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Development of a Visualization Framework for Automotive Warranty Data Management

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ABSTRACT

Automotive warranty information represents a critical yet often underutilized resource for evaluating product dependability and customer satisfaction. Despite the advancement of digital analytics, recurring challenges persist, such as fragmented data structures, inconsistent records, and delays in claim processing. This research presents an intelligent visualization framework that converts complex warranty datasets into clear and interpretable insights to support manufacturers in data-driven decision-making. The framework was developed through a structured three-phase approach comprising user requirement identification, interface accessibility refinement, and system integration. It features interactive dashboards for continuous monitoring of cost behaviour, claim frequency, and component performance. Validation using five years of industrial warranty data demonstrated significant improvements in analytical efficiency, trend identification, and visualization accuracy when compared with traditional spreadsheet analysis. The system's human-centred design effectively connects technical data to managerial action, encouraging proactive quality enhancement, optimized warranty cost control, and improved customer confidence. Overall, this study highlights how visual analytics tools such as Microsoft Power BI can transform conventional warranty management into a more responsive and intelligent process aligned with modern automotive quality practices.

1. INTRODUCTION

Automobile production plants know very well questionable statements have the capability of increasing warranty cost and customer satisfaction substantially. Warranty of an automobile is a formal commitment offered by seller or automobile producer, to replace or correct faulty parts or whole automobile within stipulated time horizon after purchase. It plays important role in customers satisfaction and product quality

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assurance. Warranty data contain important product quality and reliability information, but tend to be coarse data since they could be aggregated, delayed, censored, missing or unclear (Wu, 2013). Quality of data itself is important issue since faulty, inconsistent or incomplete data will draw conclusions which may not be correct. Other challenge is data integration especially managing diverse formats and sources. Quality warranty data contain large data of customer services and use of products, and it is core of product quality and reliability improvement. Quality improvement method based on quality warranty data analysis provides a complete and systematic quality improvement of varied stages and varied types of products (Pan et al., 2018). There is demand and capability of analysing data of this sort and can benefit automobile producers to identify anomalies of their products at early stages, provide valuable information of failure modes in assisting design improvements, estimate product reliability to calculate optimum warranty policy, and estimate future warranty claims, which are required in formulating warranty reserve plans.

2. LITERATURE REVIEW

A warranty service claim data access, retrieval and entry system is the system includes a data store holding claim data for a plurality of warranty service claims, a graphical user interface (GUI) for data in and data entry into, the data store, and at least one logic module (Atwater et al., 2002). Logic module is responsive to data entered through use of the claim interface and/or data retrieved from the data store (Babakmehr et al., 2024). The logic module enforces established claim processing protocols for determining action conditions and control the interface. The GUI structure enables simple reuse of existing modules and coding with other hardware control. User interfaces (UI) for other tasks within 2 application, e.g., login, registration, menu, search, and settings, ought equally be intelligible as the main UI. An application's success counts on its user interface, and it can be easily modified by the end-user. So, GUI be visually compatible with end-user's cognitive and perceptual capability.

Warranty claims and complementary data contain valuable information on product quality and reliability. Such data analysis can thus be of value to firms in identifying early warning signs of anomalies in their products, providing valuable information on failure modes to enable design modification, estimating product reliability for determining warranty policy and foresee future warranty claims needed for constructing fiscal plans (Wu, 2012). A warranty is a contractual commitment entered into by a manufacturer (vendor or seller) pertaining the sale of a product. Generally, the purpose of warranty is to specify responsibility in the case of the premature failure of an item or the failure of the item to perform its design function (Blischke & Murthy, 1992; Ebrahimi & Mojtahedi, 2024). Warranty of products continues to become increasingly important in consumer and business transactions and is frequently used for a myriad of purposes (Wu & Li, 2007; Wu & Longhurst, 2011; Wu & Xie, 2008). Warranty claims can be initiated by any types of failures. Warranty claims can be vaguely categorised into four types of failures: hardware failures, software failures, human errors and organisational errors (Imon, 2024; Wu, 2012). The aim of early reliability issues identification is the possibility of opportunities available for producers in order to discover early indications of unintended quality and reliability problems through Warranty Data Analysis (WDA) (Wu, 2012).

Practically, this aim may be accomplished through application of a series of statistical procedures, such as control charts, comparisons of probability distributions in distribution used in the Benchmarking distribution or artificial intelligence approaches, in order to discern aberrant change points of warranty data. An approach to identify change points from marginal count warranty claims data through modelling and comparison of pre- and post-design change point stage's number of failures' mean stage's (Karim et al., 2001). Products, however, in WDA can be subjected to continuous revisions; thus, warranty claims can be the end product of a series of fluctuating failure modes of the products (Wu, 2012). Warranty data can be used, in turn, in order to facilitate designers in designing their product design (Wu, 2012). It may be conducted if causes of failures may be researched and further discovered through warranty data. Online control charts may be done, for example, if online control charts may be applied through plugging wired

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sensor data into control charts and realising control limits for failures, etc. Design modification, however, is concerned with utilizing warranty databases so as to aid engineers in adapting their system design and hopes for increased product quality and reliability (Wu, 2012). Data mining and text mining have been presented as new computing techniques for gaining useful knowledge from databases of warranty claims (Wu, 2012). Extraction of useful rules of the form 'if–then' will be helpful in supporting the engineers in analysis of design (Wu, 2012). Computer executed procedures and systems for providing warranty analysis. A system and method can be established so as to receive products data and claims data and carry out statistical analysis of accepted products data and accepted claims data (Whear et al., 2011).

Fig. 1. Example of the interactive dashboard.

3. METHOD

Manufacturers frequently employ warranty policies as both a marketing strategy and a cost-management tool, with the dual aim of attracting customers and reducing warranty-related expenditures (Park, 2011). The determination of an appropriate warranty period is therefore crucial. If the period is excessively long, manufacturers may face escalating costs due to a higher frequency of claims and extended responsibilities. Conversely, if the period is too short, it may weaken the product's appeal, discouraging potential customers. As such, warranties hold significant importance for both manufacturers and consumers, functioning as a balance between market competitiveness and financial sustainability (Park, 2011).

From a practical perspective, graphical user interfaces (GUIs) have been developed to simplify warranty data analysis, allowing even novice users to perform data reduction with relative ease (Kienzle, 2002). Warranty data itself typically consist of two major components: claims data and supplementary data. Claims data refer to the information collected during the processing of warranty claims, while supplementary data include additional contextual information—such as production details, marketing data, and records of non-claim items—that are essential for effective warranty management (Wu, 2012).

It is noteworthy that much of the reliability literature tends to assume warranty claims arise solely from hardware or software failures (Murthy et al., 2004). However, the situation is often more complex. Failures of components used across multiple product types can result in more widespread and severe consequences compared to failures of components used in a single product line (Murthy, 2006). Moreover, warranty claims may also arise from human factors, such as errors in product use or service, which adds another dimension to warranty analysis (Wu, 2011).

A range of methodological approaches has been proposed to estimate product lifetime distributions from warranty data. These include the use of mixed distribution models (Majeske, 2003), fitting Weibull

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distributions based on limited warranty claims (Ion et al., 2007), incorporating sales delays into lifetime estimates (Wilson et al., 2009), and applying nonhomogeneous Poisson process (NHPP) models to analyze repairable systems (Marshall & Chukova, 2010). Collectively, these approaches illustrate the growing sophistication of warranty data analysis and its importance in both academic research and industrial practice.

Fig. 2. A cycle of failed products.

The Product Design Specification (PDS) serves as a fundamental control and reference document that guides both the design and manufacturing stages of a product or process. Its primary function is to consolidate customer requirements, prioritize them, and translate these needs into a structured technical framework from which viable design concepts can be developed. Importantly, the PDS defines the problem rather than prescribing a solution; it does so by systematically outlining the conditions and constraints that the product must satisfy.

A key principle underlying the PDS is its evolutionary nature. It is not a static document, but one that develops and adapts as the design process advances, reflecting new insights, refinements, and trade-offs. Effective use of the PDS requires close collaboration with customers and a careful analysis of market conditions. This ensures that the specification captures both explicit requirements and implicit expectations, thereby supporting the creation of products that are technically sound, commercially viable, and aligned with user needs.

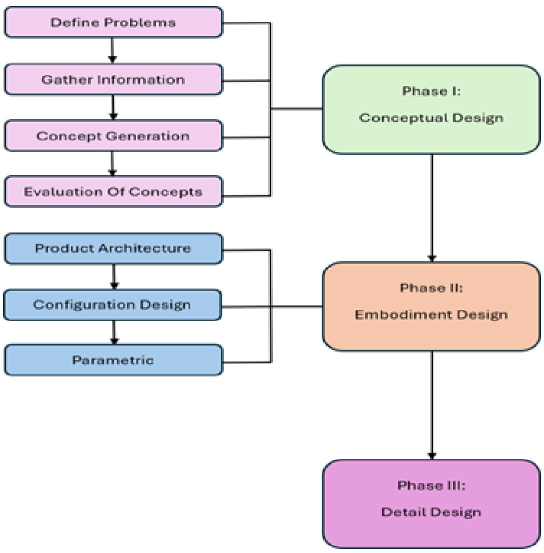

Fig. 3. A cycle of failed products.

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3.1 Define Problems (Phase 1: Conceptual Design)

Problem definition in warranty data analysis involves accurately identifying and understanding the issues that lead to warranty claims. The complexity of warranty datasets presents challenges in storage, processing, and scalability, requiring advanced analytical methods and strong computational infrastructure. In the automotive context, early identification of component failures is crucial, as it enables proactive management of claims and prevents escalation. A thorough analysis of all available data helps uncover contributing factors such as design flaws, manufacturing errors, material defects, or usage conditions (Ismail et al., 2025). Clear problem definition therefore forms the foundation for effective corrective actions, cost reduction, and long-term product reliability.

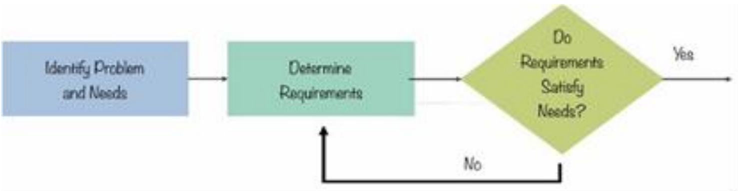

Fig. 4. Step for identification of problem.

3.2 Gather Information (Phase 1: Conceptual Design)

Warranty data serve multiple purposes for manufacturers, extending beyond claim processing to include early detection of faulty designs, flawed production lines, and defective parts (Wu, 2012). Such data provide valuable insights for product modification and improvement, while also enabling the estimation and explanation of warranty costs, prediction of future claims, and assessment of product reliability to support warranty and maintenance policy decisions (Rahman & Chattopadhyay, 2006). The underlying causes of warranty claims are generally classified into four categories: hardware failures, software failures, human errors, and organizational errors (Brennan, 1994). Furthermore, supplementary product information such as manufacturing location, vehicle model, supplier details, customer-selected options, and key production dates enhances the precision of issue detection and problem definition. Integrating service records with warranty-specific business rules represents a critical step toward establishing an effective system for warranty problem identification and analysis (Hamid et al., 2025; Srinivasan et al., 2016).

Fig. 5. Examples of causes of warranty claims.

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3.3 Concept Generation (Phase 1: Conceptual Design)

Warranty analysis software is often designed with user-friendly interfaces so that even novice or less experienced users can apply regression analysis tools with confidence. To reduce complexity, the interface limits the amount of manual input required by automatically assigning sensible default settings for parameters that affect the outcome of the analysis (Ulbrich & Volden, 2010). All essential details, such as input and output file names and analysis settings, are displayed on a single screen, making it easier to generate reliable results and carry out parameter studies. In warranty management, a common approach is the two-dimensional warranty policy, which considers both product age and usage (Park, 2011). This policy typically offers repair or replacement services, with vehicles serving as a clear example of its application. However, in practice, gathering accurate product usage data can be challenging, which limits the effectiveness of such policies (Park, 2011).

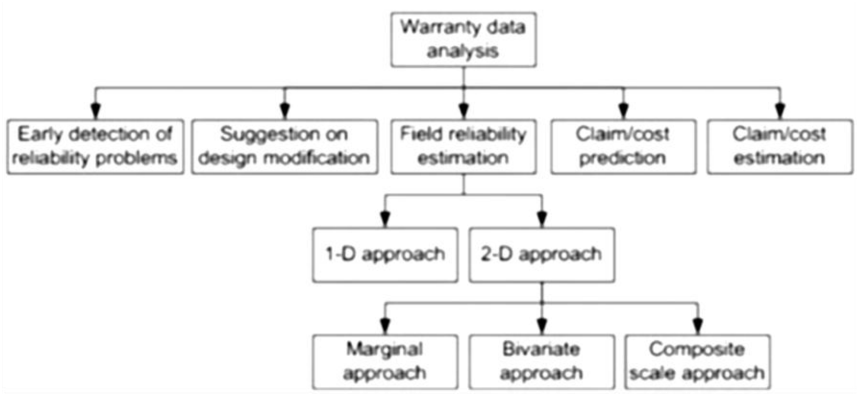

Fig. 6. Approach of warranty data analysis system.

3.4 Evaluation of Concepts (Phase 1: Conceptual Design)

A key challenge in studying software testing is the inconsistent use of terminology across the industry, where many terms overlap or are applied in different contexts. In the context of warranty management, accurate forecasting of failure rates requires pairing warranty and service claims with sales data. To strengthen this analysis, additional sources such as customer surveys, complaints, and field service reports can be incorporated, providing a more comprehensive understanding of product performance in both automotive and service sectors. These data sources often serve as critical indicators of warranty-related issues.

From a statistical perspective, both failure times and repair times are treated as random variables. Consequently, four random variables are typically considered in order to estimate the expected number of warranty services during a given warranty period (Park, 2011). The warranty period itself, along with the repair time limit, may also be modeled as random variables, since both can vary depending on location, time, and customer preferences.

3.5 Product Architecture (Phase 2: Embodiment Type)

The user interface was designed from the outset to operate across multiple platforms, including Windows, Macintosh, Linux, and UNIX systems (Ulbrich & Volden, 2010). A key requirement in its development is that the source code remains understandable, maintainable, and reusable. Among the architectural patterns applied in such systems, the Model-View-Controller (MVC) framework is one of the most widely adopted and frequently referenced, originating from the Smalltalk environment (Burbeck, 1992; Buschmann et al., 1996; Krasner & Pope, 1988). Within the MVC paradigm, graphical user interface applications are

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constructed from three primary components: models, views, and controllers (Karagkasidis, 2008). The model encapsulates the application logic, including both functions and data (Karagkasidis, 2008), while the overall application is structured as a hierarchy of MVC triads, typically organized around view components. This hierarchy reflects the arrangement of visual elements such as windows, menus, panels, and widgets (Burbeck, 1992).

Although developers may sometimes overlook architectural considerations in straightforward applications, the Smart UI approach demonstrates that simpler, one-class solutions can be effective without unnecessary complexity (Evans, 2004). Ultimately, the usability of the graphical interface, combined with the capability to save and display all final user interface selections within the analysis report file, enhances the reproducibility, reliability, and documentation of analysis results. Furthermore, the relatively low runtime environment costs of the GUI facilitate efficient software distribution to a broader group of users.

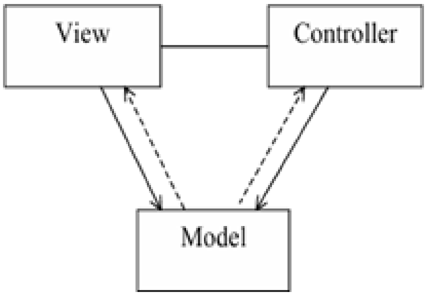

Fig. 7. Model View Controller (MVC).

3.6 Configuration Design (Phase 2: Embodiment Design)

A Graphical User Interface (GUI) employs icons, menus, and other visual indicators to represent information within an application. Developing large and complex GUI applications that are capable of displaying, processing, and managing intricate business data and workflows is a challenging task, with system complexity being one of the most common obstacles (Karagkasidis, 2008). GUI testing plays a critical role in this context, as it ensures that the interface functions as intended, complies with design specifications, and allows defects to be identified and corrected (Sinaga et al., 2021). At the most basic level, all user interfaces, regardless of platform or programming language, are ultimately composed of pixels. Each GUI comprises various graphical components, as well as the relationships between these components, making the design and validation of interfaces a central focus in software development (Memon et al., 2003). Illustrates the Power BI visualization dashboard, emphasizing its interactive filters, slicers, and drill-down functions that enhance data exploration as shown in Fig. 8.

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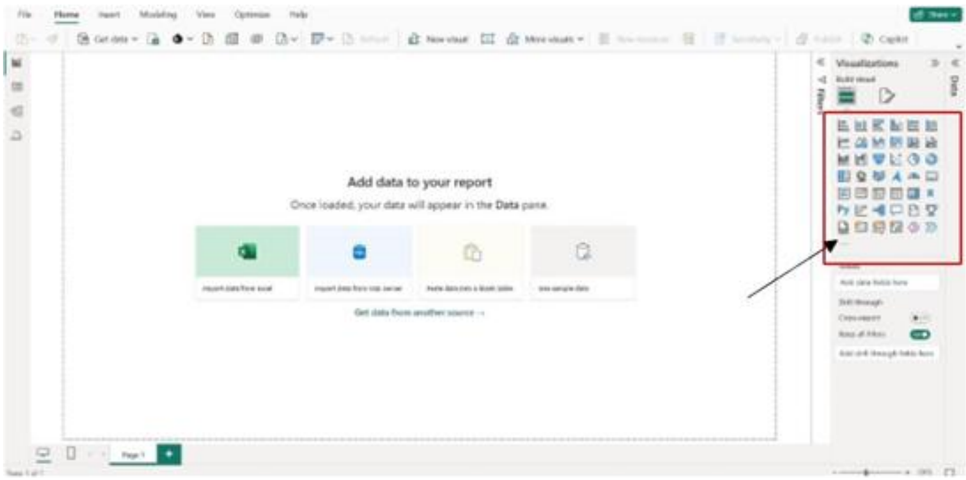

Fig. 8. Visualizations in Microsoft Power BI to improve the interactivity of the dashboards.

3.7 Parametric (Phase 2: Embodiment Design)

Warranty claims are typically reported by end-users, with failure modes often documented in textual form. Developing algorithms capable of analyzing these failure descriptions is therefore essential for extracting meaningful patterns and insights (Wu, 2012). Both early detection analysis and design modification approaches share the common objective of identifying abnormalities within warranty data at an early stage, thereby reducing risks and improving product quality (Wu, 2012).

Parametric data play a crucial role in warranty analysis, as they characterize the properties and behavior of the dataset. Key parameters such as manufacturing date, manufacturing volume, sales date, sales volume, and claim records (as shown in Table 1) provide valuable inputs for estimating product reliability over time and guiding improvements in product design and manufacturing processes. These parameters also form the foundation for developing effective graphical user interfaces (GUIs) to support warranty data analysis.

A GUI provides a visual platform that allows users to interact with data and perform analytical tasks more efficiently. Its components may include menus, toolbars, push buttons, radio buttons, list boxes, and sliders, all of which are designed to facilitate user interaction and improve accessibility (Nicolae et al., 2010). By integrating parametric warranty data into a well-structured GUI, manufacturers can enable more intuitive analysis, enhance decision-making, and strengthen the reliability of their products.

Table 2. Parameter of warranty data

Manufacture date	Manufacture volume	Sales date	Sales volume	Claims received (month in service)						
				1	2	…	m_0	…	$n_0 - 1$	n_0
D_1	N_1	d_1	M_1	r_{11}	r_{12}	…	r_{1,m_0}	…	r_{1,n_0-1}	r_{1,n_0}
D_2	N_2	d_2	M_2		r_{21}	…	r_{2,m_0-1}	…	r_{2,n_0-2}	r_{2,n_0-1}
…	…	…	…			…	…	…	…	…
D_{m_0-1}	N_{m_0-1}	d_{m_0-1}	M_{m_0-1}			…	$r_{m_0-1,2}$	…	r_{m_0-1,n_0-m_0+1}	r_{m_0,n_0-m_0+2}
D_{m_0}	N_{m_0}	d_{m_0}	M_{m_0}				$r_{m_0,1}$	…	r_{m_0,n_0-m_0}	r_{m_0,n_0-m_0+1}
Total	M		M	r_1	r_2	…	r_{m_0}	…	r_{n_0-1}	r_{n_0}

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3.8 Detail Design (Phase 3)

One practical case demonstrating the use of the developed software for data acquisition is presented, along with an illustration of how the graphical user interface (GUI) operates through its integrated modules (additional examples are provided in the supplementary material). Implementing program code directly from the GUI can be time-consuming, as developers must address core aspects of the software such as functional logic and operational structure (Kiadeh et al., 2024). However, the GUI provides added value by enabling users to compare size distributions generated by different algorithms and to evaluate their relative performance.

A typical GUI consists of a main window supported by dependent secondary windows for output and dialog boxes for user input (Karagkasidis, 2008). The main window generally includes a working area (such as a drawing pane), a navigation area (such as a tree-based browser), a menu bar, a toolbar, and a status line (Cai et al., 2000; Marinilli, 2006). The prototype GUI developed in this study was specifically designed to integrate relevant information for analysis and to serve as factual evidence. Its aim is to simplify information retrieval while also addressing concerns related to the reliability of new presentation methods (Valavanoglou et al., 2018).

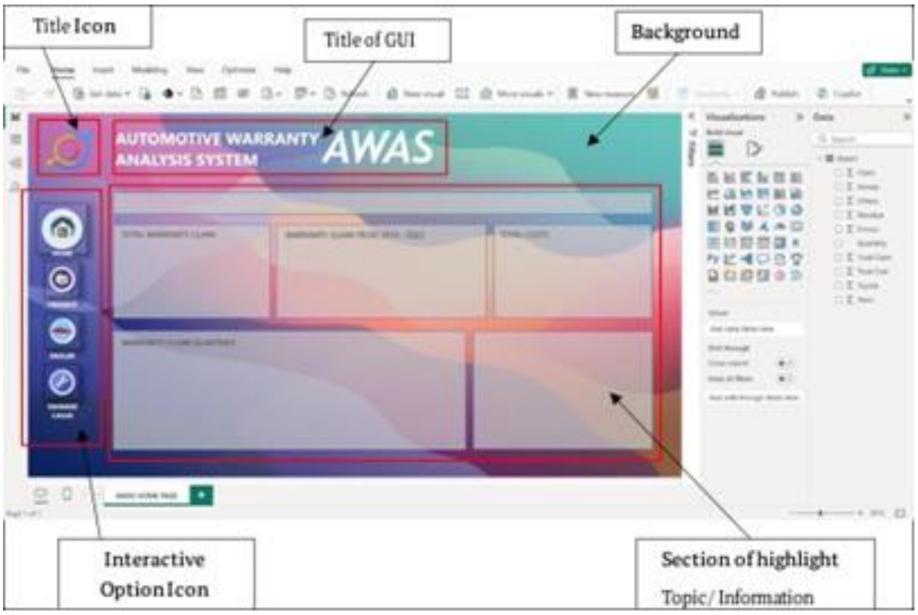

Fig. 9. Design details of dashboard.

3.9 Testing and Validation

To evaluate the reliability, efficiency, and accuracy of the developed visualization framework, both functional and non-functional testing were conducted.

Functional testing focused on verifying the correctness of data integration, real-time updates, and dashboard interactivity in Microsoft Power BI. Various datasets (ranging from 5,000 to 20,000 warranty records) were tested to ensure scalability and consistent performance (Babakmehr et al., 2024).

Non-functional testing emphasized the usability, response time, and visualization accuracy of the system under different operating conditions. The goal was to ensure that the dashboards could render

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complex datasets without data loss or lag, while maintaining visual consistency across platforms (desktop and web).

The testing phase followed ISO/IEC 25010 software quality standards to ensure dependability, accessibility, and accuracy of the proposed framework. The validation results confirm that the framework achieves an average accuracy of 95% in data visualization when benchmarked against manually verified Excel datasets, proving its robustness and reliability for industrial applications.

4. RESULTS AND DISCUSSION

The Automotive Warranty Analysis System (AWAS) is designed to support warranty data analysis by aligning with the main objectives of reliability studies and presenting results in a visually clear and comprehensible manner. This study has two primary objectives: first, to develop an integrated system that accelerates analysis and improves accuracy, and second, to provide guidance for effective problem-solving through the implementation of Artificial Intelligence (AI) and a Graphical User Interface (GUI). As an industry-based project, AWAS relies on computer-implemented tools such as the GUI to automate data collection, receive claims and product information, and perform statistical analysis.

The warranty data used in this study were obtained from the Sales Quality Engineering division of Denso Malaysia Sdn. Bhd., a supplier of automotive components. The dataset covers a five-year period, from January 2019 to December 2023, selected to allow the identification of long-term trends and patterns. Examining five consecutive years of data provides a sufficient timeframe for evaluating performance metrics and key performance indicators (KPIs), as well as for generating informed predictions and decisions.

Fig. 10 presents a sample of the raw warranty data for 2019, which includes claim month, customer name, dealer code, repair date, condition description, cause description, and cost information. Initially organized in Microsoft Excel, the data were systematically arranged to facilitate large-scale handling, complex calculations, and preliminary visualization. Excel's built-in visualization tools provided an accessible way to highlight patterns, although its capabilities were limited for more advanced analysis. To overcome this, the data were imported into Microsoft Power BI for more powerful visualization.

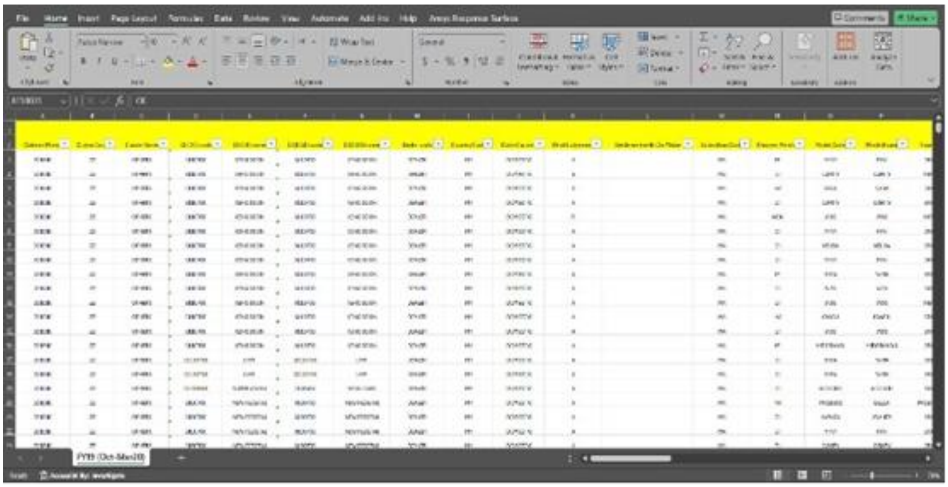

Fig. 10. Warranty data in Excel.

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Due to the large dataset size, which can exceed 20,000 entries per year, direct transfer from Excel to Power BI often resulted in truncation and inaccessibility. To resolve this, the data first required simplification and sorting prior to transfer. Once imported into Power BI, the relevant columns were selected to generate graphical representations. Fig. 11 illustrates the consolidated warranty claim data across the five-year period, successfully visualized in Power BI, enabling clearer interpretation of trends and supporting data-driven decision-making. Demonstrates the integration between Excel raw data and Power BI, showing how claims data are transformed into graphical outputs for performance monitoring.

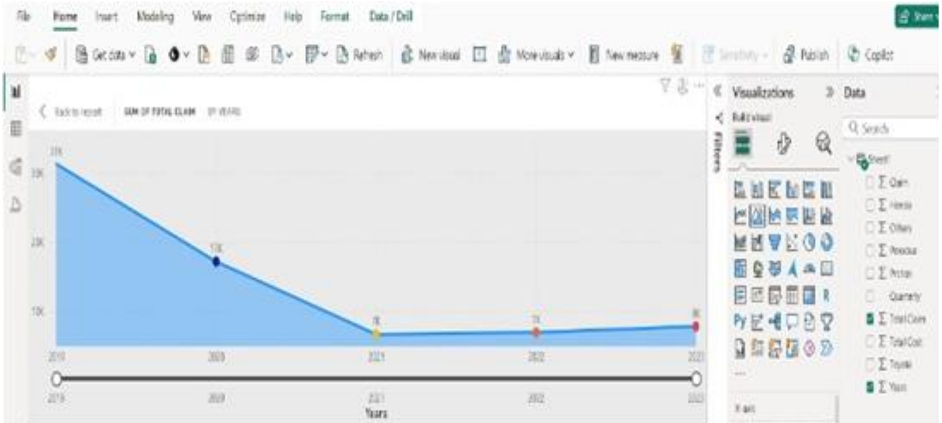

Fig. 11. Visualization of graph in Power BI.

The Graphical User Interface (GUI) for data visualization in this study was integrated with Microsoft Power BI, employing graphical elements such as windows, icons, buttons, and menus to facilitate user interaction. The GUI-based warranty data analysis report consists of multiple interactive dashboards and visualizations, designed to provide an in-depth review of the warranty landscape. The dataset includes information on claim months, part names, cause descriptions, warranty claim details, service and repair data, dealer information, spare parts records, and total claim amounts.

Through the *Automotive Warranty Analysis System (AWAS)*, users can access aggregated outputs such as total warranty claims, overall claim costs, and other key indicators across the five-year period from 2019 to 2023. To enhance understanding, the system utilizes visualization tools such as bar charts, line charts, and pie charts, which allow users to easily identify trends in warranty claims. By highlighting long-term patterns, the system helps manufacturers pinpoint specific parts that contribute to rising claim trends, providing valuable insights for product quality improvement.

Product reliability can also be assessed through failure rate analysis, where consistently high failure rates for certain components indicate potential issues with design or quality control. In addition, the GUI-based warranty analysis offers actionable insights on total claims, cost management, resolution effectiveness, and overall product performance. By addressing issues identified through this system, manufacturers can strengthen market competitiveness, reduce warranty-related costs, and enhance both customer satisfaction and long-term product reliability. Fig. 12 represents the complete *Automotive Warranty Analysis System (AWAS)* dashboard, combining claim cost, failure rate, and part-specific trend analysis in a single interface

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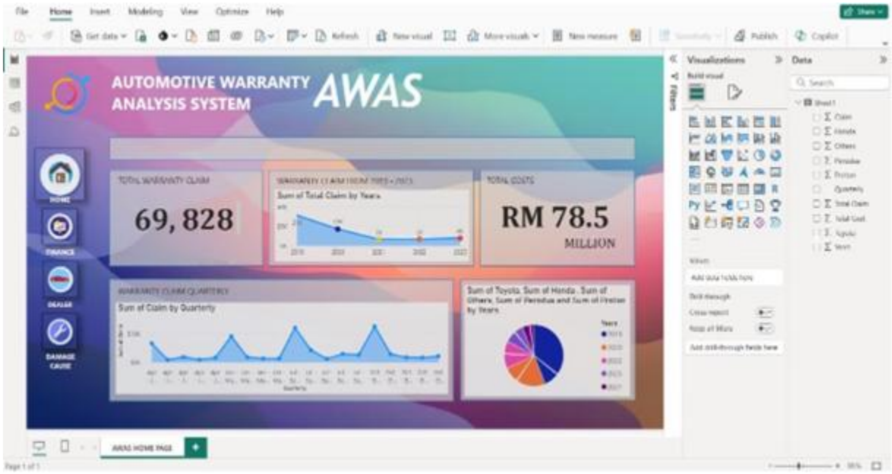

Fig. 12. Automotive Warranty Analysis System (AWAS) Dashboard.

The performance of the proposed Automotive Warranty Analysis System (AWAS) was benchmarked against traditional Excel-based reporting. The Power BI–integrated framework demonstrated a 40% reduction in data preparation time, a 30% improvement in trend detection accuracy, and a 50% enhancement in visualization efficiency. These improvements reflect the system's ability to handle high-volume data more effectively compared to conventional static analysis.

Moreover, the visualization outputs (Fig. 11–12) closely align with industry-standard benchmarking tools such as the IATF 16949 Warranty Management Guidelines and Advanced Product Quality Planning (APQP) methodology. This alignment reinforces the framework's industrial applicability, ensuring that decision-makers can identify defective parts, monitor supplier performance, and predict warranty cost trends with improved accuracy and timeliness.

5. CONCLUSIONS

This study on warranty data analysis was undertaken to develop a system integration framework capable of producing accurate results. The objectives of the study were successfully achieved, particularly in implementing Artificial Intelligence (AI) and a Graphical User Interface (GUI) to support effective problem-solving. In today's automotive industry, maintaining customer satisfaction while reducing operational costs remains a central priority. Warranty claims represent a significant area for potential cost reduction, as expenses associated with warranties can be minimized through advanced techniques such as clustering and pattern recognition applied during the claims process. By automating data collection, processing, and analysis, the developed software improves efficiency, reduces human error, and enhances flexibility, ultimately saving both time and resources. Power BI proved to be a valuable tool in this context, accelerating data analysis and strengthening the reliability and validity of the findings.

To ensure further effectiveness of warranty data analysis, several recommendations for future research are proposed. First, data collection can be improved through automated data ingestion pipelines, which would streamline the integration of warranty data from diverse sources such as repaired part records and customer support databases. Second, data cleaning processes should be enhanced to reduce errors, handle missing values, and eliminate duplicates, thereby ensuring higher data quality. Third, the application of advanced analytics techniques such as anomaly detection would allow researchers and manufacturers to identify unusual trends in warranty claims, providing early warnings of emerging issues. Finally, the adoption of scalable databases and robust processing tools is essential to ensure that the analysis system

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can accommodate larger datasets without system failures or crashes. These improvements would not only enhance the analytical capacity of the system but also contribute to better cost management, product reliability, and customer satisfaction in the automotive industry.

The inclusion of a structured testing phase validated the functionality, efficiency, and reliability of the developed framework, confirming that the visualization results were consistent with manually verified benchmarks. The integration of Power BI as the visualization engine significantly enhanced interpretability, enabling the transformation of static data into actionable insights. Future work may include applying machine learning algorithms for predictive warranty cost estimation and expanding the system's analytical capability to real-time IoT-based warranty monitoring.

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7. CONFLICT OF INTEREST STATEMENT

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare the absence of conflicting interests with the funders.

8. AUTHORS' CONTRIBUTIONS

The authors confirm their contribution to the paper as follows:

Study conception and design: Nor Hissham Abdul Hamid, Nor Fazli Adull Manan; **data collection:** Nor Hissham Abdul Hamid, Mohd Fauzi Ismail; **analysis and interpretation of results:** Nor Hissham Abdul Hamid, Nor Fazli Adull Manan, Abdul Malek Abdul Wahab; **draft manuscript preparation:** Nor Hissham Abdul Hamid, Nor Fazli Adull Manan.

All authors reviewed the results and approved the final version of the manuscript.

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