**14. Appendices**

**14.1. Include the Complete Minutes of Meetings for Reference.**

**PHASE 1**

To identify where time wastage is happening in the service, we conducted an analysis that revealed 34% of the time was consumed by 77 cars of five specific models under Preventive Maintenance Service (PMS), while the remaining 66% was utilized by 575 cars of 29 other models under Repair and Replacement (RR). Notably, 55% of the cars are serviced and processed within a day or less. Certain models, including BALENO, CELERIO, NEW ERTIGA, NEW SWIFT, SWIFT, and WAGON R, were found to consume 34% of the total service time.

Based on these findings, it was decided that the delays in service processing were caused by specific car models. To mitigate these delays, increasing manpower in the PMS was suggested since it is the most utilized service and consumes the most time. Additionally, implementing Warehouse Management Software (WMS) to organize and manage parts in the warehouse was recommended.

Action items include using data analysis and visualization with TABLEAU to identify time inefficiencies in the service process, educating and training employees in areas where time inefficiencies occur, and considering future use of machine learning models to predict and forecast service management issues

**PHASE 2**

The second phase aimed to find the root cause of time consumption in the service process through data analysis. Discussions highlighted the improper representation of data labeling in visualizations, which needed improvement for better communication. It was also noted that PowerPoint presentations required enhancements to be more informative and engaging. Emphasis was placed on providing detailed and clear information, especially in data analysis.

Decisions made during this phase revealed unequal distribution of service assignments among technicians, impacting service delivery. Delays in PMS and RR services were identified as negatively affecting customer satisfaction and operational efficiency.

Action items included collecting critical data for analysis, examining day-to-day service occurrences at the service center, and analyzing technicians' daily time expenditure considering all possible aspects.

**PHASE 3**

This phase focused on statistical analysis and supply chain management with Robotic Process Automation (RPA). Analysis of the past three months’ data showed that services such as PMS, RR, and Breakdown Assistance and Parts Procurement (BANDP) were consistently encountered. However, tasks in BANDP services, like color spraying and parts changing, were time-consuming due to manual handling and a low number of technicians.

The decision was made to implement RPA in supply chain management to streamline operational processes, reduce costs, and increase data accuracy and visibility. This technology provides car service companies with an opportunity to optimize supply chain management processes across all departments.

Action items included collecting required datasets (customer feedback, job card, employee performance), creating a new feedback form with OCR implementation, and developing a strategy for updating service status and reminders via SMS and WhatsApp, focusing on extremely happy and sad customers.

**PHASE 4**

The fourth phase analyzed the count of services received month-wise. Data from February to December revealed that August had the highest count of job cards, and PMS had the highest number of services from April to December.

The team discussed developing an Optical Character Recognition (OCR) form to enhance both technical and customer satisfaction at the service center. It was recommended to create sub-teams to focus on different aspects of the identified problem, working independently and then collaborating to draw correlated conclusions aimed at achieving the primary goal.

Action items included implementing improved questioning techniques to gather customer satisfaction information more clearly and efficiently, focusing on the efficiency of the entire service chain, devising metrics to measure customer satisfaction, and identifying areas for improvement and optimization. The team emphasized deriving problems from their root causes by working concurrently on different aspects of the problem.

**PHASE 5**

The final phase aimed to analyze the correlation of specific vehicles and conduct research between third-party warranties and Maruti Suzuki. Data showed 1682 job cards in 2022 and 1657 in 2023, the highest counts since 2011. Out of 9666 cars, 2100 were newcomers or had changed their service center. Service counts were PMS= 671, FR=812, and Unknown= 617.

Decisions made included age profiling over the last 13 years, with 2022 and 2023 having the highest job card counts. In 2018, PMS peaked in service rates, which drastically fell in 2020. Advantages of Maruti Suzuki insurance included seamless integration, trust, reliability, and tailored coverage, whereas third-party insurance was cheaper and offered more choices but covered less and was less convenient.

Action items included developing B2B market strategies to stay ahead of the competition, capitalizing on opportunities to identify a ballpark value, and visualizing customer-directed convergence.

**14.2. Provide Additional Data Tables and Charts Used in the Analysis.**

**Technician Performance Data**

This section includes a table listing technicians, service types (FR1, FR2, FR3, PMS, RR), the count of serviced items, and the average time taken for each service type. This table helps in analyzing technician efficiency and workload distribution, providing insights into which technicians are more efficient and which may need additional support or training.

**Service Trends Analysis**

The **Service Trends Analysis** is illustrated by a time series graph showing trends in Preventive Maintenance Service (PMS) and Regular Repair (RR) services from July 30th, 2023, to August 29th, 2023. This chart indicates a correlation between PMS and RR services, suggesting that cars undergoing PMS often require additional repairs. Additionally, a separate time series graph depicts trends in Fast Repair (FR) services categorized into FR1, FR2, and FR3, highlighting the service center's offerings and customer demand for quick services.

**Revenue Generation by Service Type**

This section includes a chart listing various service types and their revenue contributions. It identifies PMS and Body & Paint (BANDP) services as the most profitable, suggesting these as key focus areas for the service center to maximize revenue. Understanding which services generate the most revenue can help in strategic planning and resource allocation.

**Technician Workload and Efficiency**

In terms of technician workload and efficiency, the analysis reveals disparities in workload distribution. For instance, Technician Ramesh completed the most services with an average time of 9 hours, while Technician Subramani completed the fewest services with an average time of 7 hours. This information points to the need for a more balanced distribution of tasks to ensure all technicians are utilized effectively and no single technician is overburdened.

**Customer Distribution Analysis**

The **Customer Distribution Analysis** uses a map created from customer data to show the geographical distribution of customers visiting the service center. This map highlights the service area's reach and potential market segments, providing valuable information for targeted marketing and service expansion strategies.

**Phase-wise Analysis and Recommendations**

This section includes a detailed phase-wise analysis from a technician perspective and statistical analysis using one-way ANOVA classification. The analysis provides insights into service time variations among different service types, revealing that Repair and Replacement (RR) services take the longest time on average. Recommendations are made for optimizing technician assignments, improving training programs, and enhancing resource allocation to address service delays and improve operational efficiency. These recommendations aim to streamline operations, reduce service times, and ultimately enhance customer satisfaction.

**14.3. Include Any Technical Documentation Related to the Feedback Form and Other Implementations.**

### Feedback Form Implementation

The feedback form is seamlessly integrated into the car service process, capturing customer experiences to drive continuous improvement. The process begins when the customer brings their car to the service center, initiating the first interaction between the customer and the service team. A service advisor then assesses the car to determine the required service, categorizing it as either minor or major.

For minor services, the vehicle is routed through a quicker and less expensive service path, ensuring efficiency and faster turnaround. In the case of major service needs, a technical advisor is consulted for a detailed discussion with the customer about the necessary repairs. This step is crucial as it involves customer consent and detailed insights into the service requirements. After the consultation, the customer reviews the recommendations and decides whether to approve or deny the proposed services, ensuring they are fully informed and in control of the decisions.

Once the customer approves the service, the car is serviced by skilled technicians. Upon completion, a designated driver picks up the car, ensuring it is ready for customer collection. The process concludes with the customer providing feedback on their service experience, which is essential for assessing service quality and identifying areas for improvement.

### Technical Documentation on Other Implementations

**Warehouse Management Software (WMS) Integration:**

The service center integrates Warehouse Management Software (WMS) to effectively organize and manage parts in the warehouse. This integration enhances inventory management, ensuring that necessary parts are readily available, thereby reducing service delays and improving operational efficiency.

**Car Servicing Dashboard Analysis:**

The service center employs a comprehensive dashboard to analyze various aspects of the service process. The dashboard provides insights into service trends, such as models like Maruti Suzuki dominating the service numbers. Heatmaps show the time taken for servicing different car models, helping identify patterns and bottlenecks. Additionally, scatter plots are used to understand the relationship between different car models and their respective service times, providing a clear picture of service efficiency and areas needing improvement.

**Actionable Insights:**

Based on the dashboard analysis, several actionable insights emerge. There is a need to investigate why certain models require more time for servicing and to optimize service procedures for high-volume models. Furthermore, managing inventory to ensure the availability of frequently used parts is critical for maintaining efficient service operations.

**Technician Performance Analysis:**

Key metrics such as the count of services completed by each technician and the average time taken per service are analyzed to evaluate technician performance. This analysis highlights areas where technicians can improve their efficiency and service quality. Recommendations include balancing service assignments to avoid overburdening any technician and providing targeted training to enhance skills and efficiency.

**Service Time Consumption Analysis:**

Using ANOVA classification, the service center compares different service types to identify disparities in service time consumption. This analysis underscores the need for better workload distribution among technicians and improved resource allocation to optimize service times and enhance overall efficiency.

**Challenges Identified:**

Several challenges are identified, including high time consumption in manual tasks like Body & Paint (BANDP) services, which are labor-intensive. Additionally, there is a need for more technicians to handle these tasks effectively, suggesting that the service center should consider hiring more staff or redistributing existing resources to better manage labor-intensive services.

### Conclusion and Recommendations

To optimize service operations, it is crucial to implement fair distribution of service tasks among technicians, ensuring balanced workloads and preventing burnout. Continuous training programs should be provided to enhance technicians' skills and efficiency, ensuring high-quality service. Moreover, hiring additional technicians or redistributing existing resources can help manage the service load better, particularly for labor-intensive tasks. These measures will lead to more efficient service operations and improved customer satisfaction.

**15. References**

**15.1. Compile a Comprehensive List of All Sources and References Used Throughout the Report**

### Service Types and Proportions

The report draws from various sources and references throughout its comprehensive analysis of the car service center's operations. The service types and proportions are a focal point, detailing how services like Periodic Maintenance Service (PMS), Body & Paint (BANDP), Refueling (REFF), and Washing (WASH) contribute to the overall operations. The revenue generation by these service types is also scrutinized to understand their financial impact.

### Challenges and Recommendations

Challenges and recommendations form another critical section of the report. It highlights issues such as manual tasks in BANDP, repetitive motion disorders, chemical exposure, and the presence of inexperienced technicians. To address these challenges, the report suggests implementing better ventilation systems and providing enhanced training for technicians to improve their skills and safety.

### Time Series Analysis

A significant part of the report is dedicated to time series analysis, where the average service times are plotted over different periods. This analysis focuses on the service times for PMS, Running Repairs (RR), and BANDP, examining their distribution and variability. The findings help identify trends and potential areas for improvement in service efficiency.

### Technician Performance

Technician performance is thoroughly analyzed by breaking down the services performed by each technician and the average time taken. This analysis reveals the workload distribution among technicians and suggests recommendations for optimizing technician assignments to reduce service time disparities and improve overall efficiency.

### Customer Data and Geographic Distribution

Customer data and geographic distribution are also explored in the report. By extracting customer location data using pin codes, the report provides a geographic analysis of the customer base, showing how the service center receives customers from various parts of Chennai. This information is valuable for understanding customer demographics and planning targeted marketing strategies.

### Service Interval Tasks

Furthermore, the report outlines maintenance tasks based on mileage intervals, such as oil changes, tire rotations, and filter replacements. These tasks are essential for maintaining the vehicles and ensuring their optimal performance.

### Weekly Service Requests

Lastly, the report identifies patterns in weekly service requests, noting that there are spikes in requests on Wednesdays and Saturdays for PMS. This information is crucial for scheduling and resource allocation to handle peak service times efficiently.