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MAS MOTORS, LLC's WEB-BASED AUTO SERVICE MANAGEMENT SYSTEM

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Abstract—

For MAS Motors LLC, a certified Toyota dealership in Libya, this project aimed to create a web-based vehicle service management system. Every day, the service division at all branches will be able to do less manual processing thanks to the technology. Service Advisors, Workshop Managers, Storekeepers, Technicians, Customers, and Upper Management are the designated users of the system. Manila, Philippines: Ace Lagman Graduate School Department of Far Eastern University-East Asia College Cristianogman at futech.edu.ph warehouse workers, and service technicians. The secret to success is coordinating your efforts and working as a team. On top of that, companies can't succeed without a well-thought-out strategy to guide their daily operations. Due to the rapid expansion of the firm, the manual method became more inefficient and ill-suited to the new demands placed upon it. The project's stated goal was to implement a unified system that could serve the company's day-to-day operations across all of its locations. Alpha and beta software testing were used to evaluate the project's output. An interview was also done by the researcher to gather information about the business process, present business challenges, and planned system features. A set of respondents were asked questions that would be used to evaluate the program quality using the Hewlett-Packard FURPS model. The model stands for Functionality, Usability, Reliability, Performance, and Supportability. The client's needs were satisfied, and the system was determined to be fully operational. Auto Service Management, Data System, Toyota, and Vehicle Upkeep are some of the keywords.

INTRODUCTION

The rapid pace of technological advancement in the modern era has greatly simplified people's daily lives. Businesses now have the tools they need to better manage their workloads thanks to technological advancements. It satisfies the growing need for more efficient solutions. Accredited car lots are required to provide high-quality service, and the management is constantly faced with the problem of finding win-win solutions. Vehicle dealerships might benefit from technological advancements in areas such as the management of routine operations and the development of more sophisticated business analysis tools that could help them maximize earnings while decreasing expenses. The use of job cards has become standard practice in automotive workshops. Customer, vehicle, and task data are all part of a job card's comprehensive description of a client's work. Job cards are an essential tool for efficient car dealerships and workshops to carry out their day-to-day operations. Job cards are useful for keeping track of workers' assignments, customers' information, and the specifics of the work (including any replacement components required). Furthermore, the job card facilitates the coordination of service advisors' responsibilities, 18. $31.00 978-1-5386-7767-4 Copyright 2018 by the IEEE In order to accomplish their goals, firms use management systems to oversee the interdependent aspects of their company. Among the numerous possible domains for such goals are operational efficiency, health and safety on the job, environmental performance, and the quality of the product or service itself [1]. Nearly every company evolves and develops on a daily, weekly, monthly, or annual basis. The norms have shifted thanks to the development of information technology, allowing individuals to seek and gather information from almost any location nowadays. In order to stay ahead of the competition and keep up with the ever-changing technological landscape, many companies have invested in information technology systems that can store and analyze data. As a software solution, Automobile Service Management Information System (ASMIS) helps car dealerships carry out their

ISSN 2454-9940

www.ijasem.org

Vol 19, Issue 2, 2025

duties and adhere to business rules electronically. This eliminates the need for manual tasks and processes, makes data easily accessible and accurate, and provides management with reports to aid in decision-making. II. The Study's Context "MAS" means "diamond" in Arabic. Mubarak Abdullah Sousi is the proprietor of the firm, and the name is an abbreviation of his. MAS Motors LLC, located in eastern Libya, is a certified Toyota dealership that opened its doors in 2011. Established in Benghazi, the company's original focus was on providing clients with the "3S" function—sales, spare parts, and services—through its two primary divisions, sales and service. Selling brand-new automobiles on an installment or cash basis is the main emphasis of the sales department. General repair, body and paint, preventative maintenance, accessories, and authentic replacement parts are all part of the service division's offerings. Many new customers, both private and public sector, have signed on with the firm within the last few years. Three branches have been added to the total. From the very beginning, the company's day-to-day operations were managed by hand using very simple apps like Excel spreadsheets, Word documents, and paper papers supported by Visual Basic for apps. Human mistake was an unavoidable part of the decision-making process, and the firm is still maturing and growing. With this massive quantity of labor, the tried-and-true approach can't keep up with the pace of success. In addition, it became more difficult to handle the spare parts warehouses that came with the growing number of outlets.

OBJECTIVES OF THE STUDY

Section A: Overarching Goal Building an online vehicle service management system for MAS Motors LLC is the overarching goal of this project. Section B. Particular Goals 1. Create the following sections: The modules are as follows: a. Administrator, b. Inventory, c. Job card management, d. Reports, i. Technician productivity and efficiency analysis, ii. iii. e. Service history and Forecasting, f. Unit of time management, g. Marketing, and h. Customer. 2. Create an interface that caters to the following users: a. Senior executives, b. The system administrator, c. Supervisors of work areas, d. Advisors on customer service, e. Retail employees, f. Service technicians, and g. End users Third, consider the system's functionality, usability, reliability, performance, and supportability while making your evaluation.

REVIEW OF RELATED LITERATURE AND STUDIES

Literature Review on the Subject from the Area In order to keep track of the financial and inventory needs that correlate to each sale, the sales inventory system updates the company's database automatically. There is an online sales and inventory system that can handle generating sales from numerous points or locations with ease. There will be no lag in data transfer, particularly to the inventory unit, since the information is updated in real-time. Thus, processing and shipping delays might be avoided, which would greatly satisfy the consumer [2]. According to the paper, customer happiness is enhanced by avoiding delays caused by the real-time updating of database information. The suggested system's inventory module organizes branch-level business transactions and updates the centralized database in real-time. In addition, branches may deliver replacement components to work orders so that customers can get services thanks to the inventory module's integration with the job card module. A more agile response to market shifts is one of the many benefits of implementing a business process automation system into your supply chain management strategy. A company may gain an advantage over rivals, provide superior service, and capture a bigger share of the market with the help of a well-planned business automation strategy that lets it respond faster to changes in the environment and customer needs. The proprietors will be able to devote more time and energy to running their companies and become market leaders as a result [3]. The significance of information system-based business process automation was emphasized in the aforementioned paper. With the help of these tools, the company's management may streamline internal operations, respond quickly to changes in demand, and focus on becoming the market leader. Every business relies on its capacity to efficiently arrange its day-to-day operations. However, internal process organization may be time-consuming, which slows down their unrolling speed and efficiency. Thanks to technological advancements, such as Service Management Systems, we no longer have to face these challenges alone [4]. In order to reduce processing time, allow efficient job processing, and boost the organization's chances of success, the article suggests embracing new technology, particularly service management systems. Part B: A Survey of Relevant International Literature The evolution of web-based apps has been remarkable in recent years, thanks to advancements in technology

and security. The majority of web-based apps are significantly more cross-platform compatible than the majority of installed software. A web browser is usually the bare minimum. There are hardly any system requirements for the end user's workstation beyond the installation on the server. decreased support and maintenance, fewer demands on the end user system, and a streamlined design all contribute to drastically decreased costs [5]. According to the report, web-based apps make it possible to cover several locations in a safe, centralized, and scalable manner. On the user's end, these apps function just using a web browser and utilize very little system resources. The service management capabilities of the Elva Dealership Management System (DMS) include the following: scheduling of necessary maintenance work and personnel, analysis of service operations, and a status report on all service work [6].

A job card management module is part of the suggested system that, according to the aforementioned article, automatically arranges technicians' labor. You may track the progress of your technicians and automobiles in the workshop in real-time using the reports feature. If the service adviser doesn't have access to up-to-the-minute data on inventory, accessible car parts, and schedules, they may not be able to provide customers with accurate information on services, costs, and availability. It is challenging to identify all the places responsible in the event of significant damage. By streamlining the servicing process and addressing these issues, Maxworth's vehicle service management system left a favorable impression on the client [7]. According to the aforementioned article, the suggested solution updates consumers in real-time with the inventory's spare component availability. Furthermore, it offers a simple and dynamic way to create comprehensive service estimates and to market services to clients using (short message text) SMS. Customers are more satisfied and have a better experience overall with the service thanks to automated birthday greetings and reports on their service history. Read the owner's manual and check the vehicle's service record before you purchase it. In addition to confirming the mileage, seeing the whole history will offer you piece of mind that the automobile has been thoroughly examined and must be dependable. If you save the car's history record, you may increase its worth when the time comes to sell it [8]. With reference to the aforementioned article, the suggested system incorporates a service history feature that allows customers to monitor their vehicle's maintenance records, ensuring that repairs are carried out according to the manufacturer's specifications. This, in turn, increases the vehicle's resale value. More consumers will seek out the dealership to repair their cars and may request the service history records, which is good for the client's company. Organizational use of information technology (IT) has been on the rise. From automating organized activities to introducing innovative solutions that modify core corporate methods, the usage of technology has advanced. The belief that "More than being helped by computers, companies will live by them, shaping strategy and structure to fit new information technology" is a strong one. [9]. According to the report, companies are increasingly embracing IT due to its ability to adapt to changing business needs. There were several benefits for companies as a result of technological advancements. An acceptable collection of functionality, including tools to assist decision making, is intended to be provided by the proposed system, which is not restricted to everyday business process automation. C. A Survey of Relevant Regional Research The study titled "Integrated Sales and Inventory Management System Implemented in Three-Tier Architecture" [10] found that after all the tests and evaluations, the system was found to be cheaper, faster, less resource-intensive, effective, and efficient for gaining substantial profit compared to the manual system and other alternatives used to improve business processes. It was able to provide high-quality results quickly while also reducing the need to report and analyze failures.

This research is important for the proposed system since it focuses on time savings, dependability, and the potential to enhance revenue while decreasing operational expenditures via the use of an integrated sales and inventory system. When compared to manual options, the aforementioned approach was leagues superior. An inventory module is part of the system that this project proposes to use; it will consolidate and streamline the various branches' inventory management processes. The data that is presented in the reports and analyses is correct, up-to-date, and trustworthy. Management might benefit from the reports module since it provides data that can be used as a reference when coming up with plans to cut down on needless spending. D. An Analysis of Relevant International Research Big data analytics, which is closely connected to business intelligence and analytics (BI&A), has grown in prominence in the last 20 years, according to both academics and businesses [11]. Research in the field has brought attention to this noteworthy change. For instance, business analytics was included as one of the four main technological trends of the 2010s in the IBM Tech Trends Report (2011), which was based on a poll of more than 4,000 IT experts from 93

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www.ijasem.org
Vol 19, Issue 2, 2025

countries and 25 different sectors. Bloomberg Businessweek (2011) surveyed the current status of business analytics and concluded that 97% of organizations with sales over $100 million utilize business analytics in some way. The aforementioned research highlights the increasing significance of analytics and business intelligence. The benefits of adopting information technology in business, particularly in business analysis, are evident from the fact that 97% of large organizations are using it. The study's recommended approach offers management decision-makers forecasts and reports to help them make better choices. The system facilitates day-to-day job management, according to the research titled "Car Dealer Management System for Chanota Automobiles" [12]. Decisions made by managers may also be aided by the data generated by this system. The organization and its supporting operations will greatly benefit from the installation of this system. This research is important for the proposed system since it will help with daily process management and will provide decision makers facts to back their decisions. Results showed that the previous system had the following issues, according to "Automobile repairs and maintenance information system for auto tech engineers" [13]: The process of preparing cost estimates for vehicle repairs and allocating technical specialists to specific tasks takes a considerable amount of time. • They don't have a reliable database system, which means they can't get the data they need in the format they want when they need it.

Providing information on fixed cars, customers, and sold replacement parts within agreed upon time constraints is not always feasible. Data maintainability and timeliness in a controllable and accessible format is the most important aspect of this research for the proposed system since it leads to time savings and reduces the stress on staff. In addition to generating service estimates, the suggested system may assign technicians to specific project orders. Chap. V. Methods A. Research Strategy • Applied Research Method—This study made use of the applied research approach. Applied research is a kind of scientific inquiry that aims to address real-world issues faced by people or communities. Since the goal of this study is to address a real-world issue that the customer is facing, it may be categorized as applied research. After conducting interviews to gather information and data, the researcher was able to pinpoint the issues plaguing the current business process and design a new system to address them. The data will also be useful for figuring out how well the system will work. In the quantitative study that was carried out for this project, the researchers relied on the Likert scale to assess how the stated system was seen by the participants. The findings were then compared to the interpretation table. B. Tool for System Development The project's software development technology was the Rapid Application Development (RAD) approach, as shown in Figure 1. The key reasons for choosing RAD were its emphasis on early delivery, adaptability to change, and user input.

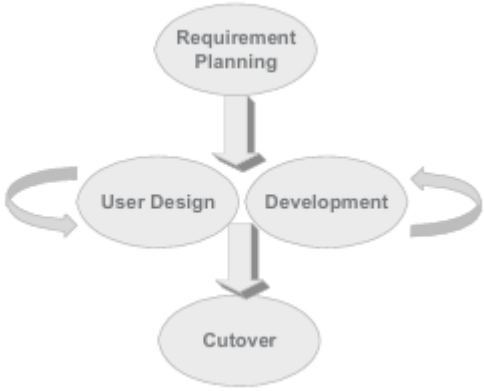

Fig. 1. RAD Software Development Methodology

C. Planning the Project The back-end of the system was built using the Laravel framework, the MariaDB database management system, and the PHP programming language. The front-end of the system was built using the following libraries: Chart.js, Offline.js, HTML5, JavaScript, and CSS3. It was driven by the Twitter Bootstrap 4 framework.

The developer himself conducted the alpha testing. The purpose of this kind of software acceptance testing is to find and fix any issues with the program before it is released to the public. Because of its greater reliability and relative ease of use in relation to the system's scope and functions, the black-box testing approach was chosen. By ignoring the program's inner workings in favor of its inputs and outputs, black-box testing ensures that the program works as intended.
The second step is beta testing, which

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www.ijasem.org

Vol 19, Issue 2, 2025

involves releasing the program to a small group of users so they can test it on their own systems to ensure all of the features work as expected. The goal of beta testing is to improve the program with the help of users so that the final product is of the highest possible quality. The researcher used beta testing since it helps to ensure that the product would work properly by concentrating on the software's functionality. Section E: Statistical Analysis In this project, the client's satisfaction with the proposed system was evaluated using the weighted mean (1). When one or more sample items are given a monetary value, the resulting average is known as the weighted mean.

$$WM = \sum fx / N \qquad (1)$$

TABLE 1 INTERPRETATION TABLE

Mean Range	Scale	Interpretation
4.51 – 5.00	5	Excellent
3.51 – 4.50	4	Very Satisfactory
2.51 – 3.50	3	Satisfactory
1.51 – 2.50	2	Fair
1.00 – 1.50	1	Poor

ANALYSIS AND DISCUSSION

The study made use of the purposeful sampling approach, which allows for the acquisition of subject samples with precise features with minimum effort. A website with a content management system and a system for managing vehicle services were among the products of the built system. Ten people were asked to test and assess these things based on the following criteria: (FURPS) the following: functionality, usability, reliability, performance, and supportability. Both MAS Motors LLC customers and workers were asked to fill out a system assessment survey. Here are the results for the respondent profiles (Table 2) based on the data that was retrieved: five MAS Motors LLC. workers and five MAS Motors LLC. consumers.

TABLE 2 FREQUENCY DISTRIBUTION OF THE RESPONDENTS

Group	Total	
	frequency	*Percentage*
Service Center Employees	5	50%
Service Center Customers	5	50%
Total	10	100%

especially when considering the system's usefulness. Since there are no options for users to revise their submissions after they have been submitted, "the system provides easy controls to change mistakes" had the lowest mean score of 4.00. On the work, "using the system would enhance effectiveness" and "does the system functions give accurate results" are the two indicators with the highest means of 4.40. Together, they demonstrate how the system facilitates the operations and delivers the anticipated correct outcomes. According to the responses, the functioning criterion yielded a weighted mean score of 4.27, which is considered quite good.

TABLE 3 WEIGHTED MEAN AND DESCRIPTION OF THE FUNCTIONALITY OF THE AUTOMOBILE SERVICE MANAGEMENT SYSTEM FOR ALL RESPONDENTS

INTERNATIONAL JOURNAL OF APPLIED SCIENCE ENGINEERING AND MANAGEMENT

ISSN 2454-9940

www.ijasem.org

Vol 19, Issue 2, 2025

Indicators	Group Response			
	A	*B*	*Mean*	*Descripti*
Does the system functions give accurate results	4.40	4.40	4.40	Very satisfacto
Using the system would enhance effectiveness on the job	4.60	4.20	4.40	Very satisfacto
The system provides easy controls to change mistakes	4.60	3.40	4.00	Very satisfacto
The system provides the common functionalities as it is expected	4.40	4.20	4.30	Very satisfacto
General weighted mean	4.50	4.05	4.27	Very satisfacto

The weighted mean of the two groups of respondents about the system's usability is shown in Table 4. The indication with the lowest mean score of 3.90 is "does the system require extensive knowledge to operate" because of all the features on the system that users need to be trained on. The page view is produced depending on the user's job title and displays all connected features, which is why "the overall layout of the system and navigation of the interface is understandable" has the highest mean score of 4.50, which is extremely good. In the end, the respondents rated the usability as extremely acceptable, with a mean score of 4.30.

TABLE 4 WEIGHTED MEAN AND DESCRIPTION OF THE USABILITY OF THE AUTOMOBILE SERVICE MANAGEMENT SYSTEM FOR ALL RESPONDENTS

Indicators	Group Response			
	A	*B*	*Mea n*	*Descripti*
Software can be easily navigate and understood	4.40	4.40	4.40	Very satisfacto
Does the system require extensive knowledge to operate	3.80	4.00	3.90	Very satisfacto
The system functions can be easily understood as it is presented.	4.20	4.60	4.40	Very satisfacto
The overall layout of the system and navigation of the interface is understandable	4.60	4.40	4.50	Very satisfacto
General weighted mean	4.25	4.35	4.30	Very satisfacto

The weighted mean of the two groups of responders about the system's dependability is shown in Table 5.

This indication has the lowest mean score of 3.90 due to issues with the shared hosting provider that impact the Laravel framework. "Generates right and accurate results" has the highest mean of 4.50 indicators, indicating that the system's output is accurate for the majority of its operations. Respondents rated the dependability to a weighted average of 4.27, which is considered extremely excellent.

TABLE 5 WEIGHTED MEAN AND DESCRIPTION OF THE RELIABILITY OF THE AUTOMOBILE SERVICE MANAGEMENT SYSTEM FOR ALL RESPONDENTS

Indicators	Group Response			
	A	*B*	*Mean*	*Description*
The system provides error messages in wrong data entries	4.20	4.40	4.30	Very satisfactory
The system is always available to use	3.80	4.00	3.90	Very satisfactory
Generates right and accurate results	4.40	4.60	4.50	Very satisfactory
Free from system error or crashes	4.40	4.40	4.40	Very satisfactory
General weighted mean	4.20	4.35	4.27	Very satisfactory

System runs on shared hosting with restricted resources and bandwidth; CSS and JavaScript libraries based on content delivery networks (CDNs) require some time to load. With its remote server architecture and the fact that all customers need is a web browser, "the system does not consume too much computer resources" stands out as the signal with the highest mean score of 4.60. With a weighted mean of 4.46, performance is excellent.

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TABLE 6 WEIGHTED MEAN AND DESCRIPTION OF THE PERFORMANCE OF THE AUTOMOBILE SERVICE MANAGEMENT SYSTEM FOR ALL RESPONDENTS

ISSN 2454-9940

www.ijasem.org

Vol 19, Issue 2, 2025

Indicators	Group Response			
	A	*B*	*Mean*	*Descripti*
The system does not take too much time to load	4.20	4.40	4.30	Very satisfacto
The system does not consume too much computer resources	4.80	4.40	4.60	Excelle
The system does not take much time to boot up	4.80	4.20	4.50	Very satisfacto
General weighted mean	4.60	4.33	4.46	Very satisfacto

When looking at the system's supportability, Table 7 displays the weighted mean of the two groups of responders. Due to the scarcity of customer-facing account settings and the relatively high number of system configurations needed to operate the system, the two indications with the lowest mean of 3.60 are "can the system be easily configured" and "can the system be extended to meet the demands." With a mean score of 3.70, "is the system easy to maintain" is clearly the most important factor, as keeping the system up-to-date is a breeze. Based on the scores supplied by the respondents, the overall weighted mean for supportability is 3.63, which is considered extremely good. The platform may be used by all branches to gather and analyze data for marketing and reporting reasons; this is described in Table 7, which also includes the weighted mean. Section II: Suggestions and Upcoming Projects The findings informed the following suggestions for moving on with the system's development and enhancing it: 1. Customers of the service should be able to get appointment reminders by automated SMS notification. 2. Based on their previous visit and the factory servicing schedule, customers should be reminded via SMS to come back. 3. It would be helpful to include a phone number box on the main page's customer contact form. 4. Combine the system's blog functionality with social media.

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