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Digitalization of Specialist Modification Workshop Services Through a Customer Relationship Management Approach for Transparency in Vehicle Work Stages

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Abstract: *Digitalization of specialist modification workshop services is necessary to address fragmented service records and limited customer access to information regarding vehicle work progress. This study aims to develop a web-based information system using a Customer Relationship Management (CRM) approach to integrate customer relationship management with transparent vehicle work-progress monitoring. The research employed an applied research design with a descriptive approach and the Prototype development method. Data were collected through observation, interviews, documentation, and literature studies, involving workshop owners or administrators, mechanics, and customers as informants selected based on their involvement in the workshop service process. The system was developed using PHP, CodeIgniter 3, and MySQL, with CRM implementation covering the Acquire, Enhance, and Retain stages. The results demonstrate that the system integrates customer and vehicle data, bookings, mechanic assignments, work-progress updates, photographic documentation, consultations, estimate approvals, complaints, feedback, and service history within a unified platform. Its main contribution is the integration of CRM processes with vehicle work-progress monitoring, enabling customers to access more structured and traceable information about each stage of the modification process. System functionality was evaluated through user evaluation during prototype development and Black Box Testing conducted using 28 test scenarios covering authentication, access control, data management, bookings, work monitoring, communication, reporting, and session security. All 28 test scenarios produced outputs consistent with the expected results. These findings indicate that the developed system provides functional support for workshop service digitalization, improves information transparency, and facilitates more structured communication among customers, administrators, and mechanics.*

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Introduction

Digitalization has transformed the way organizations conduct business processes, manage data, and provide services to customers. The use of information systems enables the integration of operational activities, increases efficiency, and supports decision-making (Plekhanov et al., 2023). Digital transformation also encompasses changes in the technology, strategy, and operational aspects of an organization, so its implementation must be aligned with business needs (Kraus et al., 2022; Elia et al., 2024). In specialist vehicle modification workshops, digitalization is crucial because the service process involves design consultations, component selection, mechanic scheduling, step-by-step execution, and documentation of work results.

Service management that still relies on books, personal messages, and verbal communication can leave customer information, vehicles, and work progress scattered and difficult to track. This situation highlights the need for an integrated information system to support service efficiency and business competitiveness. Research on digital transformation emphasizes the importance of aligning technology with organizational processes and needs so that digital change can systematically support business activities (Kraus et al., 2022; Elia et al., 2024). Furthermore, integrating customer data and service history can help maintain information consistency and support customer satisfaction (Gazi et al., 2024).

The main problem faced is limited customer access to information on vehicle repair stages, from queues, dismantling, component installation, and completion. Customers must contact the repair shop repeatedly to check on the progress of the work, while staff must manually search for data when providing information. This situation has the potential to reduce service efficiency and customer trust due to delays or inconsistencies in information. Issues regarding information access and reservation management were also identified in the development of a website-based body repair service reservation system, which provides customers with availability information (Wibawa & Ariasih, 2022).

Another issue is the unintegrated management of customer data, modification needs, communication history, orders, complaints, and feedback. A Customer Relationship Management (CRM) approach can help organizations systematically manage interactions and service history to support ongoing service and customer retention (Guerola-Navarro et al., 2024). The implementation of electronic Customer Relationship Management is also related to customer loyalty through the quality of the relationship formed between the organization and customers (Magatef et al., 2023). Therefore, customer relationship management needs to be supported by a system that can integrate customer information and interactions within a single service flow.

Ferreira et al.'s (2023) study discusses the integration of mobile CRM and electronic CRM with a user-centered design approach in the real estate sector. While emphasizing the importance of ease of use, the study did not address the transparency of vehicle repair stages in specialist modification workshops. On the other hand, research on CRM development indicates that utilizing technology in customer relationship management requires attention to organizational processes and needs (Ledro et al., 2023). Therefore, a system is needed that not only manages customer relationships but also integrates status updates and photographic documentation of vehicle progress so customers can more clearly monitor the progress of the

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repair.

This research aims to build a web-based information system with a CRM approach to manage customer data and interactions and present vehicle work progress transparently. The urgency of this research lies in the need to improve information transparency and service quality, while its novelty lies in the integration of customer relationship management with work progress monitoring, photo documentation, complaint handling, and service assessment in one system. This integration is expected to support a more structured workshop service management while making it easier for customers to obtain information on the progress of their vehicle work. This research is entitled "Digitalization of Modification Specialist Workshop Services through a Customer Relationship Management Approach for Transparency of Vehicle Work Stages."

Research Methods

This research is an applied research with a descriptive approach that aims to build a web-based information system for the digitalization of specialist modification workshop services through a Customer Relationship Management (CRM) approach. The system development uses the Prototype method which includes communication of needs, planning, initial design, prototype construction, user evaluation, improvement, implementation, and testing. The system is designed to integrate the management of customer data, vehicles, orders, mechanic assignments, progress documentation, consultations, complaints, and service history.

Data collection instruments included observation guidelines, interview guidelines, documentation, and literature review. Data were obtained through observations of the workshop service process, interviews with owners or administrators, mechanics, and customers, and collection of service-related documents. Data analysis was conducted by identifying service processes, analyzing problems, determining user needs, compiling functional and non-functional requirements, and implementing CRM through the acquire, enhance, and retain stages. Next, the system was evaluated with users and tested using Black Box Testing to ensure functionality ran as designed.

The research was conducted at PT Indah Sakti Motorindo, located at Jl. Arief Rahman Hakim No. 11, RW. 14, Sukaramai II Village, Medan Area District, Medan City, North Sumatra 20236. The subjects of data collection included workshop owners or administrators, mechanics, and customers involved in the service process. However, the population and sample size as well as sampling techniques were not specifically explained in the research materials provided.

The research process began with literature review, observation, interviews, and documentation to identify problems and user needs. The next step was to analyze business processes and design a system using UML, databases, and interfaces. A prototype was then developed using PHP, CodeIgniter 3, and MySQL, with CRM implementation at the acquire, enhance, and retain stages. The system integrated customer management, ordering, communication, photo documentation, and vehicle work status updates. The prototype was then evaluated with users, refined based on feedback, and tested using Black Box Testing to ensure each function ran as needed and support transparency of the vehicle work stages.

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Results and Discussion

Results View



Figure 1 Login View

According to Figure 1, all roles use a single login page. The system verifies the account identity and directs the user to the dashboard based on their access rights.



Figure 2 Dashboard Page

In Figure 2, the dashboard displays one customer, one vehicle in progress, no pending bookings, and one active complaint. Operational CRM includes Acquire for registration and booking, Enhance for progress monitoring and communication, and Retain for service history, complaints, feedback, and follow-up.



Figure 3 Customer Data Page

Figure 3 shows customer data with the code PLG001 in the name of Andi, a customer. Customer information serves as a link between accounts, vehicles, bookings, work, consultations, complaints, and service history.



Figure 4 Vehicle Data Page

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In Figure 4, Andi's customer's vehicle, BK 1234 AR, is registered as a black 2022 Honda CB150R. Linking vehicle data to customers allows for traceability of service history based on the same vehicle, even if the customer has serviced the vehicle more than once.



Figure 5 Mechanical Data Page

Figure 5 displays a mechanic with the code MKN001, Budi Mekanik, specializing in Modification and Electrical, and active status. The mechanic's designation in the job data clarifies the person responsible for the job and the source of the progress updates received by the customer.



Figure 6 Modification Service Page

Based on Figure 6, the system stores several services, such as Finishing and Detailing, Custom Exhaust, Lighting and Electrical Modifications, Suspension Upgrades, and Body and Appearance Modifications. Each service has an estimated day and base price, which can be used as initial information before the admin verifies the work.



Figure 7 Booking Page

In Figure 7, booking BKG260901001 was submitted by Andi, a customer, for vehicle BK 1234 AR with Body and Appearance Modification services. The booking schedule is recorded on September 5, 2026, with a budget of Rp2,500,000 and the status is Approved.

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Figure 8 Work Page

Figure 8 shows the job JOB260905001 originating from booking BKG260901001. The job was handled by Budi Mekanik, starting on September 5, 2026 with an estimated completion date of September 8, 2026 and a Modification Process status.

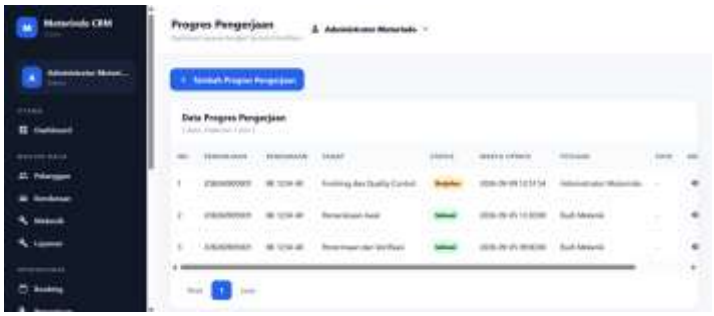


Figure 9 Work Progress Page

In Figure 9, there are three progress histories for the JOB260905001 job. The Acceptance and Verification and Initial Inspection stages have the status Completed, while the Finishing and Quality Control stages have the status Ongoing.



Figure 10 Estimate Approval Page

Figure 10 shows that no estimate changes have been requested in the test data. Although the table is still empty, the page structure has been prepared so that any changes can be recorded and responded to by the customer, so that changes to the work are not communicated solely through verbal communication.

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Figure 11 Consultation Page

In Figure 11, Andi's customer consultation for vehicle BK 1234 AR has the subject "Modification concept selection" and the status "Completed." The "Details" button is used to open a conversation between the customer and the admin.



Figure 12 Settings Page

Based on Figure 12, the workshop identity is determined as PT Indah Sakti Motorindo with the address Jl. Arief Rahman Hakim No. 11, RW.14, Sukaramai II Village, Medan Area District, Medan City, North Sumatra 20236. The progress rules emphasize that each update contains stages, time, descriptions, and supporting documentation if available. This arrangement serves as a reference so that work information is delivered in a consistent pattern.

System Testing

Table 1 System Testing

No.	Tested Features	Testing Scenario	Valid Data	Invalid Data	Test Results
1	*Login*	Enter the correct username or email and password.	✓	✗	✓The dashboard appears and a user session is created.
2	*Login*	Entering an incorrect username, email, or password.	✗	✓	✓Access is denied and an error message is displayed.
3	Customer Registration	Register customers with valid name, email and password.	✓	✗	✓Customer accounts are saved and can be used to log in.
4	Customer Registration	Register an email that is already in use or the required data is empty.	✗	✓	✓The system rejects the data and displays a validation notification.
5	Access rights	Opens the page according to the role of Admin, Mechanic, or Customer.	✓	✗	✓Menus and functions appear according to account access rights.
6	Access rights	Open protected pages without a login session.	✗	✓	✓The system directs the user to the login page.

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7	Customer Data	Add customer data with complete identity and contact.	✓	✗	✓Customer data is saved and displayed in a table.
8	Customer Data	Save customer data with empty required columns.	✗	✓	✓The save is cancelled and validation is displayed.
9	Vehicle Data	Add vehicles with owner, license plate number, make, type, year and color.	✓	✗	✓Vehicle data is stored and connected to customers.
10	Vehicle Data	Adding vehicles without owners or license plates.	✗	✓	✓The system rejects incomplete data.
11	Mechanical Data	Add mechanics with code, name, specialty, contact, and status.	✓	✗	✓Mechanical data is stored and can be selected during processing.
12	Mechanical Data	Stores mechanical data without a name or master data.	✗	✓	✓The system rejects the data and displays a notification.
13	Modification Services	Add services with correct categories, estimated days, and base prices.	✓	✗	✓Services are saved and can be selected on booking.
14	Modification Services	Filling in the base price or estimated days in an incorrect format.	✗	✓	✓The system rejects values that do not meet the rules.
15	*Booking*	Customers submit bookings with complete vehicle, service, date and budget.	✓	✗	✓Booking requests are saved and can be verified by the admin.
16	*Booking*	Sending a booking without a vehicle, service, or date.	✗	✓	✓Submissions are not saved until the data is completed.
17	Booking Verification	The admin approves or rejects the selected booking.	✓	✗	✓Booking status changes according to admin decision.
18	Mechanic Assignment	Admin assigns mechanics to approved bookings.	✓	✗	✓The mechanic is listed as the person in charge of the work.
19	Workmanship	Create jobs from approved bookings.	✓	✗	✓Job data, dates, estimates, and saved status.
20	Work Progress	Add stages, status, time, description, and photos in the appropriate format.	✓	✗	✓Progress updates are saved and appear in the job history.
21	Work Progress	Uploading photos in an unauthorized format or with empty data stages.	✗	✓	✓The system rejects inappropriate data or files.
22	Estimate Approval	Record changes in costs or time and store customer feedback.	✓	✗	✓Changes and approval status are recorded in the history.
23	Consultation	Customer or admin sends message in consultation conversation.	✓	✗	✓Messages are saved and appear in chat history.
24	Complaint	Customers send complaints and admins provide responses.	✓	✗	✓Complaints, responses, and handling status are saved.
25	Feedback	Customers provide ratings and comments after the service.	✓	✗	✓Feedback is saved and can be viewed in the service history.
26	Report	Open the report details and then run the print function.	✓	✗	✓The report page opens and the print view can be run.
27	*Pagination*	Select First, page numbers 1 to 5, and Last in the table.	✓	✗	✓Data moves according to the selected page.
28	Logout	Press logout and try to reopen the protected page.	✓	✗	✓The session expires and the protected page cannot be accessed without logging in.

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Discussion of Implementation Results

The implementation results show that the system has connected the workshop service process from customer registration to work monitoring in a single application. The Acquire stage in CRM is visible in customer registration, vehicle data, initial consultation, and booking. The Enhance stage is implemented through booking verification, mechanic assignment, work, progress, documentation, communication, and approval of estimate changes. The Retain stage is supported by service history, complaints, feedback, and customer follow-up. This division ensures that customer relationship data is not separate from the workshop's operational processes, but is stored alongside the vehicle and the work being or has been performed.

Transparency in work stages is achieved through job data and progress history, which captures stages, statuses, update times, personnel, descriptions, and supporting documentation. Customers not only receive the final status, but can also track changes to the work and make informed decisions when estimates are adjusted. Chat consultations maintain communication records, while reports and service history provide reusable records for the workshop. Based on Black Box testing, the system's core functions provide outputs according to established scenarios, including authentication, access restriction, data management, booking, mechanic assignment, progress updates, consultations, complaints, feedback, reports, pagination, and session security after logout. With this flow, the system supports service digitization while clarifying information between customers, admins, and mechanics during the vehicle modification process.

Conclusion and Recommendation

This research produces a web-based information system with a Customer Relationship Management (CRM) approach to digitize the services of a specialist modification workshop at PT Indah Sakti Motorindo. The system integrates customer and vehicle data management, booking, mechanic assignment, progress monitoring, photo documentation, consultation, estimate approval, complaints, feedback, and service history. The implementation of the Acquire, Enhance, and Retain stages supports integrated customer relationship management, while recording status, update times, descriptions, and progress documentation helps increase transparency of vehicle work stages. The results of Black Box Testing indicate that the tested functions run according to the specified scenario. Thus, the system can be a supporting tool for operational digitization and communication between customers, admins, and mechanics.

This study has limitations because the evaluation focused on the system's functional suitability based on test scenarios, thus not providing quantitative evidence regarding improvements in customer satisfaction, service time efficiency, or customer retention. Furthermore, the test data presented is limited and does not include actual proposals for estimate changes. Future research is recommended to involve more users and measure user experience, customer satisfaction, and service efficiency through prolonged use of the system. Practically, workshops can utilize this system to consolidate service records, document work progress, and maintain more structured communication with customers. Further development can also focus on direct usability evaluation and feature refinement based on customer, admin, and mechanic needs.

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