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Innovation Through AI Integration: A Study of AI Technology Adoption for the Maritime Inspection and Consulting Sector Using Soft System Metodology

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ABSTRACT

The maritime industry, a global powerhouse for trade and transportation, is on the cusp of a transformative era driven by Artificial Intelligence (AI). This paper explores the potential of AI to revolutionize various aspects of the maritime sector, from navigation and route optimization to predictive maintenance and enhanced safety. In this paper, AI implementation in inspection and consulting industry will be studied, this AI will help fasten regulatory compliance process and maintenance services in maritime Industry. The study showed that there are four main stakeholders in AI implementation, which are Operational expert, Managers, Clients, and AI team. Each stakeholder has a crucial part to play in the successful implementation of AI in this industry. This study will map out the interest of each stakeholder using SSM, therefore giving a clear picture of what each stakeholder wants and their apprehensions. The result of this study is some conditions that need to be met by each stakeholder for the implementation of AI in this sector to be successful.

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INTRODUCTION

The digital era is characterized by rapid technological advancements, with artificial intelligence (AI) emerging as a transformative force across various industries (Brynjolfsson & McAfee, 2017). AI boasts impressive capabilities in data analysis, pattern recognition, and generating insightful recommendations, offering significant advantages for streamlining processes and improving decision-making (Varian, 2018). The maritime inspection and consultancy sector presents a prime example of where AI can potentially revolutionize workflows. Traditionally, ensuring shipping safety, environmental protection, and efficient trade relies on standardized procedures established by the International Maritime Organization (IMO) (e.g., MARPOL Annex VI). However, individual member state interpretations and implementation of these policies can lead to legal and operational discrepancies (Stopford, 2009).

This study focuses on the potential of AI to address these challenges within the Indonesian maritime inspection and consultancy sector. Indonesia, with its burgeoning economy and widespread technology adoption, presents a compelling case study for exploring AI integration in this domain. While companies are increasingly recognizing the potential of AI, a deeper understanding is required to overcome the barriers associated with its adoption and fully leverage its benefits.

This research aims to conduct an in-depth exploration of the challenges and opportunities associated with integrating AI in the Indonesian maritime inspection and consulting sector. By gaining a comprehensive understanding of these factors, we hope to empower companies to make more informed decisions regarding their AI strategy. Ultimately, the goal is to unlock the full potential of AI for sustainable growth and enhanced efficiency within this crucial sector.

LITERATURE REVIEW

The transformative potential of artificial intelligence (AI) extends across various industries, presenting both opportunities and challenges (Brynjolfsson & McAfee, 2017). In the food supply chain (FSC), AI adoption holds promise for addressing food safety, quality, and waste reduction by enhancing transparency and traceability (Dora et al., 2021). This finding underscores the critical role AI can play in tackling complex supply chain management issues. However, the integration of AI in the educational sector faces ethical concerns and implementation hurdles (Tahiru, 2021). This highlights the importance of considering sector-specific ethical and practical challenges when deploying AI technologies.

Beyond its benefits in supply chain management, AI demonstrates potential in the healthcare sector. Research by Simon et al. (2018) suggests AI's ability to address knowledge gaps in cancer care, paving the way for improved diagnostics and treatment. Similarly, AI and machine learning applications offer promising solutions in environmental challenges like biodiversity conservation and forest management (Shivaprakash et al., 2022). These findings suggest that AI adoption within the maritime inspection and consultation sector could potentially contribute to environmental and sustainability goals. Additionally, Osamy et al. (2022) showcase how AI techniques can address data collection, aggregation, and dissemination challenges in wireless sensor networks. This emphasizes AI's potential to streamline data management in complex operational environments, potentially benefiting maritime operations.

While AI adoption offers promising advantages for the maritime inspection and consultation sector, several knowledge gaps and challenges remain. A critical area for future research is exploring the specific challenges and opportunities of AI implementation within the maritime industry, considering its unique operational environment and regulatory landscape. Understanding the potential ethical implications and challenges associated with AI use in maritime inspection and consultation is also crucial. Investigating the barriers and facilitators of AI adoption in this sector is necessary, considering the complexities of maritime operations and regulatory compliance requirements.

Furthermore, integrating AI with digital feedback systems could support the implementation of measurement-based care in the maritime industry (Lyon et al., 2019). This approach has the potential

to improve operational processes and decision-making in maritime inspection and consultation. Learning from AI tool penetration in other sectors like banking can also benefit AI adoption in maritime operations. Studies by Marinakis et al. (2021) and Schlögl et al. (2019) offer valuable insights into best practices and potential challenges that can inform the maritime sector.

RESEARCH METHOD

This research employs Soft Systems Methodology (SSM) (Challender, 2000) to explore the complexities surrounding implementation of AI in the maritime inspection and consultation context. SSM offers a structured approach for tackling ill-defined problems often encountered in social and managerial situations, particularly those with multiple stakeholders and conflicting viewpoints (Vidal, 2005).

This methodology prioritizes understanding the problem space from diverse perspectives rather than focusing solely on finding the optimal solution. Here's how SSM will be applied in this study:

1) Rich Picture Development:

A comprehensive "rich picture" will be constructed to visualize the complexities of the situation. This diagram will depict the relevant actors (individuals, groups, organizations), their activities and interrelationships, and the influences that shape the situation. Stakeholder workshops and in-depth interviews will be conducted to gather data for constructing a rich picture that reflects the various perspectives involved.

2) Root Definition Formulation:

Key elements of the situation will be defined using the CATWOE framework (Wheeler et al., 2000). This framework clarifies the:

Customers: Who are the beneficiaries of a potential solution?
Actors: Who is involved in the situation and how do they interact?
Transformation: What is the current process or situation being investigated?
Weltanschauung (Owner's Worldview): What are the underlying assumptions and values guiding the current system?
Owners: Who has the authority to implement changes?
Environment: What are the external factors impacting the situation?

3) Generating and Comparing Conceptual Models:

Building upon the rich picture and root definition, different perspectives on how the situation could be improved will be explored. This stage involves brainstorming and developing conceptual models that represent potential solutions. These models will consider different stakeholder viewpoints and address the root causes identified earlier. Doing so will help the researcher to paint a complete picture including the complex motivational web that hinder or push the problem forward. The findings from this conceptual model will be used to inform recommendations for practical action steps. This may involve proposing changes to existing policies, procedures, or organizational structures based on the insights gleaned through SSM.

Justification for Using SSM:

The choice of SSM is justified due to the "complex and multifaceted nature of AI implementation in the maritime inspection and consultancy." This methodology allows for a deeper understanding of the various viewpoints and challenges surrounding the issue, leading to more comprehensive and well-rounded solutions (Bradbury, 2015).

SSM is an iterative process requiring ongoing participant involvement. Additionally, the quality of the outcomes depends on the facilitator's skills and participant engagement. While limitations exist, SSM provides a valuable framework for exploring complex situations in the maritime inspection and consultation domain.

RESULT & DISCUSSION

Step 1: Rich Picture Development

While artificial intelligence is a technology that is widely accepted for its uses, there have been some challenges in its implementation in the maritime inspection sector. The challenges start from the very root of daily operation up to the complexity of decision making at management and top management level as AI implementation need dedicated team and expertise, which are currently in high demand everywhere around the world. Of course, the need of team can be delegated into external third party, but that carries it own risk related to breach of trust as data in inspection industry is often contains internal client data.

Therefore, implementation of artificial intelligence is a process that needs agreement between multiple stakeholders.

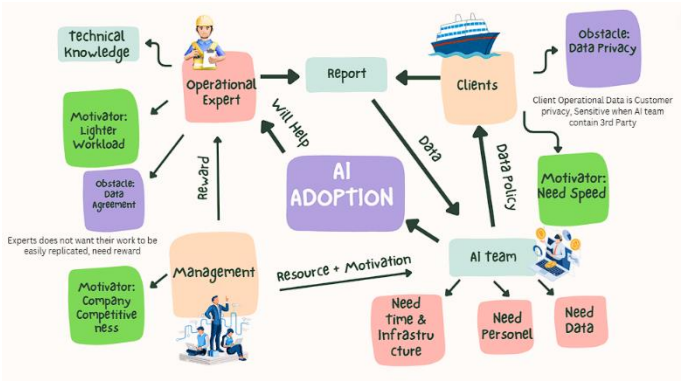

Figure 1. Rich Picture
Source: Author, 2024

Step 2: Root Definition Formulation

Root definition will be formulated using CATWOE model, this is to capture the essence of the situation clearly, while placing the stakeholder at the appropriate position in this particular problem. RD will be analysed using each stakeholder motivator motivator as the base of the analysis, this will be used to create a complete picture on how each stakeholder motivation interact. As for the AI team which is the main driving force of AI Implementation, the RD will be centered around problem that arose in the implementation.

Table 1. CATWOE Analysis RD 1

RD 1 Lighter Workload For Operational Expert	
Element	**Description**
Costumer	Operational Expert
Actors	AI Team
Transformation	Faster and Stronger Data Analysis and Report Generation by using Artifical Intelligience that have learned from past reports
Wordfiew	Currently there are many repetitions, and the expertize of one expert does not practically help other when they are on different projects
Owner	Management, Customer
Environment	Operational expert expertise will be needed by the AI team to create the AI, therefore communication between the two will need to be facilitated.

The first root definition is from the viewpoint of Operational Experts. With Artificial Intelligence, these experts can spend less time looking at multitude of report and data to finish their work. This technology also enable past report – making experience to influence present projects, either by checking incostintencies or by giving a better foundational knowledge, thus making the quality of report more robust and more standarized across all project. The main worries is the reduced financial worth of the project that they worked on, and the fear of getting replaced by the tools.

Table 2. CATWOE Analysis RD 2

RD 2 Company Competitiveness for Management	
Element	**Description**
Costumer	Management
Actors	AI Team, Operational Expert
Transformation	Increased company competitiveness based on increased operational speed and better quality of work
Wordfiew	Currently the quality of the project is very determined by the quality of the expert involved in the project, by the help of AI this can increase project quality across the entire company
Owner	AI Team, Customer
Environment	Artificial Intelligence is gaining popularity, therefore infrastructure needed and expertize in the field is on a very high demand. Other than that, customer data use need to be adressed.

The making of an AI need a lot of resource, For this, planning need to be done in allocation of resource for the AI team. Other than that, as the AI need to be trained through past report, therefore important NDA with the clients need to be adressed for the AI Implementation to be able to start.

Table 3. CATWOE Analysis RD 3

RD 3 Faster Speed of Service for the Client	
Element	**Description**
Costumer	Clients
Actors	AI Team, Operational Expert
Transformation	The faster service is provided, the faster it is for business cycle to roll.
Wordfiew	Currently as maritime inspection often assess about regulatory compliances, the faster the speed of the service the faster compliance could be proven thus allowing business to start / continue.
Owner	Manager
Environment	Artificial Intelligence is gaining popularity, therefore infrastructure needed and expertize in the field is on a very high demand. Other than that, customer data use need to be adressed.

AI is considered a plus in the maritime sector. It is viewed as a powerful tools that produce accorate result when used by the expert in the field. Therefore, the main obstacle in the AI adoption process is operational data secrecy. For the AI implementation to be successfull, the client need to be convinced that the data used will not harm them in any way whatsoever.

Table 4. CATWOE Analysis RD 4

RD 3 AI Team Needs	
Element	Description
Costumer	AI Team
Actors	Operational Expert, Client
Transformation	Addition of expertize, proper data, and good infrastructure will ensure the success of the project
Wordfiew	The expert on field of AI is high in demand, and insufficient data and structure will make the project took longer to be finished.
Owner	Manager
Environment	Permission is needed to Gett data from each data holder for the AI team to use.

AI team is where the work of implementing an AI is done. Often companies will not have specific expertise to work on this project, therefore additional experts will be needed. Considering the current market and how fast AI is developing, this AI Implementation could be resource intensive and those experts need to be internalized so that the company does not fallen behind on the rapid progress of AI advancement.

Step 3: Generating and Comparing Conceptual Models

A conceptual model is needed for planning and designing of the solution for AI implementation for the companies. The conceptual model will focus on 'what needs to be done' or 'what needs to happen' for AI implementation to be a success. Then comparison will be held with the assumption that the company does not have any IT resource specific to this AI sector and have not done any action towards their implementation of AI.

Table 5. Conceptual Model

Conceptual Model	
RD1	Operator Viewpoint
Condition 1	AI needs to be understood to be a tool to help, not a threat.
Condition 2	Expert must be willing to give data and insight to assess the usefullness of the AI developed by the AI team, and also to give suggestion for improvement.
RD2	Managerial Viewpoint
Condition 1	The managers must be convinced that AI is a very powerful tool, therefore will be willing to impart the team with much needed resource
Condition 2	Must be willing to talk to clients and negotiate permission for data usage
Condition 3	Must plan the internalization of the newly acquired AI experts, which often times have vastly different working culture from maritime inspection experts
RD3	Client Viewpoint
Condition 1	Must be convinced that their data will not harm them in any way
Condition 2	Comminicaion with the client so that clients are willing to pay more for a faster and better quality of work
Condition 3	Must plan the internalization of the newly acquired AI experts, which often times have vastly different working culture from maritime inspection experts
RD4	AI Team Viewpoint
Condition 1	Data and Infrastructure need to be robust, as AI training speed and its quality heavily depend on those two aspecs.
Condition 2	There must be a team of expert on AI training, that are focused on AI and its advancement

CONCLUSION

Through this research, soft systems methodology has helped to clear up the multi layered needs of each stakeholder in for AI implementation in maritime inspection and consultation sector. The model captures each condition that each stakeholder needs to meet for the implementation of AI to be a success. To get each condition fulfilled, each company and their teams will have different considerations and therefore different solutions that is out of the scope of this research. Each company different environment may also produce different CATWOE analysis, therefore the result of this research should be taken in a broad sense as what that will happen when in AI implementation, and how this problem will surface will and in what form that will happen will be an unavoidable problem in the hands of each team.

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