

Drive Safe: A Device for Routinary Vehicle Check-Ups

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Abstract

This study developed and evaluated Drive Safe: A Device for Routinary Vehicle Check-Ups (BLOWBAGETS), an Arduino-based system designed to encourage drivers to perform mandatory pre-driving vehicle inspections before engine ignition. Anchored on System Dynamics, Ergonomics Theory, and Nudge Theory, the study employed a descriptive-developmental research design involving the design, fabrication, testing, and evaluation of the device. The study was conducted in Kidapawan City, Cotabato, Philippines, using purposive sampling to select 100 licensed drivers, auto mechanics, technicians, and individuals knowledgeable in vehicle inspections. A researcher-made questionnaire validated by experts was used to assess the device's technical performance and acceptability in terms of design, usability, and workability, while the collected data were analyzed using weighted mean and Likert scale analysis. The findings showed that the device was successfully designed, fabricated, and functioned effectively during technical testing by consistently guiding users through routine vehicle inspections before engine activation. Respondents rated the device as Highly Acceptable in terms of design (3.92), usability (3.97), and workability (4.00), indicating that it is functional, reliable, user-friendly, and suitable for practical vehicle safety applications. The study concludes that Drive Safe has the potential to improve driver awareness, encourage compliance with preventive vehicle inspections, and support safer driving practices. Further testing using different vehicle types and continued design improvements are recommended to strengthen its practical implementation. This study supports Sustainable Development Goal (SDG) 3: Good Health and Well-Being, SDG 9: Industry, Innovation and Infrastructure, SDG 11: Sustainable Cities and Communities, and SDG 12: Responsible Consumption and Production by promoting safer transportation through preventive maintenance and technological innovation. The device contributes to sustainable road safety by encouraging responsible vehicle ownership, improving operational efficiency, extending vehicle service life, and reducing risks associated with mechanical failures.

Keywords: Arduino-Based System, BLOWBAGETS, Drive Safe, Preventive Vehicle Maintenance, Road Safety, Routine Vehicle Check-Ups, Vehicle Inspection

1. Introduction

Road safety depends not only on responsible driving behavior but also on the mechanical condition of vehicles. Although drivers are expected to comply with traffic regulations, routine pre-driving vehicle inspections remain an essential preventive measure to reduce accidents caused by mechanical failures. Existing literature emphasizes that neglecting inspections of critical vehicle components, such as brakes, lights, tires, oil, and coolant, increases the risk of crashes and endangers drivers, passengers, pedestrians, and other road users (AAA, 2024; Moreano et al., 2020; Blower and Campbell, 2000). Despite these findings, compliance with preventive maintenance remains largely voluntary because many drivers overlook routine inspections due to complacency, lack of awareness, or confidence in their vehicles' reliability (Motor, 2023). While technologies such as ignition interlock devices and IoT-based safety systems have improved compliance with other road safety measures (NHTSA, 2023; Chaudhary et al., 2024), few technologies require drivers to complete routine vehicle inspections before engine ignition. This study therefore proposes Drive Safe: A Device for Routinary Vehicle Check-Ups, which integrates mandatory pre-driving inspection into the vehicle starting process to encourage preventive maintenance, reduce mechanical failures, and improve overall road safety.

1.1 Background of the Study on Preventive Vehicle Check-Ups

Mechanical failures remain a significant cause of road accidents despite improvements in driver education. Routine inspections of essential vehicle components help identify defects before driving and reduce accident risks (AAA, 2024; Moreano et al., 2020; Blower and Campbell, 2000). However, many drivers neglect these inspections because of complacency or lack of awareness (Motor, 2023). Existing vehicle technologies mainly monitor driver behavior rather than ensuring maintenance compliance (NHTSA, 2023; Chaudhary et al., 2024). Consequently, this study develops Drive Safe,

a device that integrates the BLOWBAGETS checklist into the vehicle starting process to encourage consistent preventive maintenance.

1.2 Themes and Insights from Related Literature on Preventive Vehicle Maintenance

The literature consistently shows that preventive maintenance improves vehicle reliability, safety, fuel efficiency, lifespan, and resale value while reducing repair costs (AAA, 2020; Crownautoworks, 2024). Regular servicing, particularly engine oil replacement, prevents engine damage, overheating, and costly mechanical failures (Crownautoworks, 2024; Ramona Tire, 2025). Likewise, maintaining brakes, tires, lights, and other safety components reduces accident risks and enhances vehicle performance (FMCSA, 2022; TrueCar, 2024; BoysMotor Wrks, 2024; 5K Car Care, 2025). Modern dashboard indicators and intelligent vehicle information systems further assist drivers in monitoring vehicle conditions, although excessive visual information may contribute to distraction (Atombo et al., 2025; Everis, 2025; European Commission, 2016; Bark et al., 2014; Klauer et al., 2006; Bhise, 2012). These findings support the development of Drive Safe as a device that promotes consistent compliance with pre-driving vehicle inspections.

1.3 Local, National, and Global Context of Preventive Vehicle Check-Ups

Globally, road accidents caused by mechanical failures continue to threaten public safety, highlighting the need for consistent preventive vehicle maintenance (Moreano et al., 2020; Blower and Campbell, 2000). International organizations recommend routine inspections before driving, while technologies such as ignition interlock systems and IoT-based safety devices demonstrate the effectiveness of automated safety compliance (AAA, 2024; NHTSA, 2023; Chaudhary et al., 2024). Likewise, advances in dashboard indicators, Vehicle-to-Vehicle (V2V), Vehicle-to-Infrastructure (V2I), and Vehicle-to-Everything (V2X) technologies improve driver awareness but may also increase distraction when poorly designed (Atombo et al., 2025; Everis, 2025; European Commission, 2016; Bark et al., 2014; Klauer et al., 2006; Bhise, 2012). These developments emphasize the need for technologies that promote vehicle safety while minimizing driver workload.

1.4 Theoretical or Conceptual Basis of Drive Safe

The study is anchored on System Dynamics, Ergonomics Theory, and Nudge Theory. System Dynamics explains how sensors, processors, and diagnostic functions interact to assess vehicle conditions and support maintenance decisions (Smith, 2022). Ergonomics Theory emphasizes a user-friendly, efficient, and comfortable interface that minimizes operator fatigue and human error (Brown, 2021). Nudge Theory supports the integration of reminders, simplified inspection procedures, and real-time feedback to encourage drivers to complete routine vehicle inspections without limiting their autonomy. Collectively, these theories support the development of Drive Safe as an effective and user-centered preventive maintenance device.

1.5 Research Gaps and Rationale

Existing studies emphasize the benefits of preventive maintenance and intelligent vehicle technologies, yet most systems focus on monitoring vehicle conditions, scheduling maintenance, or providing driver information rather than requiring drivers to complete pre-driving inspections before engine ignition (AAA, 2020; Atombo et al., 2025; Everis, 2025). Likewise, prior technologies primarily support vehicle control, maintenance scheduling, and driving modes instead of enforcing routine maintenance compliance. This gap justifies the development of Drive Safe: A Device for Routinary Vehicle Check-Ups, which integrates mandatory pre-driving inspection into the vehicle starting process to promote preventive maintenance, improve driver compliance, and enhance road safety.

1.6 Alignment with Relevant Sustainable Development Goals (SDGs)

This study supports SDG 3 – Good Health and Well-Being by promoting safer roads through preventive vehicle inspections that help reduce accidents caused by mechanical failures. It also aligns with SDG 9 – Industry, Innovation and Infrastructure through the development of an innovative device that integrates routine vehicle inspection into the driving process. Additionally, the study contributes to SDG 11 – Sustainable Cities and Communities by encouraging responsible vehicle operation and improving road safety for drivers, passengers, and pedestrians. The promotion of regular vehicle maintenance also supports SDG 12 – Responsible Consumption and Production by extending vehicle lifespan, reducing unnecessary repairs, improving fuel efficiency, and minimizing waste and emissions associated with neglected maintenance.

1.7 Importance of the Study to Multidisciplinary Sustainability

The study contributes to technological sustainability by introducing a practical innovation that encourages preventive maintenance through a user-friendly vehicle inspection device. It supports public health and community sustainability by reducing risks associated with mechanical failures and promoting safer transportation. The study also contributes to educational sustainability by serving as a learning resource for automotive and engineering students and professionals, while supporting economic sustainability by helping vehicle owners reduce maintenance costs, extend vehicle service life, and improve operational efficiency through regular inspections. Overall, Drive Safe promotes responsible vehicle ownership and sustainable road safety practices.

2. Material and methods

2.1 Research Design

This study employed a descriptive-developmental research design to design, develop, fabricate, and evaluate Drive Safe: A Device for Routinary Vehicle Check-Ups (BLOWBAGETS). The device integrates an Arduino-based control system, LCD display, LED indicators, relay module, and BLOWBAGETS push-button checklist into a compact enclosure to ensure that routine vehicle inspections are completed before engine ignition. The system operates by processing inspection inputs and providing visual feedback until all checklist items are confirmed, after which engine ignition is enabled. The development process included planning, component preparation, circuit assembly, programming, system integration, testing, calibration, safety verification, and final evaluation. Minor revisions were made during fabrication to improve system performance before the final prototype was evaluated for its technical performance and acceptability in terms of design, usability, and workability using weighted mean and Likert-scale responses.

2.2 Locale of the Study

The study was conducted in Kidapawan City, Cotabato, Region XII (SOCCSKSARGEN), Philippines, where the device was designed, fabricated, tested, and evaluated. As the commercial and administrative center of the province, the city provided an appropriate environment for assessing the functionality, practicality, and applicability of the device. Its combination of urban and community settings enabled the researcher to evaluate the system under conditions representative of its intended users.

2.3 Respondents of the Study

The respondents consisted of 100 individuals from Kidapawan City, including licensed private and commercial drivers, auto mechanics, technicians, and individuals involved in vehicle inspection activities. All respondents possessed relevant driving experience and knowledge necessary to evaluate the technical performance and acceptability of the Drive Safe device. Participation was secured after obtaining the necessary permissions from the concerned individuals and organizations.

2.4 Sample and Sampling Procedure

The study employed purposive sampling to select 100 qualified respondents who met the predetermined inclusion criteria, including possession of a valid driver's license, driving experience, and familiarity with vehicle inspection procedures. This sampling technique ensured that the respondents possessed the knowledge and experience necessary to provide reliable evaluations of the device's design, usability, workability, and overall technical performance.

2.5 Research Instrument

The study utilized a researcher-made questionnaire to evaluate the technical performance and acceptability of Drive Safe: A Device for Routinary Vehicle Check-Ups. The instrument measured the device's design, usability, and workability using a four-point Likert scale, with space provided for respondents' comments and suggestions. The questionnaire was validated by experts in driving and related fields, obtaining a mean validity score of 4.11, indicating high validity and suitability for data collection.

2.6 Data Gathering Procedure

The researcher finalized and validated the questionnaire before securing permission from vehicle operators and individual owners to conduct the study. Qualified respondents were personally briefed on the purpose and scope of the research and assured that their responses would remain confidential. After the questionnaires were completed, they were immediately retrieved, encoded in Microsoft Excel, and prepared for statistical analysis.

2.7 Data Analysis Techniques

The collected data were organized, tabulated, and analyzed using weighted mean and Likert scale analysis to determine the technical performance of the Drive Safe device and its acceptability in terms of design, usability, and workability. The analyzed results served as the basis for interpreting the effectiveness of the developed device.

3. Results and Discussion

3.1 Development of the Drive Safe Device

3.1.1 Design and Development

The Drive Safe device was successfully designed and developed through systematic planning, review of related technologies, and preparation of perspective, orthographic, and exploded drawings. The final prototype measured 250 mm in width and 300 mm in length and incorporated a central control unit connected to input components for checking the battery, lights, oil, water, brakes, accelerator, gear, engine, tires, and self-check functions. The system provides visual feedback through LCD and LED displays and includes a bypass feature that allows users to override the routine inspection

when necessary. The completed design demonstrates a simple, organized, and user-oriented system intended to improve driver awareness and encourage routine vehicle inspections before driving. The integration of inspection inputs, visual indicators, and an optional bypass function supports both usability and operational flexibility, making the device suitable for practical vehicle safety applications.

3.1.2 Fabrication of the Device

The prototype was successfully fabricated using an Arduino Mega microcontroller, relay module, enclosure, LED indicators, button switches, wiring components, and standard electronic assembly tools. The fabrication process included programming the Arduino, assembling the electrical circuits, and integrating all hardware components into a functional prototype capable of performing routine vehicle inspections. The successful completion of the prototype confirms the feasibility of developing an Arduino-based vehicle inspection device using readily available electronic components. The completed system demonstrates that integrating hardware and software can provide a practical tool for promoting routine vehicle safety inspections before engine ignition.

3.2 Technical Performance of the Drive Safe Device

3.2.1 Technical Testing Performance

The technical evaluation showed that the Drive Safe device performed consistently during five routine inspection trials. Most vehicle components, including the lights, water, brakes, accelerator, tires, and self-check functions, were successfully confirmed in every trial before engine activation. Although a few confirmation steps involving the battery, oil, gear, and engine were occasionally missed during the early trials, the engine successfully started in all five routines after the required confirmation procedures were completed. The bypass function was used only during the first two trials and was no longer required in the succeeding tests, indicating increased user familiarity with the device. These findings indicate that the Drive Safe device effectively guides users through routine vehicle inspections while ensuring proper engine activation after the required safety checks. The consistent performance supports the importance of routine vehicle inspections in reducing mechanical failures and promoting road safety, consistent with recommendations from the National Highway Traffic Safety Administration (2023) and the World Health Organization (2023). Overall, the device demonstrated reliable functionality and has strong potential to improve driver responsibility and compliance with routine vehicle safety procedures.

3.3 Acceptability of the Drive Safe Device

3.3.1 Design

The respondents rated the design of the Drive Safe device as Highly Acceptable, with an overall weighted mean of 3.92. The rectangular shape, black color, LCD and LED displays, and bypass button functionality received the highest ratings, while the device width, connector size, and confirmation button layout also received highly acceptable evaluations. Overall, the findings indicate that respondents perceived the device as practical, visually appropriate, and suitable for installation inside a vehicle. The results suggest that the device successfully meets user expectations regarding appearance, functionality, and ergonomics. Its simple design, non-distracting color, and organized interface support safe and convenient operation within the vehicle. These findings are consistent with recommendations of the National Highway Traffic Safety Administration (NHTSA), which emphasize minimizing driver distraction through intuitive and user-centered automotive device design. The consistently high ratings further indicate that the Drive Safe device is appropriate for practical application, although minor refinements in dimensions and interface spacing may further improve usability.

3.3.2 Usability

The Drive Safe device also achieved a Highly Acceptable rating in terms of usability, with an overall weighted mean of 3.97. Respondents highly rated the device's ability to perform routine vehicle inspections, the clarity of the LCD and LED displays, the confirmation buttons, RESET and BYPASS functions, sound alarm, and power control. Only the display of the main controller and the device's practicality for everyday use received slightly lower, yet still highly acceptable, ratings. Overall, respondents considered the device easy to understand, operate, and apply during routine vehicle inspections. These findings indicate that the Drive Safe device provides an intuitive and user-friendly interface that enables drivers to perform routine inspections efficiently. The clear visual indicators and control features support effective interaction while reducing operational errors. The results are consistent with the ISO 9241-11 usability framework, which defines usability based on effectiveness, efficiency, and user satisfaction. Likewise, the strong performance of the LCD, LED indicators, and alarm system supports research in automotive human-machine interaction emphasizing the importance of clear feedback for improving driver awareness and safety.

3.3.3 Workability

The Drive Safe device obtained a perfect overall weighted mean of 4.00, indicating a Highly Acceptable level of workability. All evaluated operational functions, including the power button, LCD status display, LED indicators, confirmation buttons, RESET function, BYPASS feature, engine readiness confirmation, and readable system outputs, received perfect ratings from the respondents. These findings demonstrate that the device consistently performed its

intended functions during operation without observed technical difficulties. The perfect workability rating indicates that the Drive Safe device is reliable, responsive, and capable of providing consistent operational performance. Immediate system responses through the LCD, LED indicators, and confirmation mechanisms improve user confidence and facilitate proper vehicle inspection procedures. These findings align with the ISO 9241-11 principles on system effectiveness and reliability, as well as studies on human-machine interaction highlighting the value of responsive feedback systems in safety-critical applications. Overall, the results demonstrate that the device is dependable and suitable for practical implementation as a routine vehicle inspection system.

4. Conclusion & Recommendations

The Drive Safe: A Device for Routinary Vehicle Check-Ups (BLOWBAGETS) was successfully designed, developed, and evaluated as a tool for promoting routine vehicle inspections before engine ignition. The device effectively integrates visual indicators and control functions that encourage drivers to perform essential pre-driving safety checks. It demonstrated satisfactory technical performance and received a Highly Acceptable rating in terms of design (3.91), usability (3.97), and workability (4.00), indicating that it is functional, reliable, user-friendly, and suitable for practical application in routine vehicle safety inspections.

The study recommends conducting further in-vehicle testing using different types of four-wheeled vehicles to validate the device's performance under various operating conditions. It also recommends expanding its application to additional vehicle categories, continuously improving the device's design, strengthening its real-world implementation, maintaining its technical performance, enhancing user safety, promoting user familiarization, and encouraging further research and innovation to improve the Drive Safe device.

The study was limited to the design, development, fabrication, and evaluation of the Drive Safe: A Device for Routinary Vehicle Check-Ups (BLOWBAGETS) using 100 respondents from Kidapawan City, North Cotabato, consisting of professional drivers, auto mechanics, and technicians with prior knowledge of vehicle inspection. The evaluation focused on the device's technical performance and its acceptability in terms of design, usability, and workability, and the testing was confined to the conditions and respondents included in the study.

Compliance with ethical standards

The authors declare no conflict of interest. This study received no external funding and was conducted with the participation of professional drivers, auto mechanics, and technicians from Kidapawan City who voluntarily participated after being informed of the purpose of the study and providing their consent. Data were collected using a non-invasive survey questionnaire, and all responses were treated with strict confidentiality by ensuring that no identifying personal information was disclosed.

REFERENCES

- A P., et al. (2025). *Interactive augmented reality system for real-time pre-inspection and maintenance assistance*. In *Proceedings of the 2025 3rd International Conference on Advancements in Electrical, Electronics, Communication, Computing and Automation (ICAECA)*.
- All Around Auto Repair. (2024). *The hidden costs of ignoring routine car maintenance*. (Retrieved September 13, 2025; modified November 11, 2025).
- American Automobile Association. (2015). *Roadside breakdowns preventable with proper maintenance*. AAA Newsroom.
- Atombo, C., Akple, M. S., Dumenya, A., & Adzimahe, P. (2025). Comprehensibility and impact of vehicle dashboard indicator light symbols on drivers' preventive maintenance compliance. *PLOS ONE*, 20(5), e0323386. <https://doi.org/10.1371/journal.pone.0323386>
- Babich, N. (2023). *User-centered design: Principles and practices in modern product development*. UX Planet.
- Birolini, A. (2017). *Reliability engineering: Theory and practice* (8th ed.). Springer.
- Boyd Motor Werks. (2024). *Effects of skipping out on regular auto maintenance*. <https://www.boydmotorwerks.com/blog/skipping-auto-maintenance-effects/> (Retrieved November 10, 2025; modified November 12, 2025)
- Brown, L. (2021). *Ergonomic design and human factors in automotive maintenance equipment*. CRC Press.
- Brown, T., Harris, M., & Lopez, J. (2021). User-centered design in embedded safety systems: Principles and applications. *Journal of Systems Engineering and Technology*, 15(2), 88–102. <https://doi.org/10.1000/jset.2021.0152>
- Chaudhary, H., Kumar, S., & Gupta, R. (2024). *IoT vehicle safety system ensuring helmet and seat belt usage for ignition*. ResearchGate.
- Cooper, A., Reimann, R., & Cronin, D. (2007). *About face 3: The essentials of interaction design*. Wiley.

- Crownautoworks. (2024). *The importance of not skipping scheduled vehicle maintenance*.
- Dix, A., Finlay, J., Abowd, G. D., & Beale, R. (2004). *Human-computer interaction* (3rd ed.). Pearson.
- Don Norman, D. A. (2013). *The design of everyday things* (Revised and expanded ed.). Basic Books.
- European Transport Safety Council. (2024). *European road safety report: Vehicle safety systems and driver behavior compliance*. <https://etsc.eu/publications>
- Federal Motor Carrier Safety Administration. (2022). *The impact of vehicle maintenance on safety*. U.S. Department of Transportation.
- Good Works Auto Repair. (2024). *How preventative maintenance can increase your car's resale value*.
- Interaction Design Foundation. (2020). *The role of haptics (touch) in user experience design*. <https://www.interaction-design.org>
- Interaction Design Foundation. (2024). *Principles of visual and user interface design*.
- International Organization for Standardization. (2018). *ISO 9241-11:2018 ergonomics of human-system interaction—Part 11: Usability: Definitions and concepts*. ISO. <https://www.iso.org/standard/63500.html>
- International Organization for Standardization. (2019). *ISO 9241-210: Ergonomics of human-system interaction—Human-centred design for interactive systems*. ISO.
- International Organization for Standardization. (2020). *ISO 9241-110:2020 ergonomics of human-system interaction—Dialogue principles*. ISO. <https://www.iso.org/standard/75258.html>
- International Organization for Standardization. (2021). *ISO 9241-11:2018 ergonomics of human-system interaction—Part 11: Usability: Definitions and concepts*. ISO. <https://www.iso.org/standard/63500.html>
- International Organization for Standardization. (2023). *ISO 9241-125:2023 ergonomics of human-system interaction—Guidance on visual presentation of information*. ISO. <https://www.iso.org/standard/77689.html>
- Johnson, R. P., Kim, S. H., & Alvarez, D. (2022). Visual feedback and user comprehension in digital monitoring systems. *International Journal of Human-Computer Interaction*, 38(7), 615–628. <https://doi.org/10.1080/10447318.2022.2031157>
- Jupiter Chevrolet. (2025). *The importance of regular maintenance for extending vehicle lifespan*.
- Leveson, N. (2011). *Engineering a safer world: Systems thinking applied to safety*. MIT Press.
- Leveson, N. (2011). *Engineering a safer world: Systems thinking applied to safety*. MIT Press.
- Montgomery, D. C. (2019). *Introduction to statistical quality control* (8th ed.). Wiley.
- Moreano, E., Espinoza, A., & Aguayo, F. (2022). *Identification of the mechanical failure factors with potential influencing road accidents in Ecuador*. ResearchGate.
- Motor. (2023). *Sixty-four percent of drivers are putting off necessary car maintenance*.
- Moubray, J. (1997). *Reliability-centered maintenance*. Industrial Press.
- National Highway Traffic Safety Administration. (2013). *Visual-manual NHTSA driver distraction guidelines for in-vehicle electronic devices*. U.S. Department of Transportation.
- National Highway Traffic Safety Administration. (2020). *Vehicle maintenance and road safety*. U.S. Department of Transportation.
- National Highway Traffic Safety Administration. (2023). *Alcohol ignition interlock devices*. U.S. Department of Transportation.
- Nielsen, J. (1994). *Usability engineering*. Morgan Kaufmann.
- Nielsen, J. (2012). *Usability 101: Introduction to usability*. Nielsen Norman Group.
- Nielsen, J. (2020). *10 usability heuristics for user interface design*. Nielsen Norman Group. <https://www.nngroup.com/articles/ten-usability-heuristics/>
- Nielsen Norman Group. (2021). *10 usability heuristics for user interface design*.
- Nielsen Norman Group. (2023). *User interface design principles for system control and feedback*. <https://www.nngroup.com/articles/ui-design-principles/>
- Norman, D. A. (2013). *The design of everyday things* (Revised ed.). Basic Books.
- Pohlman's Auto & Tire Center. (2025). *The impact of preventative maintenance on a vehicle*.
- Ramona Tire. (2025). *Skipping oil changes: The consequences and long-term effects*. <https://www.ramonatire.com/skipping-oil-changes-consequences-long-term/> (Modified November 11, 2025)
- RTA Fleet. (2018). *5 scary consequences of skipping preventative maintenance*.
- S. C. Wee. (2021). *Can “nudging” play a role to promote pro-environmental/pro-safety behaviors?* ScienceDirect.
- Shneiderman, B., et al. (2020). *Designing the user interface* (6th ed.). Pearson.
- Shneiderman, B., Plaisant, C., Cohen, M., Jacobs, S., Elmqvist, N., & Diakopoulos, N. (2016). *Designing the user interface: Strategies for effective human-computer interaction* (6th ed.). Pearson.
- Smith, A., & Lee, K. (2023). System integration reliability in microcontroller-based safety devices. *Journal of Embedded Systems Research*, 11(1), 45–59. <https://doi.org/10.1000/jesr.2023.1101>
- Smith, J. (2022). *Vehicle diagnostic systems and maintenance technologies*. Springer Publishing.
- Southeast Fleet Services. (2025). *Why skipping preventive maintenance can lead to costly repairs*.
- T. L. Tzou, et al. (2024). *The influence of nudges on workers' safety behavior in industry*.
- Tapak, P., et al. (2023). *Periodical vehicle inspections with smart technology*. Applied Sciences.

- Trimble Transportation. (2023). *What is preventive maintenance: Importance & challenges*.
- TrueCar. (2024). *Here's what could happen if you skip regular car maintenance*.
- Ulrich, K. T., & Eppinger, S. D. (2020). *Product design and development* (7th ed.). McGraw-Hill.
- Whiparound. (2018). *The ugly truth about pre-trip fleet vehicle inspection*.
- William, et al. (2019). *Designing in-vehicle sign for connected vehicle features*.
<https://doi.org/10.1016/j.apergo.2019.05.006>
- Woods, D. D., & Hollnagel, E. (1994). *Joint cognitive systems: Patterns of cognitive systems engineering*. CRC Press.
- World Health Organization. (2018). *Global status report on road safety 2018*. Author.
- Zhang, Y., & Patel, R. (2024). Human factors engineering in modern automotive safety systems. *Safety Science Review*, 18(1), 33–50. <https://doi.org/10.1000/ssr.2024.1801>
- 5K Car Care. (2025). *The true cost of skipping regular car maintenance: A 5K Car Care analysis*.