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Adoption of Agile Approach in Developing Fleet Management System for Cargo Companies

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ABSTRACT
This research investigates adopting Agile methodology in developing fleet management systems for cargo companies. The problem investigated is how using Agile methodology can improve the efficiency and effectiveness of Fleet Management System development and response to changes in the dynamic cargo industry. The research method involved a comprehensive literature review, interviews with cargo industry experts and Agile experts, a survey of potential users of the Fleet Management System, and functional testing and User Acceptance Test (UAT) of the developed system. The results showed that adopting the Agile methodology successfully resulted in a responsive and adaptive Fleet Management System with an intuitive user interface, good vehicle management functionality, accurate shipment tracking, and optimized system performance. This research contributes to providing a more in-depth view of the benefits and implications of using Agile methodology in Fleet Management System development for the cargo industry, as well as providing solutions that can improve operational efficiency and services for cargo companies and end users.

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INTRODUCTION

The cargo industry is essential in the global economy by connecting manufacturers, distributors, and consumers worldwide. The industry is responsible for delivering goods from one location to another, whether locally, nationally, or internationally. The development trend of the cargo industry shows a signific(Camacho-Muñoz et al., 2023; Gonzalez-Calderon et al., 2022; Jörgensen et al., 2023; Longo et al., 2022; Malik et al., 2023)ant increase along with the globalization of trade and e-commerce. Many cargo companies, such as cargo airlines, ground shipping companies, and ocean shipping companies, offer diverse delivery services, including express delivery, bulk cargo delivery, and special cargo delivery. However, the cargo industry faces challenges such as fluctuating fuel costs, security, regulations, and increasing customer demands.

A Fleet Management System is an essential information technology infrastructure for cargo companies to manage vehicle fleets and logistics operations efficiently. The system helps in fleet position tracking, vehicle performance monitoring, driver management, route management, and vehicle maintenance scheduling. Key features commonly found in Fleet

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Management Systems include real-time GPS tracking systems, fleet performance data analysis, integration with order management systems, and periodic maintenance notifications. Using a Fleet Management System, cargo companies can improve operational efficiency, reduce operational costs, improve safety, and increase customer satisfaction through timely and accurate deliveries(du Plessis et al., 2024; Hunt et al., 2023; Kim et al., 2021; Njoya et al., 2023; Polkinghorne et al., 2024; Tseremoglou et al., 2022).

Traditional approaches such as waterfall are often used in Fleet Management System development, where development is done linearly with structured phases such as analysis, design, implementation, testing, and maintenance. However, this approach has the disadvantage of needing more flexibility in responding to changing customer and market requirements. In addition, this approach takes a long time to complete projects and often results in products that must meet user expectations. In the dynamic and fast-changing cargo industry, the traditional approach may not be suitable as it cannot accommodate the rapidly occurring changes, thus prompting the need to adopt a more adaptive and collaborative approach, such as the Agile approach, in developing the Fleet Management System.

The Agile Fleet Management System development approach offers a more adaptive and responsive approach to change than traditional approaches. The fundamental principles of Agile methodology, such as collaboration between teams, prioritization of the delivery of working software, and the ability to respond quickly to changing user needs, distinguish it from waterfall approaches(Al-Saqqa et al., 2020; Bomström et al., 2023; Dingsoeyr et al., 2019; Dingsøyr et al., 2012; Estrada-Esponda et al., 2024; Najihi et al., 2022; Santos et al., n.d.; Shrivastava & Rathod, 2014). Some advantages of using Agile in fleet management system development include increased transparency, flexibility in responding to changes, and reduced project risk. By implementing Agile, cargo companies can develop fleet management systems that are more adaptive and responsive to changes in business and technology needs, allowing them to remain competitive in a fast-changing market.

Although the application of Agile methodology has become common in software development, there is a significant research gap in the literature related to the application of Agile in the development of Fleet Management Systems in cargo companies. This research aims to fill that gap by investigating how the application of Agile can benefit cargo companies in developing a more adaptive and responsive fleet management system. Through this research, it is expected to find practical guidance and insights that can help cargo companies effectively apply Agile approaches in developing their fleet management systems. The potential benefits of this research will not only be felt by the cargo industry. However, they will also contribute to our understanding of the application of Agile in an industrial context and provide insights for the academic community on the importance of adaptation of software development methodologies that suit the specific characteristics of various industries.

METHODS

The research started with a requirements definition phase, which involved a thorough literature review on the cargo industry, Fleet Management System, and Agile methodology, as well as interviews with experts and a survey of potential users of the fleet management

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system in cargo companies. This step aims to identify the primary needs and requirements in developing a fleet management system. The next stage is planning, where a suitable Agile methodology is selected, a sprint backlog is created, and a project plan is drawn up that includes an estimate of the time and resources required. Then, the research proceeded to the development stage, where the fleet management system was developed through a series of sprints based on the established sprint backlog, focusing on developing features and functionality of value to users. Finally, the research reached the testing stage, where the developed system was thoroughly tested through user acceptance testing to obtain feedback, improvements, and system enhancements before documentation and deployment to the production environment at the cargo company.

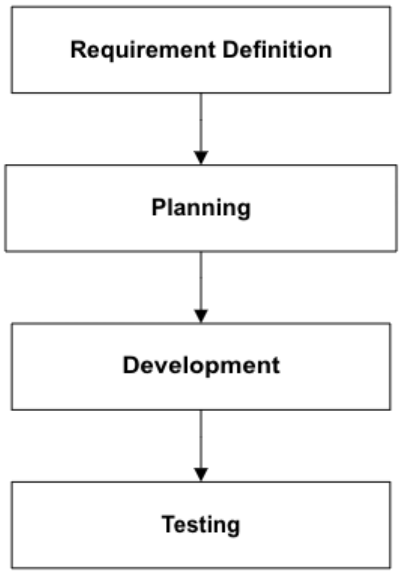

Figure 1. Research Stages

Definition of Need

The initial stage of this research began by conducting a comprehensive literature review related to the cargo industry, Fleet Management Systems, and Agile methodology. This literature review aims to gather relevant and in-depth information to understand the context and specific needs in developing a Fleet Management System for cargo companies. Furthermore, interviews were conducted with experts with extensive experience and knowledge in the cargo industry and software development practices using the Agile approach. These interviews were conducted to obtain diverse and in-depth perspectives on the needs and challenges of developing the Fleet Management System. In addition, a survey of potential users of the Fleet Management System in cargo companies was conducted to identify their needs, preferences, and expectations of the system to be developed. The data collected was then thoroughly analyzed to identify the primary needs and requirements for developing the Fleet Management System. The results of the analysis became the basis for defining the project's scope, which included the limitations and objectives to be achieved in this study.

Planning

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After defining the needs and scope of the project, the next stage is planning. At this stage, the Agile methodology considered most suitable for the characteristics and needs of the Fleet Management System development project for cargo companies is selected. The selection was based on an in-depth evaluation of the various Agile methodologies available as well as consideration of the culture and organizational environment of the cargo company. Next, a sprint backlog was created containing a list of features and functionality to be developed in each development iteration (sprint). This process involved prioritizing various features and functionalities based on business value and user needs, thus ensuring that each sprint produced valuable results. In addition, an estimate is made of the time and resources required to complete the project. These estimates form the basis for developing a project plan that includes details about the methodology, the sprint backlog, the development timeline, and the budget required for the project.

Development

After the planning is complete, proceed with the development stage. At this stage, the development of the Fleet Management System is based on the Agile methodology. The development process is carried out in a series of short, iterative sprints, where each sprint results in increased usable functionality. The team collaborates to develop features and functionality in the sprint backlog. Each code developed is then thoroughly tested through unit testing to ensure quality. Next, all the developed code sections are integrated to build a complete Fleet Management System system. System testing is carried out to ensure that the system as a whole functions correctly and meets the user needs that have been set beforehand.

Testing

At this stage, the developed Fleet Management System is tested. Testing is carried out in several stages, from user acceptance testing, which aims to obtain feedback from end users about the system's performance and functionality. The feedback is then used to make improvements and enhancements to the system, including fixing bugs and problems found during testing. In addition, documentation of the Fleet Management System was also carried out, which included writing user manuals and technical guides to facilitate the end users and the development team's use and maintenance of the system.

RESULTS AND DISCUSSION

Definition of Need

The outcome of the Requirements Definition, as shown in Table 1, shows a series of steps taken to understand the needs and critical requirements in the development of a Fleet Management System for a cargo company. A comprehensive literature review provided a deep understanding of the cargo industry context, the Fleet Management System concept, and relevant Agile methodologies. Interviews with experts and practitioners of the cargo industry and software development enriched the insights by providing first-hand perspectives from those experienced in the field. A survey of potential users of the Fleet Management System provided an overview of user preferences, expectations, and needs that

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would guide the development of the system. Careful analysis of data from all these sources of information forms the basis for defining the project's scope by setting clear boundaries and objectives. Thus, the Requirements Definition stage helps ensure that the Fleet Management System development project will be focused on meeting user needs and defined business objectives and reducing the risk of errors or non-conformance with existing expectations.

Table 1. Results of Needs Definition

Activities	Description
Literature Review	A comprehensive literature review of the cargo industry, Fleet Management System, and Agile methodology to understand the relevant context and trends.
Interview with Experts	Interviews with cargo industry experts and practitioners of software development with an Agile approach to gain in-depth insights into the needs and challenges in the development of a Fleet Management System.
User Survey	A survey of potential users of the Armada Management System in cargo companies to identify their preferences, expectations, and needs for the system to be developed.
Data Analysis	Thoroughly analyze the data from the literature review, interviews, and surveys to identify the essential needs and requirements in developing the Fleet Management System.
Definition of Project Scope	Define the project's scope by setting the boundaries and objectives to be achieved in developing a Fleet Management System for cargo companies.

Planning

The project planning for developing a Fleet Management System for a cargo company shows some of the critical steps taken in the planning process, as shown in Table 2. Selecting an Agile Methodology is a crucial first step because it determines the development approach used during the project. By conducting an in-depth evaluation of the various methodologies available, the project team can choose the approach that best suits the characteristics and needs of the project. Sprint backlog creation is the next focus in the planning stage. By creating a sprint backlog, the project team can identify and prioritize the features and functionality to develop each development iteration (sprint) based on business value and user needs. Time and Resource Estimation is also an essential step in the planning stage, as it helps the project team to make a realistic estimate of the duration and resources required to complete the project. In addition, the Project Plan is the last stage that integrates all the previous information. The project plan includes details about the development methodology to be used, the sprint backlog, the development timeline, and the budget required for the project. Thus, the Planning stage ensures that the Fleet Management System development project runs efficiently and effectively, considering all aspects required for successful software development.

Table 2. Planning

Activities	Description

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Agile Methodology Selection	Conducted an in-depth evaluation of the various Agile methodologies available to select the most suitable one according to the characteristics and needs of the Fleet Management System development project for cargo companies, taking into account the company's organizational culture and environment.
Sprint Backlog Creation	Develop a list of features and functionality to be developed in each development iteration (sprint), prioritizing based on business value and user needs. This ensures that each sprint produces valuable results that meet user needs.
Time and Resource Estimation	Estimate the time and resources required to complete the overall project, including the time required for each development sprint and the appropriate allocation of resources.
Project Plan Preparation	Develop a project plan that includes details about the methodology to be used, the sprint backlog, the development timeline, and the budget required for the project. This plan guides the development team in executing the project efficiently and by the set targets.
Prioritization and Budget Setting	Set priorities for each feature and functionality in the sprint backlog based on the needs and budget availability. By setting priorities carefully, the development team can focus on developing the most important and valuable features within the available budget.

Planning

After the planning phase was completed, the project team proceeded to the development phase, which is the phase where the Fleet Management System was developed based on the pre-selected Agile methodology. The development process is carried out in a series of short, iterative sprints, where each sprint results in increased functionality that users can use directly. The development team works co-laboratively to develop the features and functionality in the sprint backlog, prioritizing the work based on pre-established needs and priorities. Next, each piece of code developed is thoroughly tested through unit testing to ensure its quality and minimize the possibility of bugs or errors. The integration stage is done to combine all the code sections that have been developed into a complete Fleet Management System system. Thorough system testing is carried out to ensure that the system functions properly and meets the user needs set before. Thus, the development phase is critical in software development and enables developers to produce quality products that meet user expectations.

Table 3. Sprint

Sprint	Sprint Description	Fitur dan Fungsionalitas yang Dikembangkan
1	User Interface Development	- Main user interface design

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		- Main page creation - Integration of interface navigation
2	Vehicle Management Feature Development	Addition of features to view vehicle information - Development of functions to manage vehicle status - Integration of vehicle data with the system
3	Delivery Tracking Feature Implementation	- Creation of a feature to track item shipments - Enhanced tracking feature with GPS integration - Development of delivery notification function
4	System Performance Improvement User Interface Development	- Database performance optimization - Improved system security - Authentication process enhancements

The development of the Fleet Management System illustrates the iterative process followed in software development, as shown in Table 3. The first sprint focused on developing the primary user interface, indicating an initial emphasis on an optimal user experience. The next sprint led to adding vehicle management-related features, highlighting efforts to extend the system's core functionality. The third sprint emphasized implementing delivery tracking features with GPS integration and delivery notifications, enriching the system with more advanced delivery monitoring capabilities. The final sprint prioritized improving overall system performance, affirming the commitment to ensuring system reliability and security in the long term. From this analysis, the development of the Fleet Management System was done in stages with a focus on improving the system's functionality, user experience, and performance. Each sprint significantly improved the system's capabilities, reflecting the iterative approach essential in successful software development.

Testing

Table 5 presents functional testing and User Acceptance Test (UAT), showing that the Fleet Management System has undergone comprehensive and successful tests. In the functional testing, all features and functionalities of the system have been successfully tested and declared to function correctly. This indicates that the system's development has considered all the specifications and functional requirements that have been set beforehand. In addition, the UAT results show that the end users have accepted the system well and without significant problems. Positive feedback from end users, such as user satisfaction and the absence of problems found, confirmed that the system met their expectations and fulfilled their needs well. Thus, the test results show that the Fleet Management System is ready to be widely implemented and adopted by end users with confidence in its quality and performance.

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Table 5. Functionality Testing Results

Features or Functionality Tested	Functional Testing Results	Note
User Interface	Successful	Responsive and easy-to-use interface
Vehicle Management	Success	Good vehicle management functionality
Shipment Tracking	Success	Accurate and reliable shipment tracking
System Performance	Success	Optimal system performance under load

Table 6. UAT Testing Results

Test Description	Hasil UAT	Catatan
User interface testing	Accepted	User-favorable interface and easy to use
Vehicle management testing	Accepted	No issues found during testing
Delivery tracking testing	Accepted	Shipment tracking is smooth and accurate
System performance testing	Accepted	System performance is stable and responsive

CONCLUSION

Adopting Agile methodology in developing a Fleet Management System for the cargo industry is an important and successful step. The functional testing results and the User Acceptance Test show the system's success meeting end users' needs and expectations. The critical factors verified through a series of tests are the intuitive user interface, good vehicle management functionality, accurate shipment tracking, and optimized system performance. Thus, this research makes an essential contribution to the cargo industry by providing a solution that is adaptive and responsive to diverse needs in a complex operational environment.

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