PRIORITIZATION OF ENABLING TECHNOLOGIES THROUGHOUT DIGITAL TRANSFORMATION IN SHIP MANAGEMENT COMPANIES

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ABSTRACT

Identification of enabling technologies is a critical stage to manage digital transformation process in different industries. This paper investigates the priorities enabling technologies throughout digital transformation in ship management companies. As a suitable technique to this case, Analytic Network Process is utilized to clustering of organizational functions (i.e. technical management, operation management, etc.) and enabling technologies (i.e. big data analytics, internet of things, etc.). The results highlight big data analytics as the most important enabling technologies. Besides improving the managerial skills, ship management companies might consider the priorities to decide on the investments on digital transformation.

Keywords: ship management, enabling technologies, analytic network process.

1. Introduction

Researchers and practitioners in the field of maritime policy and management have been avidly driven by the increasing importance of the maritime transportation industry in international trade. Due to the complexity of the maritime industry, ship management is a specialized area that requires a high level of skill and proficiency (Celik and Er, 2008). In addition to the hazards and challenges they encounter on a global scale, ship managers must seek multidisciplinary solutions to a wide range of problems, including those affecting finance, risk management, legislation, maritime law, and so on (Lee at al., 2010). Therefore, it is essential to have highly qualified individuals in both on-board and shore-based jobs, as well as a well-structured, innovative management style, in order to carry out the shipping operations effectively (Poulsen and Sornn-Friese, 2015). For an effective operation in multi-disciplinary areas, it is necessary for ship management companies to benefit from digital technologies. Therefore, the digitalization processes of companies should be carried out meticulously and effective technologies should be integrated into the company's policy.

The aim of this study is to prioritize the enabling technologies that ship management companies should consider in their digitalization processes by using the Analytic Network Process (ANP), a well-known Multi Criteria Decision Making (MCDM) technique for illustrating quantitative outcomes, to structure a control criterion with dependency and feedback on the problem. The report completes with some last observations and suggestions for future research.

2. Literature Review

When the available literature is examined, the applications of the ANP technique in the maritime industry are observed. For example, with the help of an analytical network procedure, the environmental duties of marine stakeholders are thoroughly investigated

and measured. When applied to a real-world maritime event (an oil spill), this method assures that the most crucial dependencies and feedbacks among the responsibilities are considered (Celik and Topcu, 2009). Also, the study's overarching goal is to develop a customer-centric, sustainable maritime supply chain. Methods like Quality Function Deployment (QFD) and the ANP are used to guide the design processes at shipping businesses to attain this goal (Lam, 2015). This research was conducted to establish a hierarchy of MCDM analysis criteria for shipowners to use when choosing a maritime registry. The decision-making process of choosing a register is investigated using ANP technique (Chou, 2018). Using the ideas of the balanced scorecard (BSC) and the decision-making trial and evaluation laboratory (DEMATEL), this research hopes to evaluate the accuracy of risk assessments made in the context of maritime accidents. Based on the data, we conclude that the balanced scorecard has potential as a tool for managing marine procedures and analyzing maritime risk (Lin, 2022).

Although various studies have been carried out with the ANP technique, a detailed study should be carried out on the digitalization process of a ship management company and the prioritization of enabling technologies.

3. Objectives

Because of the maritime industry's complexity, ship management is a unique field of study that calls for a high level of expertise and competence. Ship managers are forced to look for multidisciplinary solutions to a wide range of problems, including those involving finance, risk management, legislation, maritime law, and so on, in addition to the hazards and challenges they face on a worldwide scale. Organizing the ship management company's decision-making process so that it adheres to the company's primary goals and founding principles requires a well-thought-out plan for allocating roles and duties among departments.

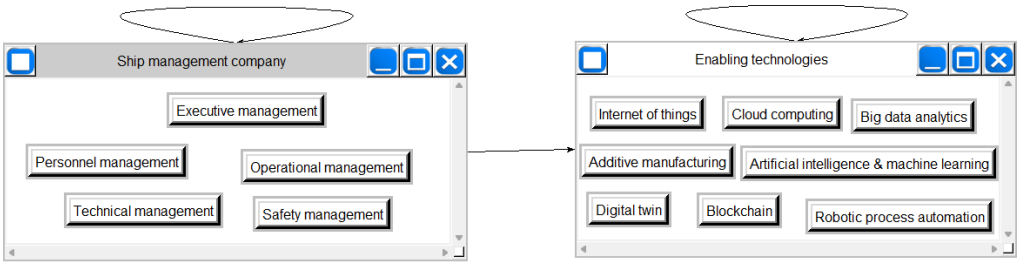
Ship management companies should choose enabling technologies in accordance with their departments in digitalization processes. Therefore, it is necessary to prioritize enabling technologies according to the departments of ship management companies and determine their order of importance. The scope and concept of relevant responsibilities are planned to be utilized as a guide in further sections for defining the key enabling technologies of ship management companies.

4. Methodology

The initial stage of ANP methodology is based on structuring a control criterion whose elements have dependencies and feedbacks. This study defines the nodes under two clusters, namely ship management company and enabling technologies. Under the ship management company cluster, there are executive management, personnel management, operational management, technical management and safety management. Also, under the enabling technologies cluster, there are internet of things, cloud computing, big data analytics, additive manufacturing, artificial intelligence & machine learning, digital twin, blockchain and robotic process automation.

Following the identification of the problem's evaluation criteria, the model's structure is refined through the establishment of inter-cluster relationships and inter-cluster dependencies. When the current linkages are created between the important components, as shown in Figure 1, the suggested multi-criteria evaluation model in *SuperDecisions Software* has a basic structure as shown in that figure.

Figure 1. Basic model structure in *SuperDecisions Software*



Inputting information into the *SuperDecisions Software* is the final stage. Several experts in the maritime sector are contacted at this point to gather their collective wisdom on the topic of paired comparisons. Ten maritime industry experts' contact information is compiled here for the purpose of conducting this study. In order to offer consistent input data for the software, the geometric means of the experts' evaluations are calculated. *SuperDecisions Software*'s output data consists of the unweighted supermatrix, weighted supermatrix, limit matrix, cluster matrix, and global priorities, all of which are calculated based on the input pairwise comparison results.

5. Model Analysis

Ship management businesses' global priority weights on enabling technologies are shown in Table 1.

Table 1. Global Priority Weights on Enabling Technologies

Enabling technology	Limiting Values	Normalized Values	%
Digital twin	0.113	0.256	%26
IoT	0.118	0.242	%24
Cloud computing	0.095	0.051	%5
Big data analytics	0.153	0.367	%37
AI & ML	0.096	0.031	%3
Additive manufacturing	0.094	0.023	%2
Blockchain	0.072	0.021	%2
Robotic process automation	0.089	0.001	%1

The results indicate that the most important enabling technology for ship management company’s digital transformation is big data analytics (%37). After the big data analytics, other enabling technologies are; digital twin (%26) and IoT (%24), cloud computing (%5), AI and ML (%3), additive manufacturing (%2), and robotic process automation (%1) and blockchain (%2). The findings of this research can be used as a guiding tool in the development of the organizational structure of a commercial ship management company in executive, personnel, operational, technical and safety management, as well as in the formulation of the company's overall strategic goals and objectives.

6. Limitations

One of the limits of the study is expert opinions, which are limited to a total of 10 participants. In future studies, a detailed examination can be carried out by taking the opinion of more experts. In addition, different MCDM techniques such as Analytic Hierarchy Process (AHP), The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) can be used to examine the digitalization processes of ship management companies in more detail.

7. Conclusions

This paper identifies the priorities of enabling technologies such as cloud computing, big data analytics and digital twin etc. in different managements of ship management companies for digital transformation process. The results indicate that the most important enabling technologies are big data analytics (%37), digital twin (%26) and IoT (%24). Ship management companies might consider the priorities to decide on the investments on digital transformation. The findings are also useful to update the required managerial skills. The findings of this research can be used as a decision aid for reorganization of a professional ship management companies. In addition, they can be used for setting and planning the general priorities within the strategic vision of the company.

8. Key References

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