of the said month to the total cost and divide the result by the cost of the project. As a result (1), an ROI of 6% is gained after eight months from implementation.

$$ROI = \frac{(savings - costs) / costs}{\frac{₱1,429,794.67 - ₱1,350,231.78}{₱1,429,794.67}} \quad (1)$$

$$ROI = 0.055 \text{ or } 6\%$$

2.7 Proposed Business Process

Customers can submit their applications online or in-store for the proposed business process. Customers can select a motorcycle unit through an online brochure (Figure 7) and apply for a loan. Submission of personal information for new customers is still required, along with other documents in current business requirements. Existing customers can also update their data if there are recent changes. Once submitted, the proposed system will analyze the submission and produce results. The proposed system notifies the Credit Inspector Lead for final review. The final results will be posted on the system and informed to the customer.

The submitted data will undergo a pre-processing activity aiming to guarantee that data is suitable, well-formatted, and complete. Consequently, data will proceed with Data Mining, where the project adopts clustering and classification. Results will be displayed on the application and its measurements, which includes true positive rate, false positive rate, precision, and recall. Also, Receiver Operating Characteristics (ROC) and the cluster of credit risk are presented. These findings will assist the Credit Inspector Lead in the decision-making of the final approval. Figure 8 displays a sample UI Design for application showing Data Mining results.

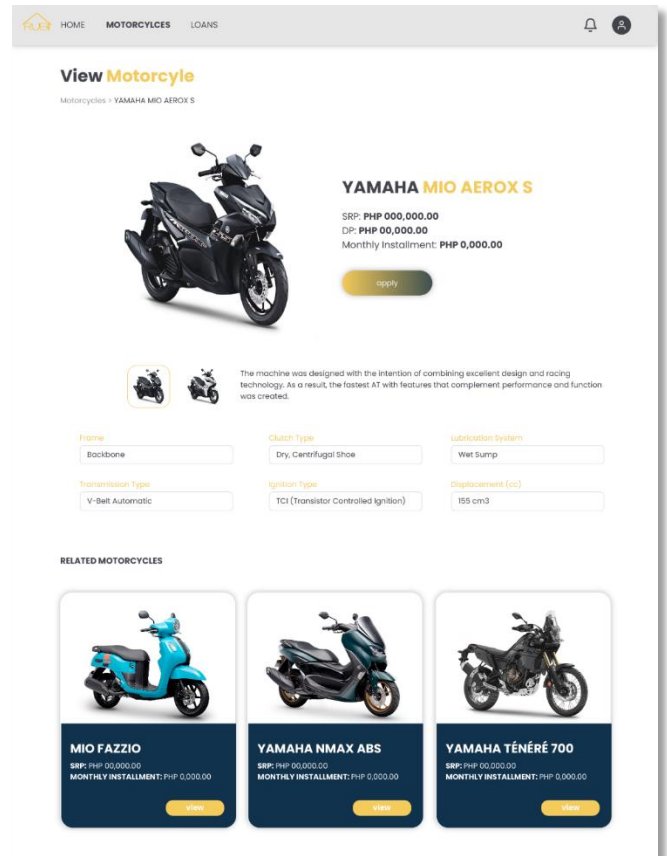


Figure 7: Sample UI Design – Online Brochure

Customers who applied in-store sign Loan Forms, Terms and Conditions, and motorcycle unit testing to ensure the contract

is aligned and the customer approves the release unit. After, the customer pays the down payment to the cashier. Once processed by the cashier, the proposed system notifies the inventory personnel of a request to test the loaned motorcycle. After, Inventory Personnel will validate the form and get the selected motorcycle. Moreover, he/she introduces basic information about the motorcycle and shares instructions and dos and don'ts. Both the personnel and customer will check and test the motorcycle to see if it is good for release. If it is good, the Inventory Personnel will release the motorcycle, and the customer will receive the unit.

On the other hand, customers who apply online sign Loan Forms and Terms and Conditions. After, the customers pay the down payment and delivery fee (if they select delivery to receive the unit) through online payment channels. Once processed, the proposed system notifies the inventory personnel of a request to test the loaned motorcycle. After, Inventory Personnel will validate the form and get the selected motorcycle. If it is good, the Inventory Personnel will release the motorcycle if pick-up and schedule a delivery for delivery option. The proposed system will notify the customer regarding the pick-up/delivery of the loan item.

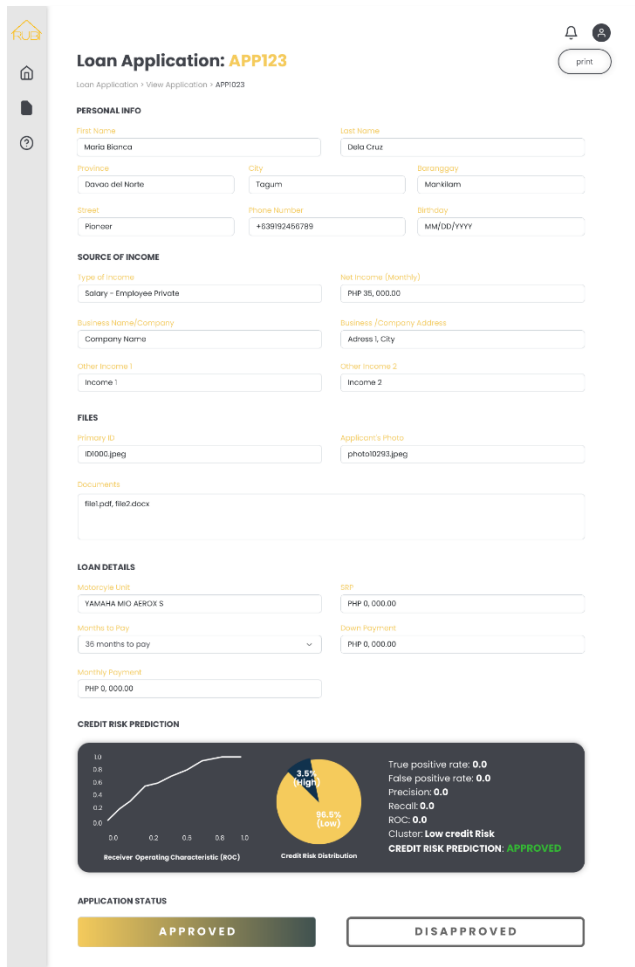


Figure 7: Sample UI Design - Data Mining

4. CONCLUSION

This proposed Web-Based Motorcycle Loan Management System supports each business department to be more productive, and the time saved from each activity may be used for other transactions with the considerable savings that the business can gain.

Table 10: Continuous Improvement

#	Continuous Improvement	Remarks	Target
1	Include additional RUBI services in the system.	The system would cover all business transactions if other RUBI services were included, making it more beneficial to the business.	May 2024
2	Dedicated mobile application for RUBI	Given that practically all loaners now have smartphones and ease of access, a mobile application for the business would be a vast improvement.	November 2024
3	Integrate the project into other branches of the business.	Business showrooms may acquire precise application information in the area because all branches have been merged into a single, centralized network.	2025
4	Implement Augmented Reality	Assist for visualizing motorcycle units and better user experience.	2026

Also, the proposal assists in the auto-generated analysis of an application's credit to aid the credit department in decision-making by performing data cleaning and applying data mining techniques tailored to this industry. With this at hand, the company anticipates securing savings of up to ₱2,144,692.00 each year of operations. Furthermore, continuous improvement became a core part of agile methodologies. It shows up in iterative development and shorter feedback loops in Scrum practices. Moreover, the recommended improvements of the proposed project are outlined in the Table 10.

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