Research Article

Design and Implementation of a Tailored Dealer Management System (DMS) for the Automotive Industry

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Abstract

This paper presents a thorough investigation into the design and implementation of a Dealer Management System tailored for the automotive industry. The DMS is intended to streamline after-sales processes such as inventory and expense management, service order creation, and financial data monitoring. The system integrates with a variety of other platforms, including ERP, CRM, and payment systems, which improves collaboration between dealers and distributors. The architecture of DMS, known as Copilot Next, is detailed, with a focus on the backend, frontend, and integration components. Sentinet and Dell Boomi are integration tools that allow for seamless connectivity with other systems. The findings show that the DMS effectively meets the needs of multiple vehicle brands, improves part ordering accuracy with AI tools, and ensures data consistency across systems. This study offers useful insights into the design and implementation of a DMS that can significantly improve dealership operations and customer service in the automotive industry.

Keywords: *Dealer Management System, Automotive Industry, Enterprise Integration.*

1. Introduction

Dealers must effectively oversee and regulate the vehicle repair and maintenance procedures in alignment with the manufacturer and importer guidelines. A Dealer Management System (DMS) can be utilized for this purpose. DMS is a comprehensive system that efficiently handles all automotive aftersales processes. This system offers a range of functions, including warehouse management, stock and cost tracking, creating service orders for individual vehicles, and providing detailed financial data monitoring.

Dealers have the ability to efficiently monitor their inventory and expenses for parts acquired from both the original manufacturer and local sources using DMS. In addition, they have the capability to handle vehicle service and parts sales orders and invoicing processes using the same system. This ensures that all processes are efficiently managed and that data is meticulously tracked for accuracy and up-to-date information.

DMS can seamlessly integrate with other systems developed or used by the distributor. This integration enables seamless data sharing and collaboration between dealers and distributors. Consequently, all post-sales procedures can be executed with greater efficiency and effectiveness. With the Dealer Management System, dealers can effectively streamline their automotive aftersales processes and enhance the level of service they offer to customers. This system optimizes dealers' workflow and enhances their productivity by handling essential tasks like inventory management, expense tracking, and financial data monitoring.

A Dealer Management System (DMS) is a crucial tool for businesses, especially in the automotive sector, to streamline operations and enhance efficiency (Iqbal & Nurwati,2023) (Rahman et al.,2019). Key features of a DMS include sales and distribution strategy management, warranty and claim processing, service scheduling, and account maintenance (Gurumoorthy,2019) (Feng et al.,2020). Additionally, DMS software focuses on dealer and sub-dealer management, providing functionalities like customer follow-up post-purchase, service reminders based on vehicle usage, and warranty service tracking. The system ensures data integration among different divisions within a dealership, preventing data redundancy and ensuring data consistency for accurate reporting. Moreover, DMS can incorporate electronic management systems for dealer control in gaming establishments, enabling authentication, authorization, and monitoring of dealer activities in compliance with regulations.

Effective dealer management in the automotive industry involves various best practices. Utilizing predictive analytics tools and classification methods can help predict dealers' cooperation based on factors like dealer performance violations, changing dealer principles, and service revenue (Ahmad et al.,2022). Implementing decision-making support systems based on network indicators analysis can optimize spare parts deliveries and enhance overall management of the dealer-service network (Makarova et al.,2012). Enhancing service quality within the dealer-service network through information-

logistics systems, feedback mechanisms, and discount systems can further improve dealer management practices (Makarova et al.,2011).

This study underscores DMS's role in integrating with other systems to streamline operations and improve data accuracy and consistency. The rest of the article comprises the following sections: Materials and Methods, Results, Discussion and Conclusions.

2. Materials and Methods

This section describes the tools, techniques, and step-by-step procedures we used throughout our research. By sharing this information, other researchers can replicate our work, validate our findings, and contribute to the knowledge in our field.

2.1. Architecture and Design of the Dealer Management System (DMS)

The Dealer Management System (DMS) technology architecture consists of various components as shown in Figure 1. The backend is powered by a system called Copilot Next, which serves as the Core Engine. It handles the core functionalities and operations of the DMS. On the frontend side, there are interfaces called Servis Management and Part Management, which provide user-friendly interfaces for managing service and parts-related activities. In addition, there are other systems integrated into the technology architecture. These include the Enterprise Resource Planning (ERP) system, Customer Relationship Management (CRM) system, payment systems, online applications used by customers, and corporate applications provided by distributor and manufacturer (OEM).

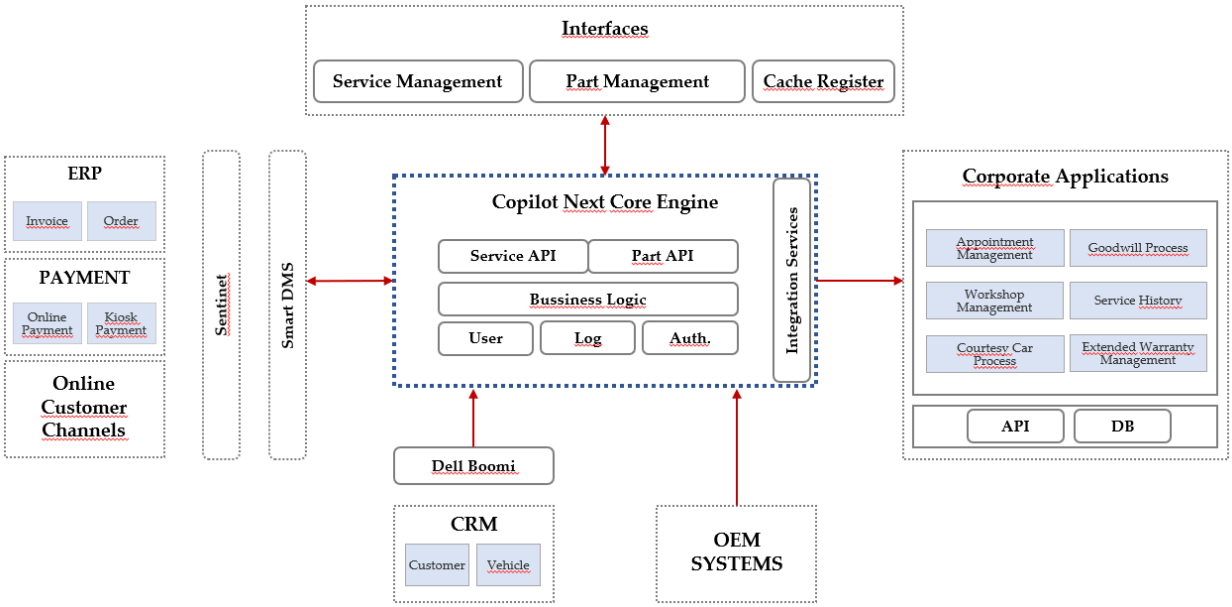

Figure 1: Architecture of the Dealer Management System (DMS)

The DMS and its integrated systems work together to streamline and automate various processes related to dealership operations, such as sales, service, parts management, inventory management, customer management, and financial management. This comprehensive technology architecture enables efficient and effective management of dealership operations, enhances customer experience, and supports business growth.

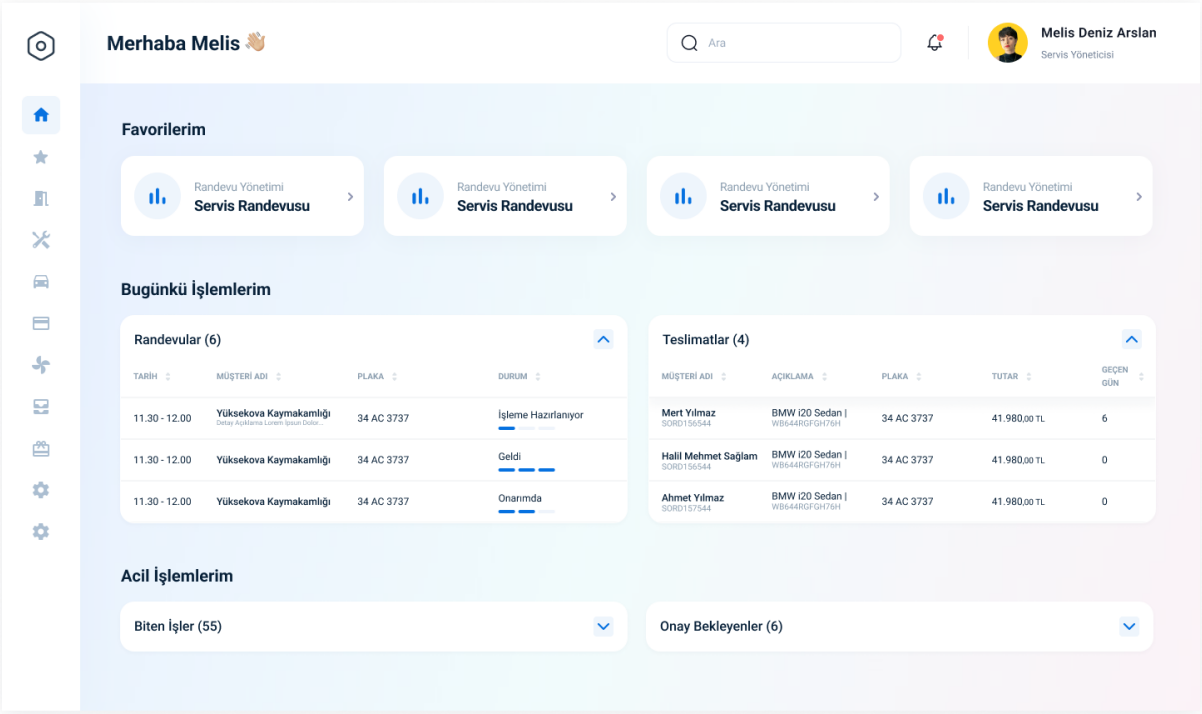

Figure 2: Homepage of the Dealer Management System (DMS)

Figure 2 shows the dealer management system (DMS) homepage. The homepage encompasses the favorite service management and parts management modules for users, as well as fields for daily task tracking. It ensures efficiency through ease of task management and user interfaces.

For integrations, the Smart DMS serves as a backend service that enables integration with different systems. The API Virtualization Tool used is Sentinet, which virtualizes APIs. Additionally, Dell Boomi is utilized as an Enterprise Service Bus (ESB). In the DMS, master data management involves transferring customer and vehicle data from the CRM to the core engine system, Copilot Next, through the Enterprise Service Bus (ESB). Information such as labor, parts, and vehicle model data, as well as standard labor times, are obtained from manufacturer-provided text documents and APIs. To retrieve maintenance and repair packages from the manufacturer's system, the vehicle chassis number is sent to the manufacturer via a socket port connection, and the

manufacturer sends the appropriate packages to the core engine system through a socket connection.

The distributor's ERP system, SAP, triggers the transfer of action information, packages, and action-related vehicle data to the DMS through the triggering of DMS APIs. For the information about the resolution of action requirements for vehicles to appear in SAP, the information is written to SAP's RFC (Remote Function Call) to trigger the process.

A data analytics model is used to predict the spare parts needs of authorized service centers. On the automatically generated order record in the DMS, spare parts specialists can manually intervene. With the approval of the spare parts specialists, the spare parts orders of authorized service centers are transferred to the Distributor ERP system through SAP RFCs.

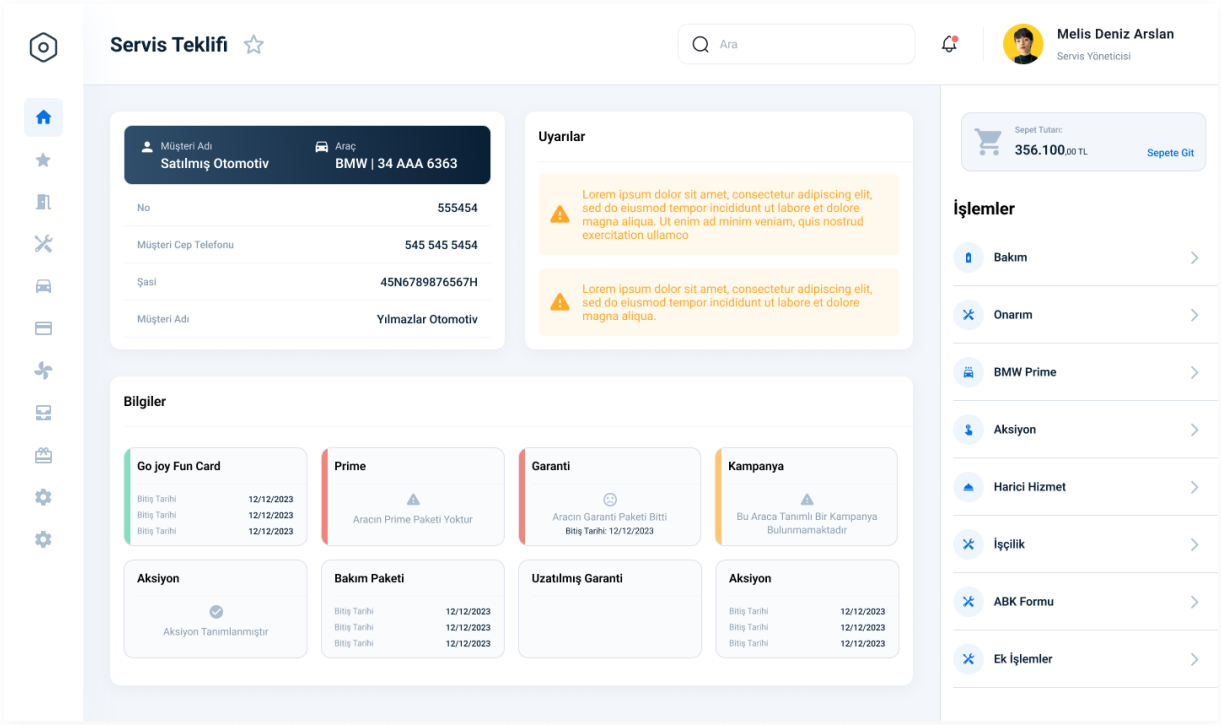

Figure 3: Creating Service Order

The service order creation interface is shown in *Figure 3*. On the service work order creation page, customer and vehicle information, warnings, groups of transactions that can be added to the work order and total amount information are displayed.

All financial transactions generated in the DMS, such as service and retail invoices and stock movements, are transferred to the Distributor ERP system through SAP RFCs. Integration with intermediary services such as Masterpass and Octet, which enable customers to make online payments, is achieved through APIs. Authorized services have

kiosks for cash and credit card payments. There is a mutual API integration between the kiosks and the DMS for displaying invoice and payment information.

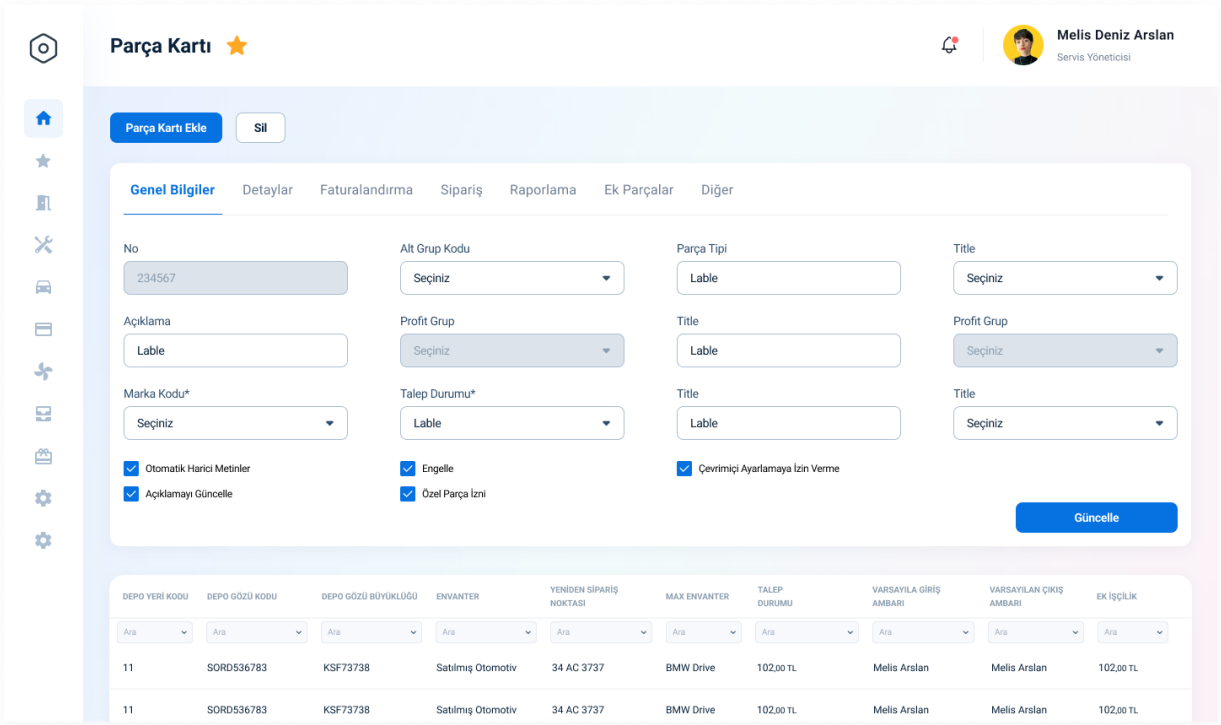

Figure 4: Creating Local Part

Figure 4 shows the local part creation page. To create a part, fields such as brand, part type, subgroup code, request status and description are entered. At the same time, the part list is also displayed.

In the online applications used by customers, DMS APIs are used to display repair and maintenance packages to customers who have booked a service appointment.
DMS APIs are used to provide master data such as customer, vehicle, work order, invoice, labor, spare parts, and maintenance and repair packages to corporate applications such as appointment management, workshop management, extended warranty management, service history, courtesy car management, and goodwill management. The interfaces used for service and parts processes in authorized service centers retrieve and display data from the Copilot Next Core Engine through APIs.

2.2.Software Implementation

2.2.1. Database

MSSQL database is used for data storage and Redis is used for caching management. Nowadays, most applications deal with large amounts of data, and effective management

and access to this data is crucial. Database systems play a critical role in this regard and have various features to meet different requirements.

MSSQL is a relational database management system developed by Microsoft and widely used. Businesses typically prefer MSSQL to store, process, and analyze their business data. MSSQL supports complex queries, ensures data integrity, and provides reliable performance.

Redis, on the other hand, is a fast and high-performance key-value storage system. It operates in-memory and associates data with keys. This allows Redis to provide fast access to frequently accessed data. It is particularly preferred in scenarios such as caching and session management.

MSSQL and Redis are database technologies that serve different purposes. However, when brought together in the right scenarios, they can provide significant advantages in data storage and access. Using MSSQL and Redis together is an effective strategy to improve performance, scalability, and enhance the user experience.

2.2.2. Backend

The systems used for user information and authentication backend are integrated with Active Directory. A single username and password are used to access all applications. The same structure is also used in Dealer Management System (DMS). Additionally, there is a log management application called Graylog in use. For the backend development of Business Logic, APIs, and Integration Services, the .NET Framework is used. It is a software platform that runs on Windows operating systems and is compatible with various programming languages. The .NET Framework provides developers with a range of tools and libraries. These tools assist in application writing, compilation, debugging, and deployment processes. Moreover, the .NET Framework offers ready-made components and libraries for various application types, which accelerates the development process and enhances code reusability. To connect to the database, the Entity Framework (EF) is used, which is an object-relational mapping (ORM) tool that runs on the .NET Framework. ORM is a technology that facilitates data access between databases and object-oriented programming languages. The Entity Framework provides developers with an object-oriented approach to perform database operations. This allows representing database tables and relationships as objects and performing database operations through objects. The Entity Framework simplifies database operations and supports object-oriented programming, enabling developers to work efficiently. Additionally, EF utilizes a language extension called LINQ (Language Integrated Query) to write database queries in an object-oriented manner. This makes database queries more readable and manageable.

2.2.3. Frontend

Angular Framework is used to create dynamic and interactive user interfaces in the Dealer Management System (DMS). It has a modular structure and follows a component-based approach, which enhances code reusability and makes application maintenance easier.

JavaScript, a programming language that runs in web browsers, is used to add interactivity and dynamism to web pages. TypeScript is used in Angular to write JavaScript code in a safer and more organized manner, especially for large-scale projects. Furthermore, component grids are used for filtering purposes in the interface.

Web Socket protocol is used to enable real-time, bidirectional communication between web browsers and servers. It allows for continuous connection and fast data transfer.

Internet Information Services (IIS) is a web server software that runs on Windows operating systems. It is used to serve, manage, and host web pages and applications. SSL certificates are used to encrypt information exchanged between servers and web pages, ensuring secure communication over the HTTP protocol.

3. Results

This study presents the design and implementation of a Dealer Management System (DMS) tailored for the automotive industry. The DMS streamlines after-sales processes such as inventory and expense management, service order creation, and financial data monitoring. It integrates with other platforms like ERP, CRM, and payment systems, enhancing collaboration between dealers and distributors. The architecture of the DMS, known as Copilot Next, is detailed, covering backend, frontend, and integration components. The study highlights how the DMS effectively meets the needs of multiple vehicle brands, improves part ordering accuracy with AI tools, and ensures data consistency across systems, benefiting dealership operations and customer service in the automotive industry.

DMS systems are adaptable and can accommodate business growth. Whether expanding to multiple locations or integrating new features, a DMS provides scalability and future-proofing for automotive enterprises. For dealerships with multiple branches, DMS offers centralized control over operations, inventory, and customer data. This simplifies management and ensures consistency across locations. A high-quality DMS empowers automotive businesses to thrive in a competitive market by optimizing processes, enhancing financial control, and delivering exceptional customer experiences. It's not just a system; it's the driving force behind sustained success in the ever-evolving automotive landscape.

4. Discussion and Conclusion

The DMS serves as a comprehensive solution, encompassing various dealership functions. It seamlessly integrates sales, service, parts management, inventory control, customer relations, and financial processes. By consolidating these aspects into a unified platform, dealerships can streamline their operations, reduce redundancy, and improve overall workflow. The user-friendly interfaces facilitate efficient navigation, ensuring that dealership staff can easily access and manage critical information.

One of the standout features of the DMS lies in its AI-driven part ordering system. Traditional algorithms often fall short in predicting part requirements accurately. However, by leveraging artificial intelligence, the DMS significantly enhances part ordering accuracy. Machine learning models analyze historical data, seasonal trends, and specific vehicle models to generate precise forecasts. As a result, dealerships can optimize inventory levels, minimize excess stock, and ensure timely availability of parts. This not only reduces costs but also enhances customer satisfaction by minimizing delays in service.

The success of any modern dealership relies on effective integration with external systems. The DMS seamlessly connects with enterprise resource planning (ERP) systems, customer relationship management (CRM) platforms, and payment gateways. This integration fosters collaboration between dealerships and distributors, enabling real-time data sharing. Such integration ensures data consistency, minimizes manual data entry errors, and streamlines administrative tasks.

In summary, the tailored DMS represents a pivotal advancement in dealership management. Its architecture, integration capabilities, and AI-driven features contribute to improved efficiency, cost-effectiveness, and customer satisfaction. As the automotive industry continues to evolve, the DMS serves as a strategic tool for dealerships to thrive in a competitive landscape.

5. Acknowledgements

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