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Digitalized Ship Maintenance Management System Website Application Innovation Strategy Using Design Thinking Method

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ABSTRACT

Purpose: The purpose of the study is to explore the benefits of digitalization, specifically in the context of PT Biro Klasifikasi Indonesia's (PT. BKI) digital transformation efforts. The focus is on how digitalization can enhance operational efficiency, productivity, customer service, and global competitiveness in the maritime industry.

Method: The research employs the Design Thinking method to identify and address customer needs and challenges. It highlights the development of the "Digitalized Ship Management Maintenance System" application, showcasing its role in simplifying ship maintenance processes. The study uses a customer-centric approach to determine modules that provide effective solutions to identified issues.

Result: The Digitalized Ship Management Maintenance System application is designed to streamline ship maintenance for customers. Utilizing Design Thinking, the study identifies customer problems and develops modules to address them. The application offers direct integration with PT. BKI's survey status, strengthening its international classification standing. Additionally, it supports government data integration, ensuring safety and environmental protection in Indonesia's maritime areas.

Implication: The implications of the study underscore the significance of digital transformation for companies in the maritime sector, particularly for PT. BKI. The "Go Global" and "Big Top 5 Asia" targets align with the broader benefits of digitalization, including enhanced operational efficiency, global market access, and improved customer service. The developed application serves as a tangible outcome of the digitalization process, contributing to PT. BKI's competitiveness and its role as a trusted classification body.

Paper type: Research paper

Keyword: *Digital Transformation, Planned Maintenance System, Design Thinking*
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I. INTRODUCTION

In the era of Industry 4.0, the digitalization of processes has emerged as a transformative force, offering multifaceted advantages to companies. This paradigm shift facilitates operational efficiency, productivity enhancement, improved customer service, and enhanced data analytics. Through the adoption of digital technologies, businesses can streamline operations by automating processes and integrating diverse systems, leading to time, labour, and resource savings. Digitalization also empowers companies to elevate customer service, market a variety of services and products across different platforms, and optimize real-time production systems.

For state-owned enterprise PT. Biro Klasifikasi Indonesia (Persero), subsequently referred to as "PT. BKI," the significance of digital transformation is pivotal. Originally established in 1964 and later rebranded as Holding ID Jasa Survey in December 2022, PT. BKI aspires to achieve World Class Company status and secure a position among the Big Top 5 in Asia, providing Testing, Inspection, and Certification (TIC) services. The company recognizes the imperative of digital evolution to stay competitive in a global landscape.

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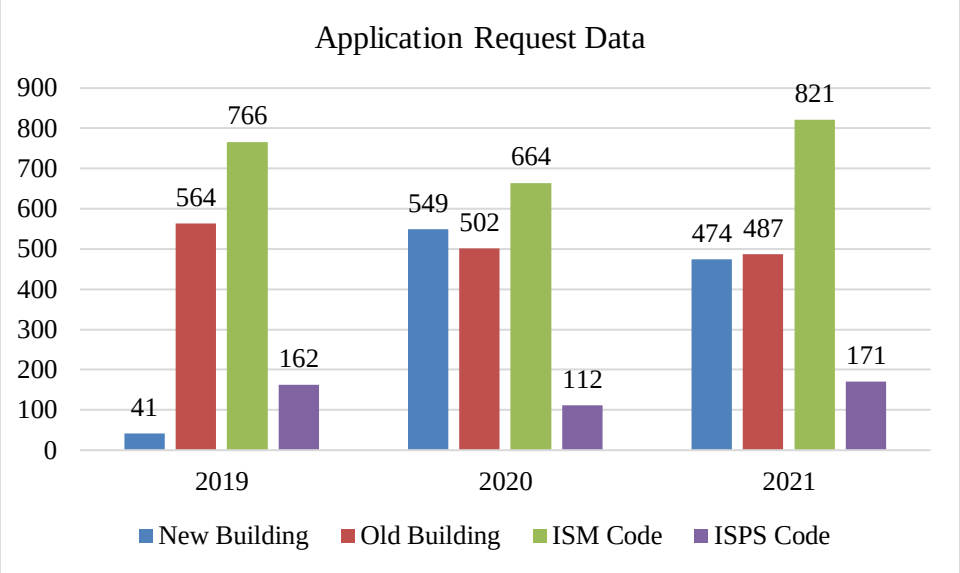

Figure 1 Application request Data to PT. BKI

Source: Annual Report PT. BKI, 2019 2020 2021(Indonesia, 2019, 2020, 2021)

The provided data outlines the annual application requests submitted to PT. BKI for the years 2019, 2020, and 2021. The requests are categorized into four types: New Buildings, Existing Buildings, ISM Code, and ISPS Code. In the New Buildings category, there was a notable surge from 41 applications in 2019 to 549 in 2020, followed by a decrease to 474 in 2021. Conversely, the number of requests for Existing Buildings witnessed a gradual decline from 564 in 2019 to 502 in 2020 and further to 487 in 2021. The data also reveals fluctuations in applications related to safety management, with ISM Code requests decreasing from 766 in 2019 to 664 in 2020 and then increasing to 821 in 2021. Similarly, ISPS Code applications fluctuated, starting at 162 in 2019, decreasing to 112 in 2020, and rebounding to 171 in 2021. This data provides valuable insights into the shifting demand for various services provided by PT. BKI over the three-year period.

The pressure for digital transformation arises from both internal and external factors, urging stakeholders to embrace digitalization as a fundamental solution. In a landscape where businesses, be they state-owned, private, or startups, vie to offer optimal solutions, technology becomes indispensable. The presence of diverse technologies across society, especially during the COVID-19 pandemic, has underscored the importance of digital innovation. Transforming into a digital-centric entity is no longer a supplementary system but a core business strategy.

The relentless pursuit of digital transformation by PT. BKI is fueled by the escalating competition, particularly from foreign classification bodies operating in Indonesia. Changes in regulations, such as KM No. 20 Tahun 2006, PM No. 7 Tahun 2013, and PM No. 61 Tahun 2014, have paved the way for foreign classification bodies to compete directly with PT. BKI. This intensifying competition, coupled with the increasing influence of International Association of Classification Society (IACS) members, poses challenges to PT. BKI's market share and revenue (Peraturan Menteri Perhubungan PM 61 Tahun 2014, 2014).

In response to the evolving landscape, PT. BKI initiated internal system developments, notably focusing on easing customer submission processes for Ship Design Approval and Construction Document Approval. This research seeks to advance these efforts by facilitating swift and efficient approval processes, providing document tracking information, and enhancing approval and structural verification within PT. BKI. The successful establishment of this ecosystem has garnered significant appreciation internally and from customers, introducing a novel approach to document approval within PT. BKI.

As PT. BKI navigates the dynamics of the post-COVID new normal in 2022, the focus extends to the development of a Maintenance System, an aspect not yet fully realized by PT. BKI but present in foreign classification bodies. Currently limited to Continuous Machinery Survey (CMS), PT. BKI aims to expand its capabilities to include Planned Maintenance System (PMS). This development aligns with Rules of Classification and Survey Section 3 no. 1.3.4 Part A, highlighting the absence of a Planned Maintenance System application.

The research scope narrows down the development of an online-based Planned Maintenance System application with a maximum of four main modules. These modules include Ship Engine Maintenance, Spare Part Request, Human Resource Management (Ship Crew), and Document Management (Classification and Statutory

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Documents). The integration of data with PT. BKI's internal systems encompasses General Ship Data, Documents, and Survey Status.

Building upon the background analysis, the problem formulation addresses key questions:

1) How to design the Planned Maintenance System application using the Design Thinking method?
2) What additional features in the Planned Maintenance System application can serve as value additions for PT. BKI?
3) How to develop the Planned Maintenance System application for customers and integrate it with PT. BKI's internal systems?

The primary objective is the full-fledged support of PT. BKI in the development of the Digitalized Ship Maintenance Management System. The development involves creating a responsive website, utilizing Design Thinking methods (Council, 2007) (Lataifeh, 2018), and incorporating features such as Crew Management, Document Integration, and Survey Alignment within the Planned Maintenance System. The application aims to be a strategic innovation supporting PT. BKI's core business.

II. METHODS

A. Flowchart Methodology

The research methodology for developing the Digitalized Ship Maintenance Management System involves a structured flowchart representing the development process of the application. The flowchart encompasses various stages, emphasizing user empathy, problem analysis, application development, and observation.

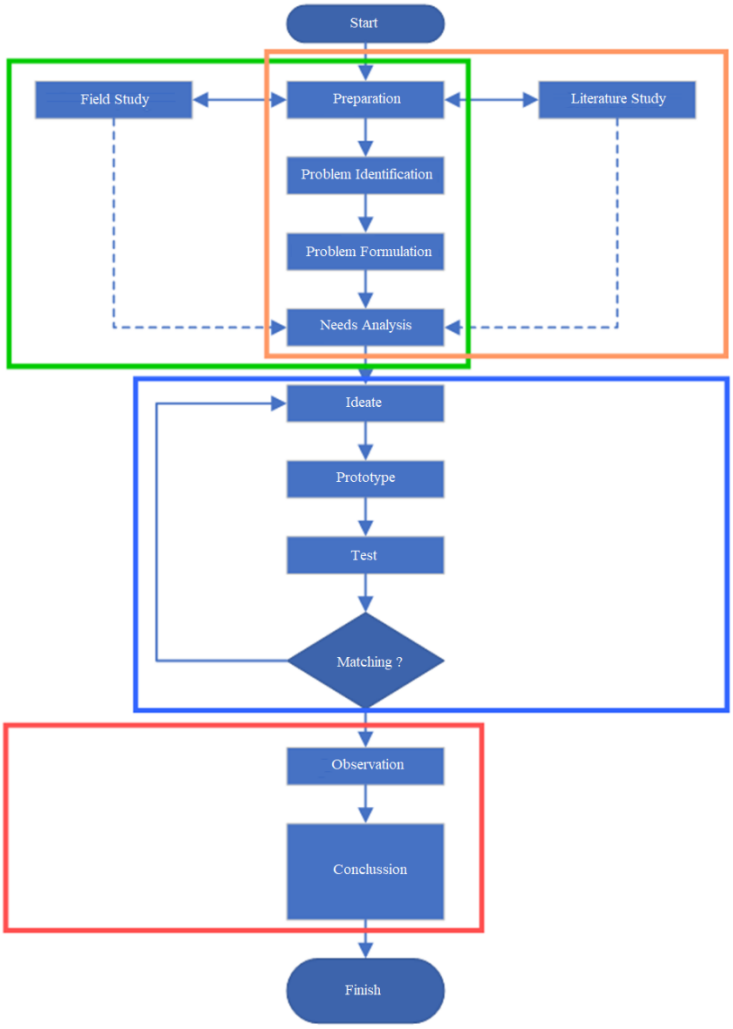

Figure 1 Flowchart Methodology

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The research stages carried out were:

1) Process Model Stage (Green)
   Utilizes Divergence and Convergence in the Empathy phase to understand user needs, involving both company and operator perspectives.
2) Problem Identification Stage (Orange)
   Addresses 'Why, What, and How' aspects of problems, considering field issues and regulatory compliance (ISM Code, Classification Body Rules, Ministry of Transportation regulations).
3) Application Development Stage (Blue)
   Implements Divergence and Convergence in the Ideation, Prototyping, and Testing phases to develop an online-based application using Design Thinking.
4) Observation and Conclusion Stage (Red)
   Involves observation and drawing conclusions using the Design Thinking method.

B. Detail Concept of Planned Maintenance System Development

The Digitalized Ship Maintenance Management System includes detailed modules (Lloyd et al., 2001) (Stazić et al., 2017) (Sampson et al., 2018):

1) Ship Data Module:
   a. General ship data (type, dimensions, registration).
   b. Component data, including maintenance scheduling, plans, and reports.
   c. Crew Management Module:
   d. Monitors ship crew across different roles.
2) Ship Documents Module:
   a. Certificate documents (hull, engine, load line).
   b. Statutory documents (safety radio, IOPP, ILLC).
   c. Seafarer documents (COC, BST).
3) Order Part Data Module:
   a. Integrates stock needs for ship spare parts with the central office.

C. Detail Concept of Design Thinking Method

In the detailed concept of the Design Thinking Method, several key components play crucial roles in guiding the development process (Vianna et al., 2012) (You, 2022) (Pereira & Russo, 2018).

Firstly, Empathy Mapping focuses on the target users, specifically Ship Owners and Operators, by creating a comprehensive map that outlines their needs and experiences. This method helps in gaining a deeper understanding of user perspectives and requirements.

Next, the User Persona aspect involves diverging and converging in both problem and solution spaces. This aids in comprehending and addressing various perspectives related to the challenges at hand.

The Micro & Macro Cycle is an integral part of the process, involving stages such as understanding, observation, definition of points of view, ideation, prototyping, and testing solutions. This cyclic approach ensures a thorough exploration and refinement of potential solutions.

The adoption of the Scrum Process is emphasized, following ISO standards such as ISO 13407 and ISO 9241-210:2019. This adherence ensures a structured and standardized approach to the design thinking methodology.

The Golden Circle concept is applied to define the 'Why', 'How', and 'What' aspects of the application's development. This helps in aligning the development goals with a clear understanding of the purpose, process, and outcomes.

Lastly, User Journey Maps are developed for different actors, including Manager Ownership, User Ownership, Manager Operator, and User Operator. These maps depict scenarios, expectations, phases, actions, mindsets, emotions, and opportunities throughout the user's interaction with the application, providing a holistic view of the user experience.

D. Development of Digitalized Ship Maintenance Management System

In the realm of website applications within the context of the company's operations, three distinct categories serve specific functions (Lewrick et al., 2018) (Zulkarnain & Malang, 2019):

In the Company-Side Website Application dedicated to Ownership, a comprehensive dashboard prototype is designed. This dashboard offers an overview of the entire fleet, including details about each ship, crew specifics, and integrated ship documents. It efficiently lists all owned ships, providing information such as maintenance plans, crew salaries, and relevant ship documents. Additionally, the application displays a crew list with placement details, alerts for expiring ship documents, and an inventory of spare parts for each ship.

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The Ship Operator Website Application, designated for operational purposes, features a specialized dashboard prototype. This platform enables ship operators to input daily monitoring data seamlessly. It also presents detailed information about each ship, including crew details, ship documents, and the current stock of spare parts.

For the Classification Body Internal Website Application, an internal login is established exclusively for PT. BKI activities. This application streamlines the display of order tracking, tracking the progression from customer request to certificate issuance. Moreover, it integrates seamlessly with PT. BKI's internal system, incorporating data from the Digitalized Ship Maintenance Management System to enhance the efficiency and accuracy of the overall process.

E. Questions Regarding Issues and Solution Creation

Utilizing the Empathy Maps Canvas as a guide, the researcher has formulated a set of interview questions aimed at gaining a comprehensive understanding of user perspectives, challenges, and expectations within the context of ship maintenance.

The offline interview questions have been carefully crafted to delve into various aspects:

1) Years of experience in ship maintenance - to gauge the participant's level of expertise and familiarity with the field.
2) Current position and years in the role - to understand the participant's current professional standing and tenure in their role.
3) Challenges faced in ship maintenance - to identify and comprehend the specific difficulties encountered in the daily responsibilities of the participants.
4) Current use of digital or manual systems - to assess the technology adoption within the domain of ship maintenance.
5) Experience with Planned Maintenance System - to gauge the participant's familiarity and experience with existing maintenance systems.
6) Interest in additional features such as Integrated Document Management, Human Resource Management, Data Warehouse Part - to explore potential enhancements to the current system.
7) Depth of interest in DMMS application features - to understand the level of enthusiasm or curiosity regarding specific features of the Digitalized Ship Maintenance Management System.
8) Evaluation of the application's functionality and appearance - to gather feedback on both the usability and visual aspects of the application.
9) Recommendations after using the application - to solicit constructive suggestions for improvements or additions to enhance user experience.
10) Willingness to participate further in DMMS development research - to ascertain the participant's interest in contributing to ongoing research and development efforts related to the Digitalized Ship Maintenance Management System.

F. Defining Problems and Agreed-upon Solutions

The process of defining and interpreting presented problems involves a comprehensive examination aimed at gaining a clear understanding of the issues at hand. In this context, the goal is to establish a shared understanding and consensus on key challenges, thereby paving the way for the creation of user-centric solutions. This entails dissecting the problems presented, breaking them down into their fundamental components, and interpreting their implications. The collaborative effort seeks to align perspectives, acknowledging the significance of each issue and identifying common ground among stakeholders. By fostering consensus on vital issues, the groundwork is laid for the development of solutions that prioritize the needs and preferences of the end-users. This iterative and inclusive approach ensures that the solutions generated are not only effective but also resonate with the diverse perspectives and requirements of the user base.

G. User Journey Maps

Develops user journey maps for different user levels, ensuring differentiation in access based on user needs and responsibilities (Bradley et al., 2021). The development of user journey maps involves the creation of visual representations that outline the experiences of users as they interact with a system or product. In this context, the focus is on crafting distinct user journey maps tailored to different user levels, thereby ensuring a customized approach based on individual needs and responsibilities.

By delineating the unique paths and touchpoints for various user levels, the goal is to provide a comprehensive understanding of the user experience at each stage. This differentiation in access is designed to align with the diverse needs and responsibilities associated with different user roles. For instance, users with varying levels of authority or distinct responsibilities within a system may encounter different features, functionalities, or decision points during their journey.

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By mapping out these journeys, designers and developers gain insights into the specific requirements and pain points of each user level. This approach allows for the implementation of user-centric design principles, tailoring the user experience to address the specific demands and expectations of different user groups. Ultimately, the development of user journey maps for different user levels contributes to a more inclusive and effective design, enhancing user satisfaction and usability across the entire user spectrum.

III. RESULTS AND DISCUSSION

A. Data Collection and Interview Analysis

The research involved interviews with a minimum of six users, who were customers of PT. BKI. The users included both managers and crew members, providing diverse perspectives. Journey maps were created based on the insights gathered from these interviews. The users interviewed were Dodid, Ferry, Lukas, I Made D., Nanang, and Abdi S.. The interviews identified specific problems and definitions, leading to proposed solutions.

1. User Persona and Identified Problems

Table 1 User Persona

Dodid	*Ferry*	*Lukas*
Problem: Already using a Planned Maintenance System (PMS), but desires an application for Annex IV and related documents and checklists.	*Problem: Faces challenges with manual data entry in the existing PMS.*	*Problem: Monthly reporting integration with the central office is not real-time, leading to discrepancies in maintenance.*
Definition: Needs a tool for new classification body documents.	*Definition: Requires a document management tool with standardized data.*	*Definition: Needs tools supporting PMS for real-time integration.*
Solution: Proposed the development of a Document Integration Module.	*Solution: Proposed the development of a Document Integration and PMS Module.*	*Solution: Proposed the development of a Document Integration and PMS Module.*
I Made D.	*Nanang*	*Abdi S.*
Problem: No existing PMS; seeks digitalization for ease of monitoring ship maintenance.	*Problem: Urgently requires digitalization for remote monitoring of maintenance and inventory control.*	*Problem: A need for tools to monitor ship maintenance and support operational needs.*
Definition: Needs PMS tools for digitalized ship maintenance.	*Definition: A tool for recording and accessing maintenance records.*	*Definition: Requires PMS tools for monitoring ship maintenance.*
Solution: Proposed the development of a PMS, Document Integration, and Spare Parts Module.	*Solution: Proposed the development of a PMS, Document Integration, and Spare Parts Module.*	*Solution: Proposed the development of a PMS, Document Integration, and Spare Parts Module.*

The table outlines the diverse challenges faced by various user personas in the context of a Planned Maintenance System (PMS) and the proposed solutions to address these issues (Lloyd et al., 2001) (Akyuz & Celik, 2017) (Stazić et al., 2017) (Ardhi et al., 2017) (Stazić et al., 2018). Dodid. seeks a tool for new classification body documents and proposed a Document Integration Module. Ferry encounters difficulties with manual data entry and suggests the development of a Document Integration and PMS Module. Lukas requires real-time integration for monthly reporting discrepancies and proposed a similar module. I Made D. aims for digitalization in monitoring ship maintenance, while Nanang urgently needs remote monitoring tools. Both propose a comprehensive PMS, Document Integration, and Spare Parts Module. Abdi S. emphasizes the necessity for tools

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supporting ship maintenance and operational needs and, like the others, suggests the development of the same integrated module. In essence, the proposed solutions focus on creating a versatile module catering to document integration, PMS, and spare parts management, tailored to the specific needs of each user persona.

2. User Journey Maps

User journey maps were created for each user, illustrating the stages and interactions based on their problems and solutions. These maps informed the development process, focusing on document status monitoring, integration, maintenance, and spare parts management.

a. Journey Map Ship Manager (Ownership - PMS)

This journey map focuses on the Ship Manager's perspective in terms of ownership, specifically within the context of the Planned Maintenance System (PMS). It likely outlines the various stages and touchpoints involved in the Ship Manager's responsibilities related to planned maintenance activities.

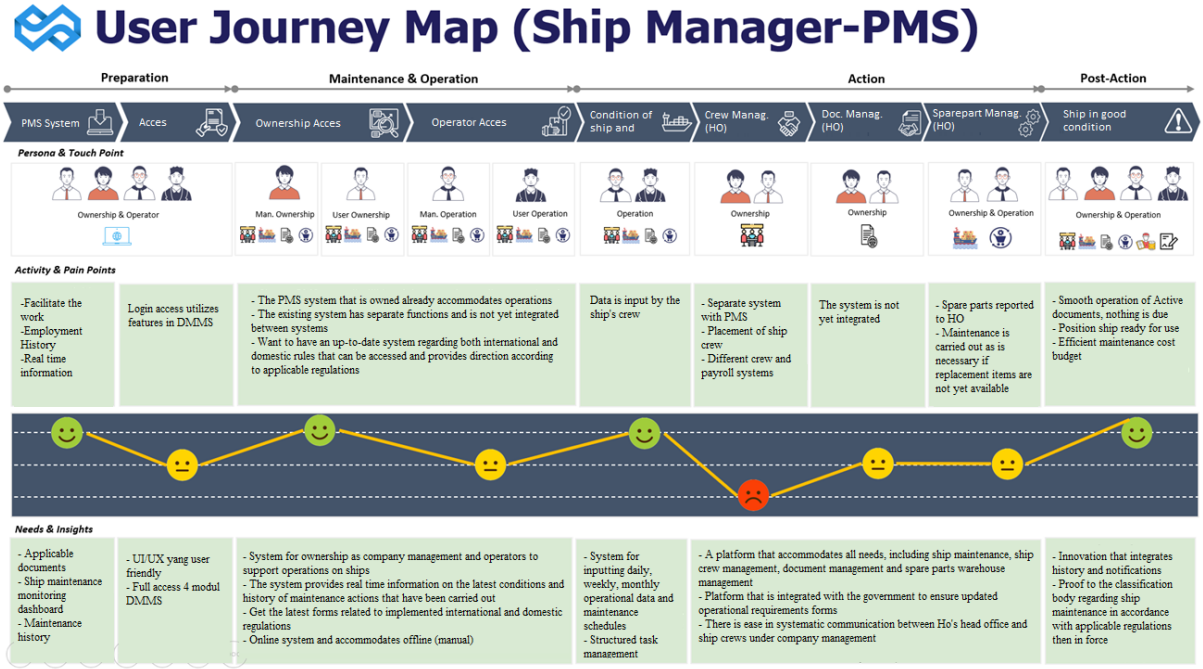

Figure 2 User Journal Map (Ship Manager – PMS)

b. Journey Maps Technical Operation (Operator - PMS)

This journey map is centered around the Technical Operator's viewpoint within the Planned Maintenance System (PMS) framework. It details the key steps and interactions involved in technical operations as part of the ownership responsibilities related to the Planned Maintenance System.

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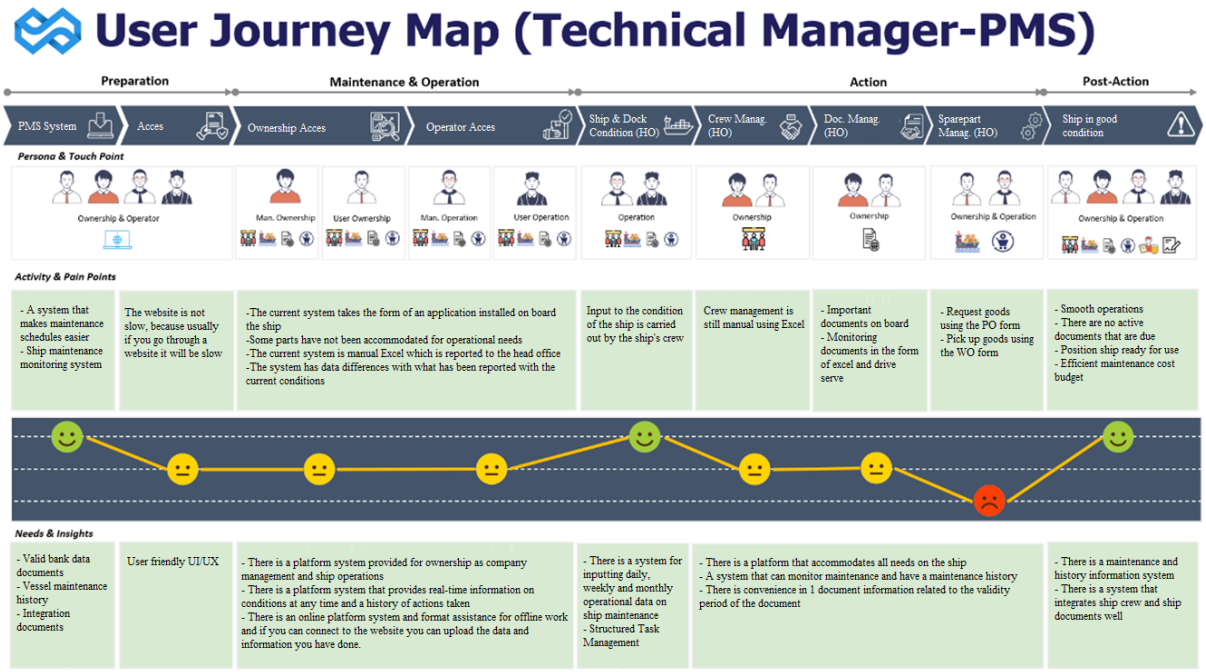

Figure 3 User Journal Map (Technical Manager – PMS)

c. Journey Maps Ship Manager (Ownership - Non-PMS)

This journey map focuses on the Ship Manager's role in ownership but outside the scope of the Planned Maintenance System (Non-PMS). It may cover different aspects or processes that fall outside the planned maintenance activities, providing a comprehensive view of Ship Manager's responsibilities in other areas.

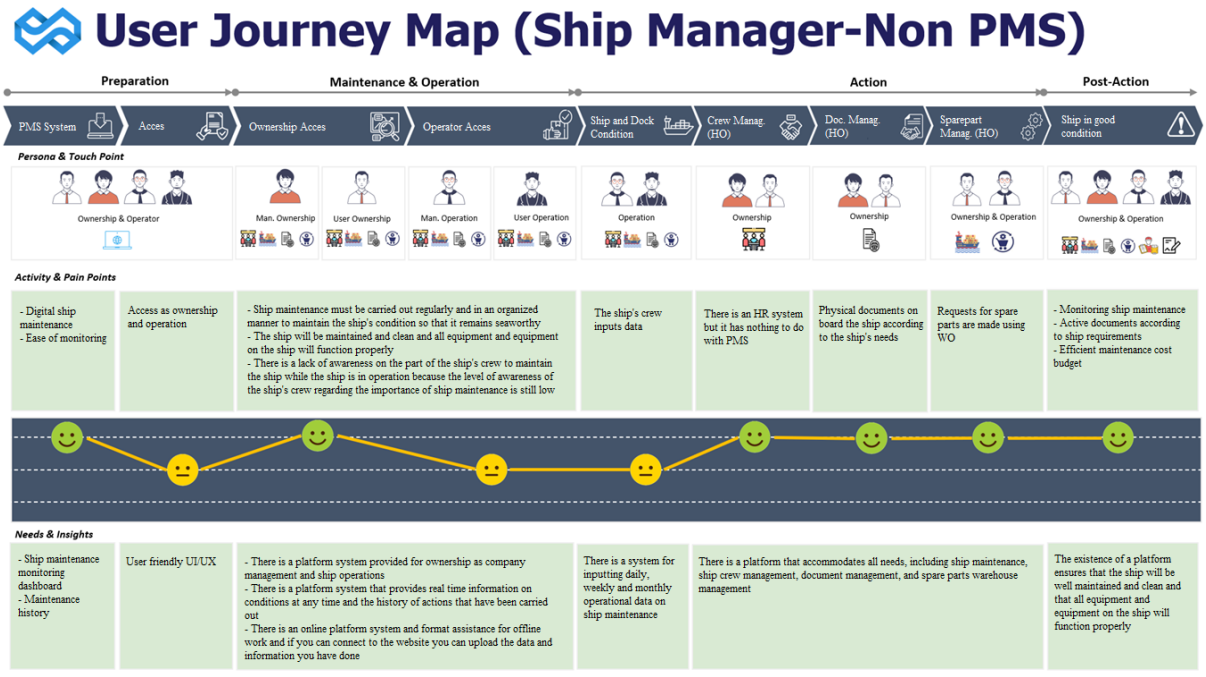

Figure 4 User Journey Map (Ship Manager – Non PMS)

d. Journey Maps Superintendent (Ownership - Non-PMS)

This journey map is tailored to the perspective of the Superintendent in terms of ownership but not specifically related to the Planned Maintenance System (Non-PMS). It likely illustrates the superintendent's

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involvement in various processes or tasks beyond planned maintenance, giving a holistic overview of their ownership responsibilities.

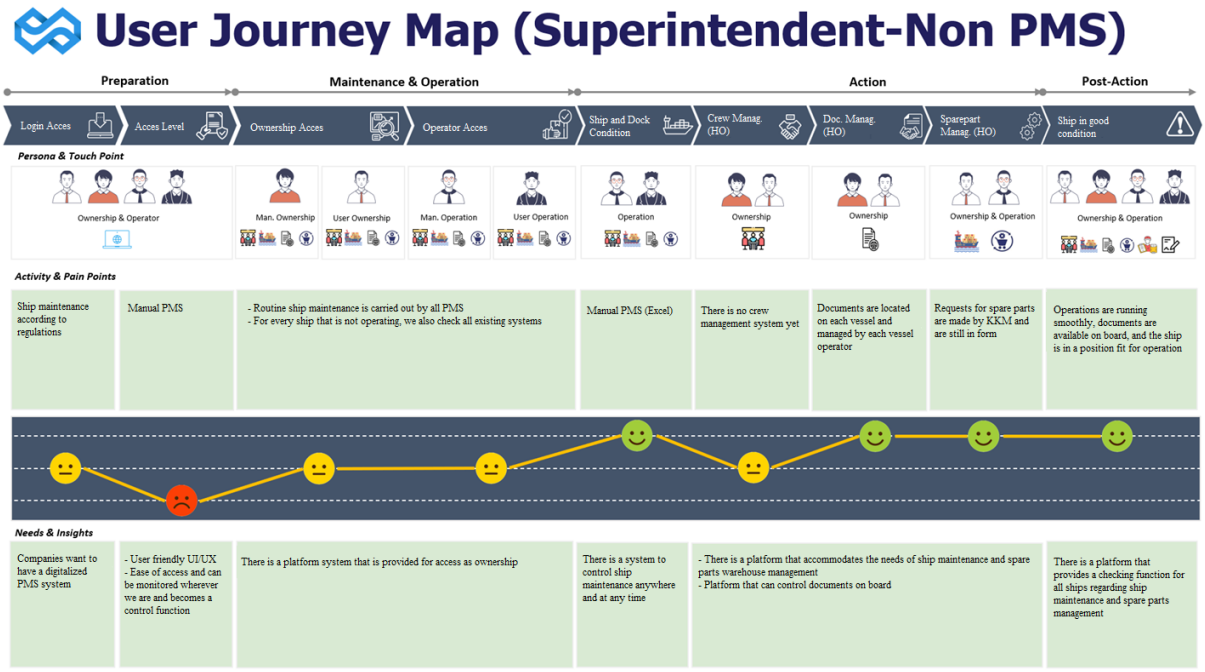

Figure 5 User Journey Map (Superintendent – Non PMS)

e. Journey Map Tech. Operation (Ownership - Non-PMS)

This journey map pertains to the Technical Operator's role in ownership, but it's not focused on the Planned Maintenance System (Non-PMS). It may outline the stages and touchpoints related to technical operations outside the planned maintenance context, providing insights into the Technical Operator's broader ownership responsibilities.

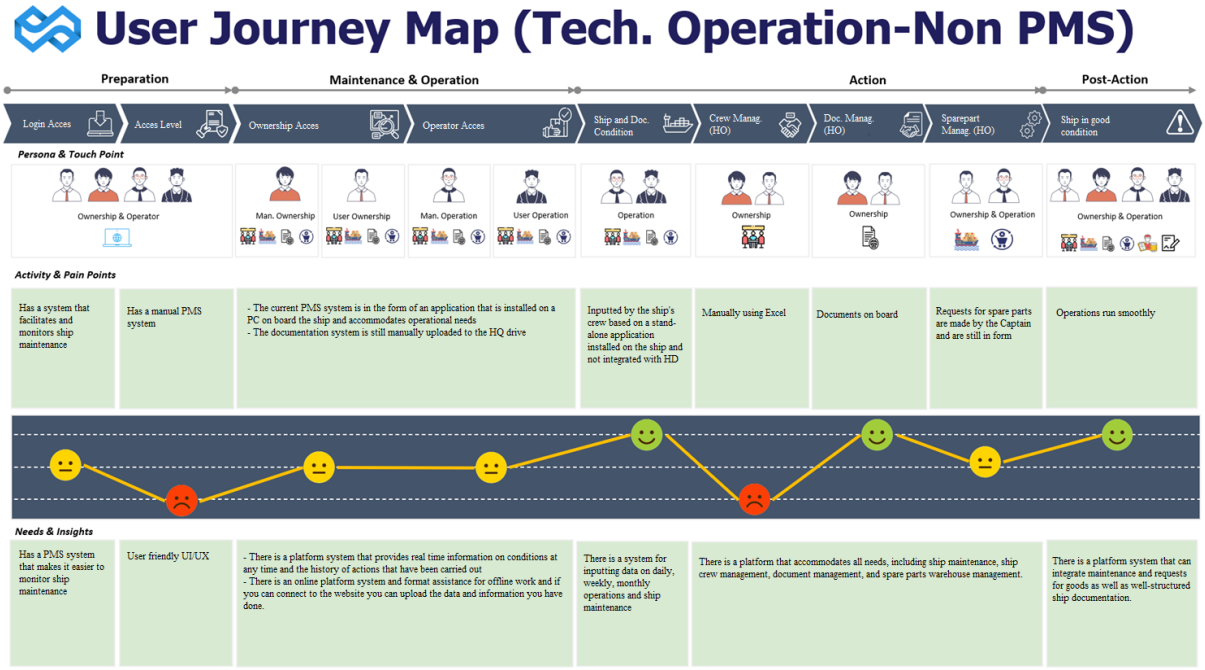

Figure 6 User Journey Map (Tech. Operation – Non PMS)

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B. DMMS Development Using Design Thinking

PT. Biro Klasifikasi Indonesia introduced a novel internal system that provides customers with convenient access to survey reports, statutory reports, survey and statutory certificates, and real-time statuses. This innovative system enhances transparency and efficiency in delivering crucial information to stakeholders.

The Digitalized Ship Maintenance Management System for external users underwent a comprehensive development process, resulting in various user-friendly web pages:

1. Manage User Page: This page displays all registered users and companies utilizing the system, facilitating easy user management.
2. Manage Fleet of Ships Page: Users can efficiently oversee and manage all fleet ships under company jurisdiction through this dedicated page.
3. Manage Documents Page: This page organizes and displays attached documents, categorized with metadata for easy navigation.
4. Manage Personnels Page: Companies can effectively categorize and manage personnel on each ship, enhancing human resource management.
5. Manage Warehouse Spare Parts Page: This page provides an overview of stock spare parts across the entire company or on a per-ship basis, streamlining inventory management.
6. Offline Upload System Page: This feature allows users to upload documents in an Excel format specified by the Digitalized Ship Maintenance Management System, ensuring flexibility in document submission.

The development sequence for the Digitalized Ship Maintenance Management System was structured to address specific problems and user needs systematically:

1. Document Integration Module: This module focuses on integrating the system with documents required by all potential users from the classification body.
2. Planned Maintenance System Module: Targeting users without existing ship maintenance applications, this module addresses planned maintenance needs.
3. Warehouse Spare Part Module: This module continues the development process by focusing on stock spare parts management.
4. Management Human Resources Module: Concluding the development cycle, this module specifically addresses personnel placement on ships.

The large-scale development timeline for the application was determined based on interviews, ensuring a comprehensive approach. However, the implementation of the Design Thinking method enables the Digitalized Ship Maintenance Management System to evolve per module, adapting to the complexity defined by user needs. This approach combines multiple problems to create holistic solutions before progressing to the development of subsequent modules.

1. Determination of 4 User Levels in DMMS Development

The application's schematic flow involves the integration of four key modules, each designed to address specific functionalities within the Digitalized Ship Maintenance Management System.

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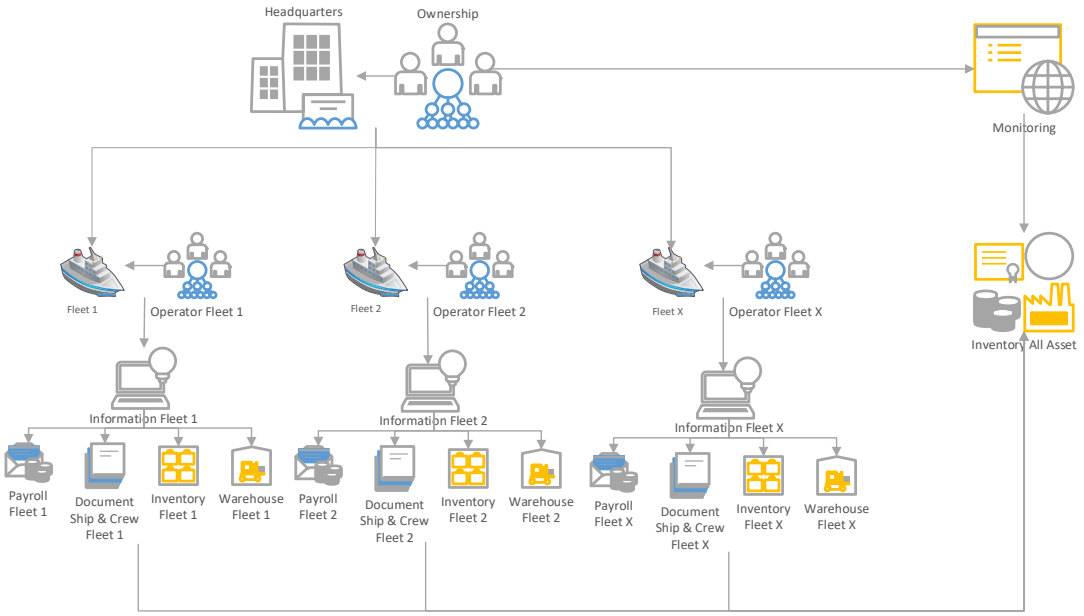

Figure 7 User Role Ownership & Operators

This graphic above presumably illustrates the roles and relationships within the Digitalized Ship Maintenance Management System. The depiction likely includes various components representing the users, their roles, and the flow of information and actions within the system. The term "User Role Ownership & Operators" suggests that the application has distinct roles assigned to different users. These roles are likely categorized based on their responsibilities and permissions within the system.

1. Ownership Management:
   This section pertains to the management level associated with ownership roles within the Digitalized Ship Maintenance Management System. Ownership Management likely includes users who have administrative control over the system, enabling them to configure settings, manage user access, and oversee the overall operation of the application.
2. Ownership User:
   Ownership User refers to individuals who hold ownership roles within the system but have a user-level access, meaning they can utilize the application for specific tasks and functions relevant to their ownership responsibilities.
3. Operator Management:
   Operator Management involves users responsible for overseeing and managing the operational aspects of the Digitalized Ship Maintenance Management System. These individuals may have administrative control over functionalities related to day-to-day operations.
4. Operator User:
   Operator User designates individuals with operational roles who use the application as end-users. They likely have access to specific features and functionalities required for their operational tasks but may not have administrative privileges.

The outlined sections provide a comprehensive overview of the user roles and access levels within the Digitalized Ship Maintenance Management System (Pinciroli et al., 2023) (ClassNk, 2013). The roles are categorized into ownership and operator levels, each further divided into management and user roles, ensuring a structured and controlled access environment based on the users' responsibilities and tasks.

2. User Feedback after Trying DMMS Prototype

Here's an explanation of the provided feedback after testing the accessible prototype at https://dmms.bki.co.id:

1. Menu PMS => Machinery Main Components - Add Scheduled Maintenance Date:
   Suggested enhancement to the "PMS => Machinery Main Components" menu by including a scheduled maintenance date. This addition aims to provide a clearer overview of when maintenance tasks are planned for each machinery main component.

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2. Menu PMS => Machinery Main Components - Add Work Order Menu:
   Proposed inclusion of a "Work Order" menu within "PMS => Machinery Main Components." This addition is aimed at streamlining the order process, allowing users to place orders more conveniently without navigating through each component individually.
3. Notification Enhancements:
   Suggested improvements to notifications by adding a feature that notifies users about jobs approaching overdue status. The notification would vary based on the type and category of components. A yellow warning could indicate an approaching overdue status (e.g., one week prior), while a red warning could signify imminent overdue status.
4. Dashboard Displaying Work Done in the Last 7 Days:
   Recommended the creation of a dashboard that showcases tasks and maintenance activities completed within the last seven days. This feature aims to provide a quick and efficient summary of recent activities.
5. Home Menu with Icon Shortcuts for Electronic/Website Product Services:
   Proposed the addition of icons to the "Home" menu, serving as shortcuts for accessing product and service offerings via electronic means or the website.
6. Enhancements to Fleet Menu:
   Expanded the "Fleet" menu to include several directories:
   a. Particulars of Ships
   b. Survey History
   c. Current status of DOC, SMC, ISSC, and MLC
   d. Download Survey Status & E-Certificate
7. Document Menu with Survey Reminders:
   Augmented the "Document" menu by incorporating reminders for surveys 1 and 2, sent to the designated Person in Charge at PT. BKI's customer locations where their emails have been registered.
8. Warehouse Menu Enhancements:
   Strengthened the "Warehouse" menu with the following features:
   a. Requisition for SPARES & STORES and breakdown of SPARES by category for each type of machinery.
   b. Added menus for PURCHASE ORDER and RECEIVING REPORT.
   c. Provided visibility into warehouse stock, both on ships and in storage facilities.
9. These proposed enhancements aim to improve the overall user experience, streamline workflows, and ensure effective management of ship maintenance processes within the Digitalized Ship Maintenance Management System.

V. CONCLUSION

The current Digitalized Ship Maintenance Management System (DSMMS) application serves as a comprehensive repository for all data-related tasks for both ownership and operators. The four main modules, including Planned Maintenance System, Human Resource, Document Integration, and Warehouse Stock Spare Part, primarily store data. They also provide simple alerts for upcoming deadlines, prioritizing information in the monitoring system. However, the application falls short of being a decision-making tool or an analytical platform for guiding ship maintenance and other modules.

The current state of the Digitalized Ship Maintenance Management System (DMMS) reflects its capacity to store comprehensive data that ownership and operators need. However, the four main application modules, namely the Planned Maintenance System, Human Resource, Document Integration, and Warehouse Stock Spare Part, primarily serve as data repositories. While the system provides basic warnings on upcoming deadlines, it falls short in enabling decision-making and data analysis for effective ship maintenance.

User interviews emphasize the importance of prioritizing the development of the Document Integration module over the Warehouse Stock Spare Part module. User perspective diversity is crucial in problem-solving, and empathy plays a pivotal role in understanding their varying viewpoints. Design Thinking, a multi-stage approach involving empathizing, defining, ideating, prototyping, and testing, can guide the development process effectively.

In the empathize stage, detailed exploration of user complaints is essential to determine solutions accurately. Tools like empathy maps help comprehend user needs and desires. The define stage requires careful evaluation to decide which modules should be developed immediately and which can be deferred based on long-term company needs.

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Ideation and prototyping stages are crucial for transforming defined ideas into practical solutions. These stages involve creating prototypes aligned with user-defined problems and needs. The testing stage ensures that the developed application meets user requirements. Design Thinking, with its convergent and divergent thinking concepts, provides clarity in each stage of the process.

DMMS, with its main modules such as Planned Maintenance System (PMS), Human Resource (HR), Document Integration, and Warehouse Spare Part, can benefit significantly from the Design Thinking approach. Empathetic understanding, accurate definition, and creative ideation contribute to the creation of prototypes that address user needs effectively.

The use of empathy maps in the empathize stage, careful assessment in the define stage, and efficient ideation and prototyping contribute to the creation of a user-centric product. The testing stage ensures that the application aligns with user requirements. By leveraging Design Thinking and appropriate tools, DMMS development can be conducted efficiently and effectively, providing tangible value to the company by enhancing operational processes through digital transformation.

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