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BRIDGING INFORMAL AND FORMAL HRM SYSTEMS IN COASTAL ECONOMIES: A SYSTEMATIC LITERATURE REVIEW OF WORKFORCE TRANSFORMATION IN MARINE SECTORS

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ABSTRACT

Objective: This study aims to examine the transformation of Human Resource Management (HRM) in the maritime sector by identifying how Digital Human Resource Management (D-HRM), Sustainable HRM, and Eco-friendly HRM function as bridging mechanisms in the transition from an informal labor system toward a formal, sustainable, and technology-driven maritime labor governance system within the context of the blue economy.

Research Design & Methods: This study employs a Systematic Literature Review (SLR) following the PRISMA 2020 guidelines. Data were collected from the Scopus, Web of Science, and ScienceDirect databases, covering publications from 2018 to 2025. A total of 37 Q1-indexed journal articles were analyzed using qualitative synthesis and VOSviewer bibliometric mapping.

Findings: The results show an upward trend in maritime HRM research after 2020, particularly regarding issues of digitalization and sustainability. Human resource management has emerged as a central theme related to sustainability, fisheries, and decision-making. This study also found that Digital HRM supports workforce formalization, while Sustainable and Green HRM strengthens workforce resilience and organizational sustainability in the maritime sector.

Implications & Recommendations: Maritime organizations and policymakers need to develop inclusive digital HR systems, strengthen workforce upskilling, and integrate sustainability principles into maritime labor governance.

Contribution & Value Added: This study positions Human Resource Management (HRM) as a strategic bridging mechanism connecting workforce transformation, sustainability, and institutional adaptation in the maritime sector.

Keywords: Sustainable HRM; Blue Economy; Informal Labor.

JEL codes: M14, O15, J24.
Article type: review paper

INTRODUCTION

The maritime industry is a cornerstone of the global trading system, with approximately 70% of the value of world trade dependent on maritime transport. The transformation of this sector is being further accelerated by global initiatives such as the United Nations' Sustainable

Development Goals (SDGs), particularly those emphasizing ocean sustainability and economic inclusion. In this context, the concept of the blue economy has emerged as a paradigm that integrates economic growth with the conservation of marine ecosystems (Bennett et al., 2019; Voyer et al., 2018). However, mainstream HRM literature–particularly in journals such as the *Human Resource Management Journal* and the *International Journal of Human Resource Management* remains dominated by assumptions of formal, land-based organizations with stable, contractual, and documented work structures (Collings et al., 2021; Cooke et al., 2021). Consequently, the labor dimension in the maritime sector, particularly in the coastal regions of developing countries, remains underrepresented in HRM theory development. Yet, this sector is significant not only economically but also socially, as it involves millions of workers operating under vulnerable, informal working conditions that are often unprotected by formal regulations.

The primary phenomenon underpinning this research is the dominance of informal labor structures in the global coastal economy. Approximately 90% of the world's artisanal fishers operate on a small-scale, community-based basis (Okeke & Gray, 2021), with a work system that relies on social relationships, trust, and local norms rather than formal contracts. From an HRM perspective, this situation challenges basic assumptions regarding practices such as recruitment, training, performance evaluation, and compensation systems, which are typically structured and documented. Studies in HRM indicate that the effectiveness of HR practices is highly dependent on the suitability of the institutional context (Guest, 2017; Jiang et al., 2012), yet informal contexts such as those in coastal regions remain rarely the focus of empirical research. Furthermore, the informal maritime workforce often faces precarious employment, characterized by income uncertainty, minimal social protection, and high occupational risks (Béné, 2020). These conditions highlight a structural gap between global HRM practices rooted in formality and the reality of a maritime workforce that is flexible yet vulnerable.

The transformation of the maritime workforce is becoming increasingly complex due to technological disruption and sustainability demands. Digitalization through shipping automation, artificial intelligence in logistics, and the integration of the Internet of Things (IoT) have altered job designs and workforce competency requirements (Kayembe & Obadire, 2025). On the other hand, regulatory pressure from the International Maritime Organization and the International Labour Organization is driving the adoption of safer, more inclusive, and more sustainable labor standards, including the decarbonization of the maritime industry and the implementation of decent work principles. Contemporary HRM literature emphasizes the importance of reskilling and upskilling in response to these changes (Collings et al., 2021), but such approaches are generally assumed to occur within formal organizational systems that possess adequate training infrastructure. In coastal contexts, limited access to formal education, technology, and training institutions creates a significant skills gap. This raises critical questions about how digital transformation and sustainability can be implemented inclusively within the context of the informal workforce. To clarify this gap, the following is a comparison of the key characteristics between informal and formal maritime labor conditions in table 1.

Table 1 Comparison Between Informal and Formal Maritime Labor Systems

Aspects	Traditional/Informal Conditions	Formal/Permanent Employment
Organizational Structure	Community-based, family-oriented, informal	Hierarchical, regulated, platform-based
Skill Base	Traditional ecological knowledge (TEK)	Formal certification, digital literacy, green skills
Pay System	Profit-sharing, irregular, no guarantees	Standard wages, performance incentives, social security
Compliance	Social norms, local beliefs	Global regulations (IMO/ILO), ISO standards
Technology	Manual tools, small boats	Autonomous ships, IoT, digital systems

Source: created by author (2026)

In addition to technological and institutional pressures, climate change adds another layer of complexity to the management of the maritime workforce. Coastal regions are among the areas most vulnerable to the impacts of climate change, such as sea-level rise, extreme storms, and the degradation of marine ecosystems (Lincoln et al., 2021). These impacts not only disrupt physical infrastructure but also create uncertainty regarding livelihoods and increase occupational risks. From an HRM perspective, these conditions are linked to issues of employee well-being, job insecurity, and workforce resilience (Cooke et al., 2021; Guest, 2017). However, the HRM literature remains limited in explaining how HRM practices can be designed to enhance workforce resilience in the context of high ecological risks. On the other hand, coastal workers possess a unique asset in the form of traditional ecological knowledge (TEK), which has the potential to serve as a source of competitive advantage in the blue economy, yet is often not recognized within formal certification systems. This tension between local knowledge and global standards further underscores the need for a more contextual and adaptive HRM approach.

The comparison in Table 1 shows that the transition to a blue economy involves not only technological change but also profound institutional and social changes. In response to these challenges, approaches such as Digital Human Resource Management (DHRM) and Green Human Resource Management (GHRM) have begun to gain attention in HRM literature (Bondarouk & Brewster, 2016; Yong et al., 2019). However, these two approaches have largely been developed within the context of formal organizations and have not been extensively explored in the context of the informal workforce. By integrating Institutional Theory and Human Capital Theory, this study proposes that the transformation of the maritime workforce requires "bridging mechanisms" capable of connecting formal HRM practices with local realities. The novelty of this study lies in the development of a conceptual framework that explains how DHRM and GHRM can function as adaptive mechanisms to transform the informal coastal workforce toward a more formal, inclusive, and sustainable work system through the interaction between institutional pressures and human capital development.

LITERATURE REVIEW

Human Capital Theory in the Context of Digital Transformation

Human Capital Theory (HCT) traditionally views investment in education, training, and experience as the primary determinants of individual productivity and economic growt (Caire, 1967). In contemporary HRM literature, HCT is no longer understood statically as an accumulation of technical skills, but as a dynamic construct that reflects the workforce's adaptive capacity in responding to technological and institutional changes (Collings et al., 2021; Jiang et al., 2012). In the context of the maritime industry, this evolution has become increasingly relevant as digital transformation has fundamentally altered the nature of work, organizational structures, and workforce competency requirements (Pagoropoulos et al., 2017). Recent scientific mapping studies indicate that human resource development in the maritime sector has shifted from an operational orientation toward a strategic one emphasizing digital literacy, data-driven decision-making, and cross-system collaborative capabilities (Mathias et al., 2026).

Digitalization in the maritime industry–through shipping automation, the use of artificial intelligence (AI), and platform-based system integration–has created a new form of human capital often referred to as digital human capital (Lang et al., 2023). This capital encompasses not only technical skills but also cognitive (problem-solving), social (collaboration), and adaptive (learning agility) competencies. From an HRM perspective, this shift transforms workers' roles from mere task executors to active agents in the organizational transformation process. This aligns with findings in the Q1 literature that the success of digital transformation heavily depends on human capital's readiness to internalize technology and adapt to new work practices (Bondarouk & Brewster, 2016). However, in the context of the informal maritime workforce, the adoption of digital human capital faces structural barriers, such as limited access to formal education, technological infrastructure, and institutionalized training systems.

Furthermore, the relationship between human capital and economic growth in the maritime sector is reciprocal. Empirical studies indicate that improvements in human capital quality can boost productivity in the fisheries and shipping sectors, which in turn contribute to regional and national economic growth (Lang et al., 2023). However, in the era of globalization, this relationship has become more complex due to phenomena such as brain drain and skill mismatch. Skilled maritime workers tend to migrate to global markets offering higher wages, while local sectors experience a shortage of qualified labor (Kartal et al., 2026). Furthermore, the mismatch between workers' skills and industry needs–particularly in the context of digitalization–can reduce the effectiveness of investments in human capital. Therefore, the literature emphasizes the importance of lifelong learning and micro-credentialing as strategies for maintaining the relevance of the workforce's skills in an ever-changing environment.

In the context of the coastal economy, the challenges of human capital development become more complex due to the dominance of the informal sector. Workers in this sector often rely on traditional ecological knowledge (TEK) acquired through experience and interaction with the environment, rather than through formal education (Béné, 2020). Although TEK holds strategic value in the sustainable management of marine resources, formal HRM systems tend not to recognize or integrate this knowledge into competency development frameworks. This creates a gap between local human capital and global standards based on formal certification. Studies in the fisheries sector indicate that integrating TEK with formal training can enhance the effectiveness of resource management and economic sustainability (Kartal et al., 2026). Thus, the development of human capital in the maritime sector requires a hybrid approach that combines local knowledge with digital competencies and sustainability.

The development of platform-based HRM in the digital economy opens new opportunities for integrating the informal workforce into more formal systems (Zhao et al., 2025). Digital platforms can serve as mechanisms to provide access to training, certification, and broader employment opportunities. However, the literature also indicates that platformization can create new forms of job insecurity if not properly regulated (Weber et al., 2021). Therefore, the role of HRM becomes crucial in designing systems that not only enhance productivity but also safeguard workers' well-being. Overall, the evolution of Human Capital Theory in the maritime context reflects a shift from traditional approaches focused on technical skills toward a more holistic and adaptive approach. This transformation demands the integration of digital human capital, local knowledge, and institutional mechanisms that support continuous learning (Mamanazarov et al., 2025). In the context of this research, HCT provides a theoretical foundation for understanding how investment in competencies–both formal and informal–can serve as a key driver in bridging the transformation of the coastal workforce toward a sustainable blue economy (Lakhawat et al., 2026).

Institutional Theory: Logic and Isomorphism in Coastal Areas

Institutional Theory provides an important analytical framework for understanding how organizational practices, including HRM, are shaped by broader environmental pressures, both formal and informal. In the classical literature, organizations operate not only to achieve economic efficiency but also to gain social legitimacy by conforming to prevailing norms, values, and rules (DiMaggio et al., 1983). In the context of HRM, the institutional approach emphasizes that human resource practices cannot be separated from the social, political, and cultural contexts in which organizations operate (Lewis et al., 2019). This is particularly relevant in the maritime sector, especially in coastal regions, where interactions between formal and informal institutions are particularly strong and often conflictual.

In the coastal economy, there is a plurality of institutional logics that shape actor behavior. On one hand, there is the logic of sustainability and professionalism driven by global actors such as the International Maritime Organization and the International Labour Organization, which emphasize decent work standards, safety, and environmental protection (Schulte et al., 2022). On the other hand, there is a local logic rooted in survival needs, community norms, and traditional practices. Studies show that conflicts between these logics can hinder the implementation of formal policies, as they are perceived as incompatible with local realities (Lewis et al., 2019). In the case of small-scale fisheries in Mexico, for example, the success of resource management depends heavily

on the ability to integrate formal rules with local norms through co-management mechanisms (Schulte et al., 2022).

The concept of legitimacy is key to bridging these differences. Institutional legitimacy refers to the perception that an organization's actions or practices are deemed appropriate and acceptable within a social value system (Breakey et al., 2025). In the maritime sector, organizations seeking to adopt formal HRM practices–such as safety standards or labor contract systems–must secure legitimacy not only from regulators but also from local communities (Tang & Zhang, 2021). This process often involves adaptation and negotiation between global and local practices. In the global HRM literature, this phenomenon is known as institutional hybridization, where organizations combine elements from various institutional logics to achieve a balance between efficiency and legitimacy (Brewster et al., 2015).

Furthermore, the process of institutional isomorphism explains how organizations within the same sector tend to become similar through three main mechanisms: coercive, normative, and mimetic. Coercive pressure stems from regulations and policies issued by governments or international institutions; normative pressure stems from professional and educational standards; while mimetic pressure arises when organizations imitate practices deemed successful (DiMaggio et al., 1983). In the maritime industry, these three mechanisms operate simultaneously. For example, IMO regulations drive the adoption of safety standards (coercive), maritime professional associations set competency standards (normative), and companies follow the digitalization practices of industry leaders (mimetic). However, in informal contexts, these pressures are often not fully effective due to institutional capacity constraints and cultural resistance.

The literature indicates that the successful implementation of HRM practices in informal contexts heavily depends on recognition of local institutions. Studies on the perceptions of coastal communities indicate that HRM practices that do not take local values and norms into account tend to be rejected or ignored (Daulay, 2025). Therefore, a top-down approach to policy implementation is often less effective than a participatory approach that involves local communities in the decision-making process. This aligns with the principle of inclusive governance in the blue economy, which emphasizes the importance of stakeholder participation in the management of marine resources (Elston et al., 2024). In the context of maritime labor transformation, Institutional Theory provides important insights into how HRM practices can be adapted to achieve legitimacy in complex environments. The integration of global pressures and local realities requires "bridging" mechanisms that enable the translation of formal practices into informal contexts. Thus, this theory complements Human Capital Theory by explaining the structural and normative dimensions of labor force transformation, and provides a foundation for understanding how change can occur sustainably within a pluralistic system.

Sustainable HRM and Green HRM in the Maritime Sector

Sustainable Human Resource Management (SHRM) has emerged as a response to the limitations of traditional HRM approaches, which are overly focused on short-term performance and economic efficiency alone. In Q1 HRM literature, SHRM is positioned as a strategic approach that integrates economic, social, and environmental objectives into human resource management practices (Karman, 2020; Yong, Yusliza, & Fawehinmi, 2019). The most widely used framework to explain the mechanisms of SHRM is the Ability-Motivation-Opportunity Framework (AMO), which emphasizes that HRM practices must simultaneously enhance ability, motivate employees, and provide opportunities for participation. In this context, SHRM functions not only as a managerial tool but also as an institutional mechanism that shapes organizational behavior toward long-term sustainability.

In the maritime sector, the implementation of SHRM has unique characteristics that differ from those of land-based sectors. The high-risk work environment, dependence on ecological conditions, and the prevalence of informal labor present distinct challenges in applying sustainability principles. Recent studies indicate that SHRM practices in the maritime sector are positively correlated with employee well-being, workplace safety, and organizational resilience against external pressures such as climate change and global economic fluctuations (Johnson et al.,

2026). The three main dimensions of SHRM–decent work, workplace democracy, and career sustainability–are particularly relevant in this context. For example, ensuring safe working conditions is not only about regulatory compliance but also about protection against environmental risks such as extreme storms and maritime accidents. Similarly, worker participation in decision-making can enhance the effectiveness of marine resource management through the integration of local ecological knowledge.

However, the implementation of SHRM in the maritime sector faces structural barriers, particularly in the coastal regions of developing countries. The dominance of the informal sector means that many workers lack access to social protection, formal training, and clear career paths (Béné, 2020). This creates a gap between the normative principles of SHRM and the reality of practice in the field. Studies in the fisheries sector indicate that HRM practices that do not account for local conditions tend to be ineffective and difficult to implement (Uddin et al., 2023). Therefore, the SHRM approach in a maritime context requires adaptation that accounts for the flexibility of work structures, resource constraints, and the dynamics of local communities.

As part of SHRM, Green Human Resource Management (GHRM) specifically focuses on integrating environmental goals into HRM functions. GHRM encompasses various practices such as sustainability-based recruitment, environmental training (green training), performance appraisal systems that incorporate environmental indicators, and incentives for eco-friendly behavior (Yong et al., 2019). In the maritime sector, GHRM plays a strategic role in supporting the transition toward a blue economy, particularly in the context of decarbonization, marine resource conservation, and maritime waste management. Cross-national studies indicate that maritime companies adopting GHRM tend to demonstrate better environmental performance and higher compliance with international regulations (Elston et al., 2024).

The effectiveness of GHRM cannot be separated from global political and institutional dynamics. Pressure from international actors such as the International Maritime Organization and the United Nations has encouraged maritime organizations to adopt more sustainable practices, including in workforce management (Christodoulou & Fernández, 2021). In the case of developed countries such as Norway and Japan, alignment between national policies, corporate strategies, and HRM practices has proven to strengthen GHRM implementation and support sustainable blue economy development (Yong et al., 2019). However, in the context of developing countries, this pressure is often not matched by adequate institutional capacity, thereby creating an implementation gap.

The development of Digital HRM (DHRM) opens opportunities to strengthen the implementation of SHRM and GHRM through the use of digital technology. Platform-based systems can be used to provide environmental training, monitor sustainability performance, and enhance transparency in work practices (Pratiwi et al., 2024). However, the literature also cautions that digitalization can exacerbate inequalities if not accompanied by equitable access to technology (Zhao et al., 2025). Therefore, the integration of SHRM, GHRM, and DHRM must be designed inclusively to reach the informal workforce in coastal areas. Overall, the literature indicates that SHRM and GHRM hold great potential to support the transformation of the maritime sector toward sustainability. However, existing approaches remain dominated by the context of formal organizations and fail to adequately account for the complexities of the informal workforce. In the context of this study, SHRM and GHRM are understood not merely as a set of managerial practices, but as strategic mechanisms capable of bridging the gap between global standards and local realities. Thus, the integration of SHRM and GHRM becomes a key element in constructing a conceptual framework capable of explaining how the transformation of the maritime workforce can proceed in an inclusive, adaptive, and sustainable manner.

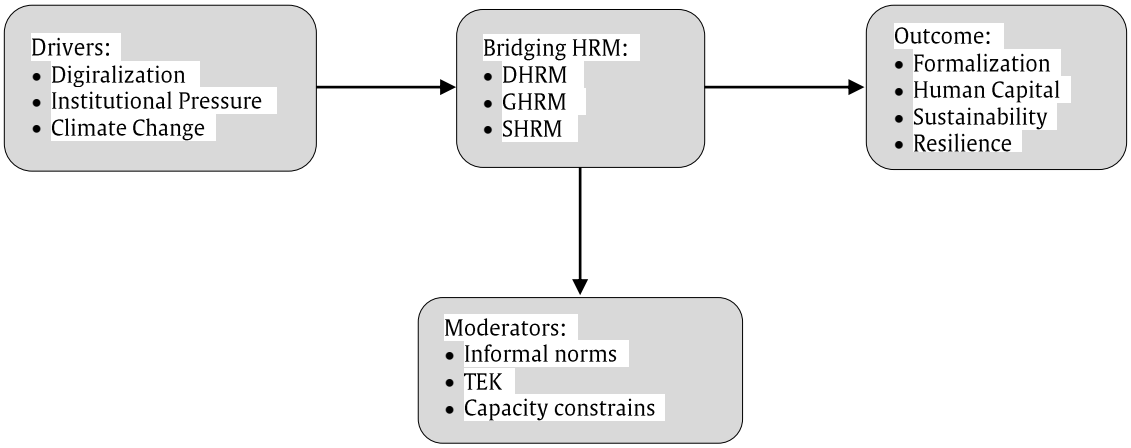
CONCEPTUAL FRAMEWORK DEVELOPMENT

The development of the conceptual framework in this study is based on the integration of three main theoretical perspectives: Human Capital Theory, Institutional Theory, and the Sustainable Human Resource Management (SHRM) approach, which encompasses Green HRM (GHRM) and Digital HRM (DHRM). This integration aims to explain how human resource

management practices can function as an adaptive mechanism in transforming the maritime workforce, particularly from an informal structure toward a more formal, inclusive, and sustainable system within the context of the blue economy.

From the perspective of Human Capital Theory, workforce transformation is understood as the result of investment in the development of skills, knowledge, and competencies relevant to changes in the work environment, particularly in the digital and sustainability eras (Caire, 1967; Lincoln et al., 2021). In the maritime sector, this is reflected in a shift from traditional skills toward digital competencies, adaptive capabilities, and the integration of traditional ecological knowledge (TEK) into modern work systems. Meanwhile, Institutional Theory explains that changes in HRM practices do not occur in a vacuum but are influenced by external pressures such as global regulations, social norms, and demands for legitimacy (DiMaggio et al., 1983). In this context, global actors such as the International Maritime Organization and the United Nations play a crucial role in promoting labor standards, sustainability, and governance in the maritime sector.

Figure 2 Conceptual Framework of Maritime Workforce Transformation through HRM Integration



Source: created by author's (2025)

A literature review indicates that the transformation of the maritime workforce is driven by three main factors: digitalization, institutional pressures, and climate change. Digitalization is reshaping job structures and skill requirements through automation, artificial intelligence, and platform-based systems (Bondarouk & Brewster, 2016). Institutional pressures are driving the adoption of formal standards related to workplace safety, sustainability, and regulatory compliance. Meanwhile, climate change creates environmental uncertainty that directly impacts the sustainability of coastal workers' livelihoods (Lincoln et al., 2021). These three factors simultaneously create a need for the transformation of a labor system that has long been dominated by informal practices.

However, the transition from an informal to a formal system does not occur automatically. Various studies indicate the presence of structural barriers, such as limited access to education, weak institutional capacity, and strong community-based local norms (Béné, 2020). In this context, HRM is no longer viewed merely as an administrative function, but rather as a bridging mechanism capable of connecting macro-level pressures with the micro-level realities of the workforce. Specifically, three domains of HRM are identified as key mechanisms: Digital HRM (DHRM), Green HRM (GHRM), and Sustainable HRM (SHRM), which collectively enable the translation of external pressures into concrete and contextual work practices.

As shown in Figure 2, HRM practices function as mediators linking macro drivers to labor force transformation outcomes. DHRM enables the integration of technology into workforce management, such as digital training, data-driven monitoring systems, and access to the labor market through digital platforms. GHRM integrates environmental sustainability values into HRM

practices, including green-value-based recruitment, environmental training, and performance evaluation systems that consider ecological impacts (Yong et al., 2019). Meanwhile, SHRM provides a broader strategic framework by emphasizing long-term sustainability through capacity building, worker participation, and workforce well-being (Karman, 2020).

The effectiveness of this bridging mechanism is strongly influenced by contextual moderating factors, such as local institutional norms, capacity constraints, and the presence of traditional ecological knowledge (TEK). Local norms can either strengthen or hinder the adoption of formal HRM practices, depending on their alignment with community values. TEK, on the other hand, is a unique form of human capital that has the potential to enhance sustainability when integrated into formal systems. Furthermore, limitations in infrastructure and institutional support are critical factors in the successful implementation of HRM practices in coastal areas.

This conceptual framework identifies four key outcomes of the labor force transformation process: labor force formalization, human capital strengthening, improved sustainability performance, and labor force resilience. Formalization reflects a shift toward a more structured and protected work system, while human capital strengthening relates to enhancing competencies relevant to the digital and green economy. Sustainable performance refers to the alignment between work practices and environmental and social goals, whereas labor resilience indicates the ability to adapt to economic, technological, and ecological changes. This conceptual framework makes a theoretical contribution by positioning HRM as a dynamic mechanism that bridges the gap between global pressures and local realities in the context of the maritime sector. This approach not only extends the application of HRM theory to non-traditional contexts but also offers a new perspective on understanding workforce transformation within an inclusive and sustainable blue economy.

METHODS

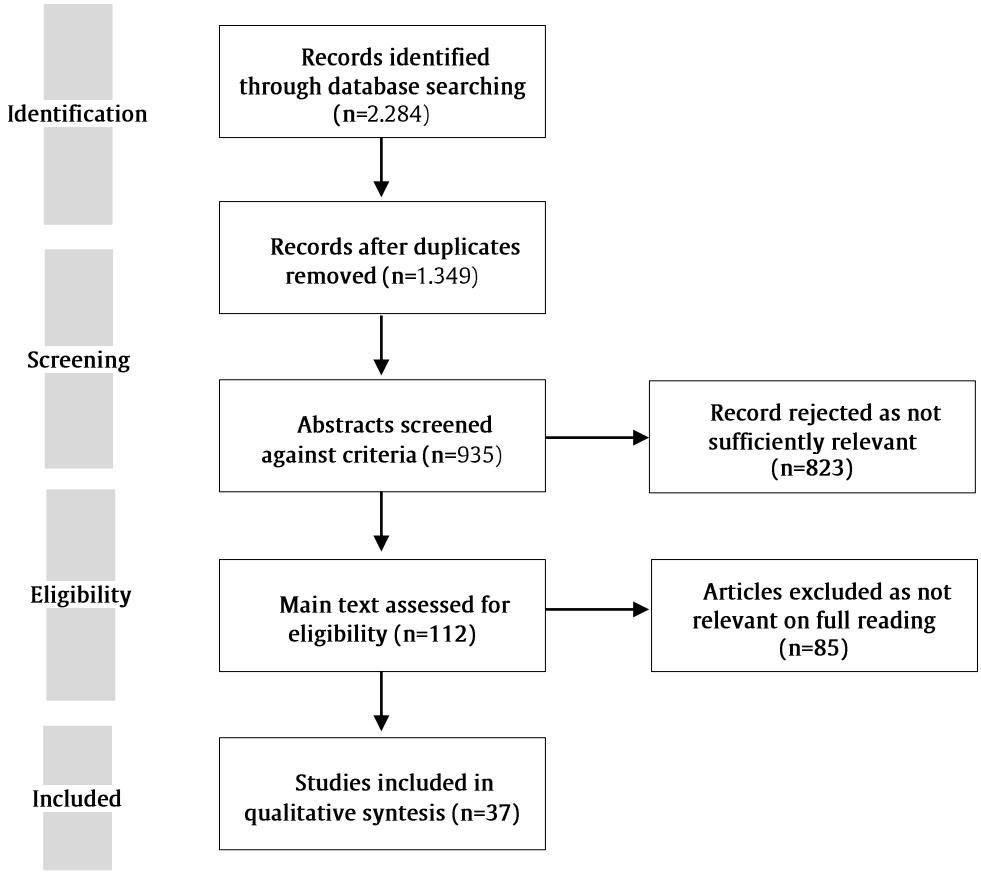
This study employs a Systematic Literature Review (SLR) approach to systematically identify, evaluate, and synthesize relevant literature on the transformation of the maritime workforce within the context of the blue economy and human resource management practices. The SLR approach was chosen for its ability to produce a transparent, structured, and replicable evidence-based synthesis, thereby minimizing the subjective bias often present in narrative literature reviews. The entire research process followed the PRISMA 2020 guidelines (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), which provide a systematic framework for the stages of study identification, screening, evaluation, and inclusion (Page et al., 2021).

A comprehensive literature search was conducted using several high-reputation academic databases, namely Scopus, Web of Science (WoS), and ScienceDirect, which are widely recognized as primary sources of Q1-ranked journal publications in the field of human resource management. To broaden the scope and reduce potential publication bias, an additional search was conducted via ResearchGate to identify relevant studies that may not have been formally indexed. The search strategy was designed using a combination of Boolean operator-based keywords integrating terms related to the blue economy, the maritime sector, and HRM, namely ("blue economy" OR "marine sector" OR "coastal economy") AND ("human resource management" OR "HRM") AND ("workforce transformation" OR "informal labor" OR "labor formalization"). The search timeframe was set from 2018 to 2025 to ensure that the analyzed literature reflects current developments, particularly regarding digitalization, sustainability, and global labor dynamics.

To ensure the quality and relevance of the synthesized studies, this research established strict inclusion and exclusion criteria. The included studies were peer-reviewed journal articles focusing on HRM practices in the maritime sector or coastal economy, whether in the context of workforce transformation, digitalization, or sustainability. Conversely, non-academic publications such as industry reports, popular articles, and opinion pieces were excluded from the analysis to maintain scientific quality consistency. Additionally, studies without a direct connection to human resource management–such as those focusing on technical maritime aspects or marine biology–

were not included in the synthesis. Articles are also limited to English and Indonesian to ensure the accuracy of interpretation and consistency of analysis.

Figure 1 Prisma flow chart visualising the article selection process



Source: created by author (2025)

The literature selection process was conducted in stages according to the PRISMA flowchart, which includes the identification, screening, eligibility, and final inclusion stages. In the initial stage, a total of 2,284 articles were identified from the various databases used. After removing 1,349 duplicate articles, 935 articles remained for the initial screening stage based on titles and abstracts. At this stage, articles irrelevant to the research focus were eliminated, resulting in 112 articles meeting the criteria for full-text evaluation. Subsequently, the eligibility assessment process was conducted by considering the relevance of the topic, methodological strength, and theoretical contribution of each study. The final outcome of this selection process was 37 core articles used in the literature synthesis. To ensure transparency and replicability of the selection process, all these stages are visualized in Figure 1 (PRISMA Flow Diagram).

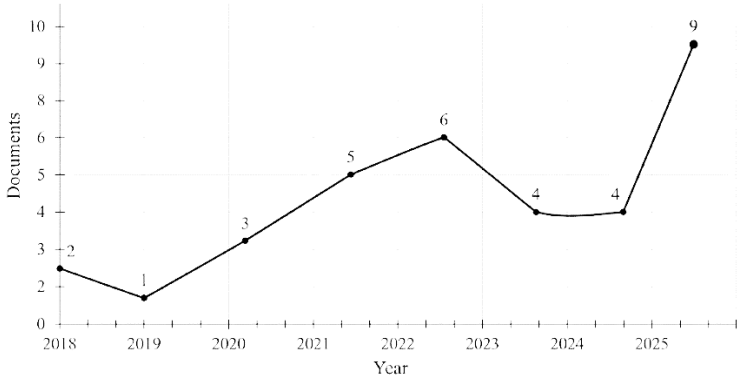
In the analysis stage, this study employed a thematic synthesis approach to integrate findings from various studies with diverse methodological designs. The analysis process was conducted iteratively through the identification of key concepts, theme clustering, and thematic integration to produce a comprehensive understanding of the phenomenon under study. This approach enables the study not only to describe trends in the literature but also to identify patterns of relationships among concepts that form the basis for the development of theoretical contributions. Thus, the methodology used in this study not only meets the standards of academic rigor in systematic literature reviews but also supports the research objective of producing an analytical synthesis oriented toward theoretical development in the field of maritime human resource management.

RESULT

Publication Trend of Maritime HRM Research

The transformation of the maritime industry toward the era of digitalization and the blue economy has triggered a paradigm shift in human resource management. To understand these dynamics, the first step taken was to map the intensity of research during the observation period. This analysis of publication trends serves as an initial indicator to measure the extent to which maritime HRM issues have been accepted as strategic topics in the global literature. The visualization in Figure 1 illustrates the fluctuations and growth in the number of synthesized articles, reflecting academics' responses to real-world challenges in the field–ranging from traditional workplace safety issues to the integration of green technology. This growth map forms the foundation for an in-depth analysis of policy directions and research priorities across various countries, which will be discussed in the following section.

Figure 2 Publication Trend of HRM Research in the Maritime Sector (2018–2025)



Source: created by author from scopus and WOS data (2025)

Based on the results of bibliometric analysis, the trend in HRM research publications in the maritime sector has shown a significant increase in recent years. In the early phase of the observation period, the number of publications was still relatively low and tended to fluctuate. This indicates that maritime HRM issues had not previously been a primary focus in studies of maritime management or economics. Research during the early period primarily addressed operational aspects of shipping, workplace safety, and the management of conventional labor in the fisheries and maritime transport sectors.

However, since 2020, there has been a stronger academic focus on maritime HRM themes. This surge is driven by several key factors. First, the acceleration of maritime industry digitalization due to Industry 4.0 technological advancements has prompted maritime organizations to adopt digital workforce management systems such as Digital Human Resource Management (DHRM), port automation, and the use of artificial intelligence in operational processes. Second, the COVID-19 pandemic has exposed the vulnerability of the global maritime workforce, particularly informal workers and seafarers, thereby creating a need for more adaptive and sustainable HRM systems. Third, the growing global agenda regarding the blue economy and sustainability has further expanded the research focus on the relationship between HRM, environmental sustainability, and marine resource governance.

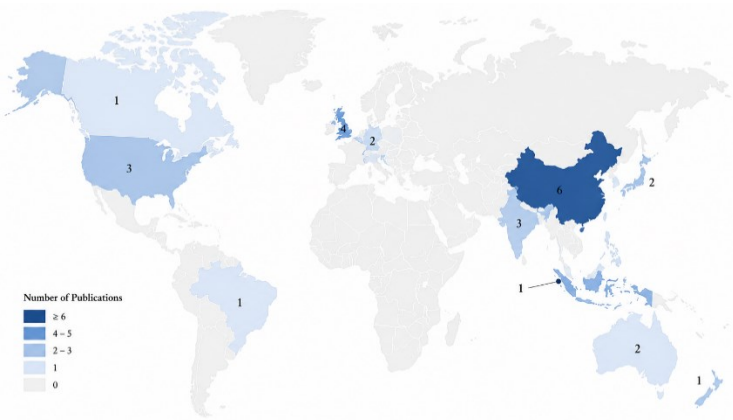
The most significant increase in publications occurred during the 2023–2025 period, indicating that maritime HRM is beginning to evolve into a multidisciplinary field of study that integrates technological, environmental, social, and institutional aspects. During this period, research no longer focuses solely on labor administration but also encompasses digital competency transformation, green HRM, workforce resilience, sustainability management, and the strengthening of coastal community capacity. This indicates that HRM in the maritime sector is increasingly viewed as a strategic instrument to support the sustainability of the global maritime industry. In addition to showing an increase in the quantity of publications, this trend also illustrates a shift in research orientation from traditional approaches toward more adaptive and human-

centered approaches. Recent research has begun to position maritime workers not merely as factors of production, but as key actors in the sustainable transformation of the maritime industry. Thus, this publication growth map serves as a crucial foundation for understanding the evolving direction of maritime HRM research while identifying opportunities for a future research agenda that integrates technology, sustainability, and the well-being of coastal workers.

Geographic Distribution

After examining the trend in the number of publications over time, the subsequent analysis focuses on the geographical distribution of HRM research in the maritime sector. This approach is crucial for understanding how academic attention to maritime labor issues is distributed globally and for identifying countries that serve as hubs for research development. In addition to illustrating the intensity of scientific contributions, geographic mapping also helps explain differences in research focus across regions based on the characteristics of the maritime industry, levels of digitalization, and the orientation of sustainability policies in each country (Aprizal et al., 2025).

Figure 3 Geographic Distribution of Maritime HRM Research



Source: Processed by authors (2025).

Figure 2 shows that maritime HRM research is concentrated in countries with strong maritime economic activity and high technological capacity. The Asian region is the dominant hub for publications, particularly China, Japan, Singapore, and Indonesia. This dominance indicates that the transformation of the maritime sector in Asia is occurring not only in the industrial and maritime trade sectors but also in technology-based and sustainable human resource management (Mathias et al., 2026). These countries have extensively developed research on digital human resource management (DHRM), workforce resilience, green shipping, and the development of technology-based maritime workforce competencies (Pace et al., 2023).

On the other hand, European countries such as the United Kingdom and Germany demonstrate a stronger research focus on sustainability management, maritime governance, and green HRM. Research from this region generally positions HRM as part of the maritime industry's sustainability strategy, particularly in addressing global regulatory pressures regarding carbon emissions, workplace safety, and the transition toward the blue economy (Jabbour et al., 2008). Meanwhile, contributions from developing countries such as India, Bangladesh, and Indonesia more frequently address issues of informal labor, small-scale fisheries, social protection for fishermen, and institutional challenges in coastal communities (Chen, 2012; Chuenpagdee & Jentoft, 2018).

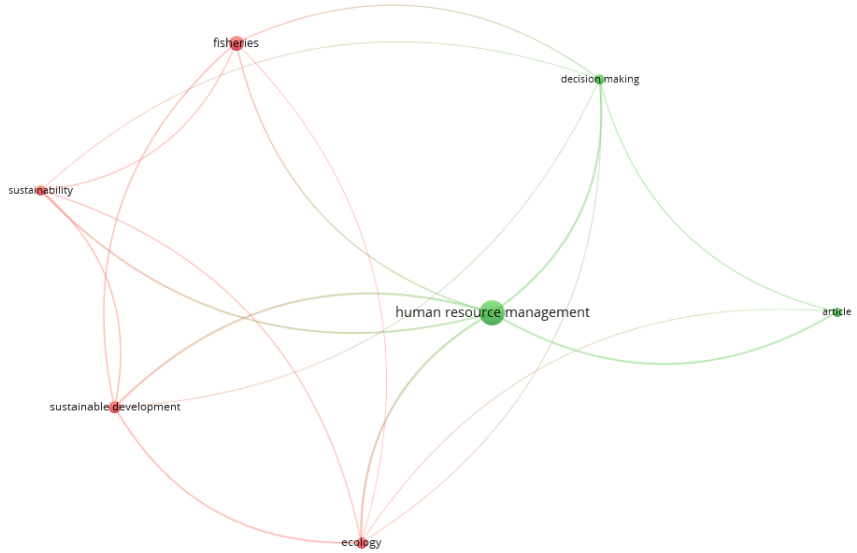
This geographical distribution indicates that maritime HRM research is evolving in a multidimensional manner in accordance with the economic and social contexts of each country. Developed countries tend to focus on technological innovation and organizational efficiency, while developing countries place greater emphasis on labor formalization, the empowerment of coastal communities, and social sustainability (Pomeroy & Andrew, 2011; Qiu et al., 2026). Thus, the geographical map of this research indicates that maritime HRM has evolved into a global field of

study that integrates aspects of technology, sustainability, and cross-regional labor transformation (Elston et al., 2024).

Bibliometric Mapping and VOSviewer Analysis

To further explore the results of the publication mapping and the geographical distribution of research, this study subsequently employs VOSviewer-based bibliometric analysis to identify conceptual structures, relationships between themes, and trends in Human Resource Management (HRM) research within the maritime sector. Bibliometric analysis is used to map keyword co-occurrence so that dominant themes, conceptual relationships, and emerging research areas in the maritime HRM literature can be identified (Donthu et al., 2021). This approach is important because the transformation of the maritime workforce is not only related to organizational aspects but is also connected to issues of sustainability, fisheries governance, and institutional changes within the blue economy (Jia et al., 2018).

Figure 4 Network Visualization of Maritime HRM Research Using VOSviewer



Source: Processed by authors using VOSviewer based on Scopus and Web of Science data (2025).

The network visualization results show that maritime HRM research is divided into two main clusters. The first cluster is dominated by the keywords "fisheries," "sustainability," "sustainable development," and "ecology." This cluster indicates that the majority of maritime research remains focused on environmental sustainability issues, coastal resource management, and marine ecological conservation (Chuenpagdee & Jentoft, 2018; Pomeroy & Andrew, 2011). Meanwhile, the second cluster consists of the keywords "human resource management," "decision making," and "article," indicating the emerging development of managerial and institutional perspectives in maritime research. The central position of "human resource management" within the network indicates that HRM is beginning to function as a bridge between workforce transformation, organizational governance, and the maritime sector's sustainability agenda (Jabbour et al., 2008).

The visualization also shows that the keyword "human resource management" has a direct connection to "sustainable development," indicating that HRM is no longer understood merely as an organizational administrative function but as a strategic mechanism to support the sustainability of the maritime industry and the blue economy (Pace et al., 2023). Furthermore, the connection between "fisheries" and "ecology" indicates that the transformation of the maritime workforce is increasingly influenced by issues of environmental conservation, marine resource management, and the resilience of coastal communities (Ratner et al., 2012). The emergence of the keyword "decision making" also reinforces the institutional dimension in this study. This suggests that

organizational decision-making, workforce governance, and co-management approaches are becoming an important part of modern maritime workforce transformation (Bennett et al., 2019). Nevertheless, the visualization results also show that themes such as "digital HRM," "green HRM," "informal labor," and "workforce transformation" still have relatively limited connections within the current research network. These findings suggest that the integration of digital transformation, the formalization of coastal labor, and Sustainable HRM remains an emerging research area that has not yet been deeply explored (Stone & Deadrick, 2015).

Overall, the results of the bibliometric analysis indicate that maritime HRM research is shifting from an approach focused on ecology and fisheries toward a more multidisciplinary approach that integrates aspects of sustainability, organizational governance, and workforce transformation. This shift reinforces HRM's role as a bridging mechanism connecting maritime sustainability, industrial digitalization, and inclusive coastal economic development.

Digital Human Resource Management (DHRM) as a Catalyst for Formalization

The literature synthesis reveals that Digital Human Resource Management (DHRM) has emerged as one of the most critical mechanisms of transformation in the modern maritime sector. Digitalization is no longer understood merely as an administrative change in human resource management but also as a strategic instrument to enhance transparency, organizational legitimacy, and the formalization of the maritime workforce–which was previously dominated by informal and community-based practices (Stone & Deadrick, 2015). In the context of the blue economy, the digital transformation of HRM is becoming increasingly critical as the maritime sector faces simultaneous pressures from industrial automation, environmental sustainability, and shifts in the global labor force structure (Chowdhury et al., 2023). In the Riau Islands (Kepri) region of Indonesia, the implementation of DHRM has been identified across various key HRM activities, including digital recruitment, online training, digital organizational communication, workforce data management, digital performance management, and the use of artificial intelligence (AI) and augmented reality (AR) in the development of maritime workers' competencies (Pratiwi et al., 2024). The use of these technologies demonstrates that maritime organizations are beginning to move away from traditional, manual, document-based HRM systems toward data-driven systems and digital platforms that are more adaptable to global industry changes (Bondarouk & Brewster, 2016).

This digital transformation enables maritime organizations to standardize workforce information more systematically through Human Resource Information Systems (HRIS), analytical dashboards, and real-time performance monitoring. In the shipping and maritime logistics industries, the use of digital platforms has proven to enhance operational efficiency, accelerate decision-making, and strengthen oversight of operational staff safety (Marler & Boudreau, 2017). Furthermore, digitalization also promotes greater organizational accountability because all labor processes are electronically documented and easier to audit in accordance with international maritime sector standards (Ren et al., 2018). In the context of the informal workforce in coastal areas, DHRM also serves as a mechanism for formalizing employment. Digital platforms enable workers to obtain formal employment status through electronic registration, digital contracts, app-based payment systems, and documentation of skill certifications. The literature indicates that the use of digital labor platforms can facilitate workers' transition from the informal sector to the formal labor market due to standardized services, identity verification, and enhanced connectivity with the formal labor market (Stewart & Stanford, 2017). This finding is highly relevant in the context of the small-scale fisheries sector and the coastal economy, which have long been dominated by informal, trust-based employment relationships and minimal social protection (Chuenpagdee & Jentoft, 2018).

The study's results indicate that the implementation of DHRM in the maritime sector still faces various structural barriers. One of the main challenges is the low digital literacy of the workforce, particularly among coastal communities and traditional fishermen who are not yet accustomed to data-driven technological systems (Deursen & Dijk, 2019). Additionally, limitations in digital infrastructure in coastal areas, such as internet access and technological facilities, further slow down the process of digital HRM transformation in developing countries (Jović et al., 2022). Another challenge identified is the shortage of professionals with the necessary expertise in

managing digital HR systems, resulting in technology implementation that often falls short of optimal performance at the operational level of maritime organizations (Theotokas et al., 2024). The synthesis results also reveal a digital transformation gap between the seagoing workforce and the shore-based workforce. Most digital investments remain focused on seafarers and shipping operations, while administrative staff and coastal communities have not yet gained equitable access to digital HR development programs (Elston et al., 2024). This situation has the potential to create a dual workforce within the maritime sector, where some workers experience increased digital capabilities and economic access, while others remain in the informal labor system and are vulnerable to technological exclusion (Bennett et al., 2019).

In addition to serving as an instrument of organizational efficiency, DHRM is also strongly linked to the agendas of Sustainable HRM and Green HRM. The use of HR analytics, digital training platforms, and data-driven monitoring systems enables maritime organizations to integrate workforce efficiency with environmental sustainability goals such as carbon emission reduction, energy efficiency, and oversight of green operational practices (Jabbour et al., 2008). The literature on Green HRM indicates that the digitalization of human resources can enhance employees' environmental awareness while supporting the development of an organizational culture oriented toward sustainability (Pace et al., 2023). From an institutional perspective, DHRM also strengthens the legitimacy of maritime organizations amid growing global pressure for transparency, workplace safety, and sustainability in the maritime industry. The implementation of digital HR systems helps organizations meet international standards regarding labor governance, maritime certification, and worker protection established by the International Maritime Organization (IMO) and the International Labour Organization (ILO) (Brewster et al., 2016). Thus, DHRM functions not only as an administrative tool but also as an institutional mechanism to strengthen the competitiveness of maritime organizations in an increasingly digitized global economy.

Overall, the research findings indicate that DHRM serves as a bridging mechanism connecting technological transformation with the formalization of the maritime workforce. Digitalization accelerates the integration of informal workers into the formal economic system, enhances organizational transparency, strengthens institutional legitimacy, and supports the maritime sector's sustainability agenda in the era of the global blue economy (Chowdhury et al., 2023).

Transformation of Roles and Redesign of Maritime Jobs

Research findings indicate that the transformation of the maritime workforce is occurring not only through the digitalization of HRM but also through job redesign and changes in workforce competency structures. In recent years, the maritime industry has shifted from traditional, physically demanding job models toward roles that are more integrated with digital technology, environmental sustainability, and flexible job competencies (Sharma, 2023). This shift is particularly evident in the port, maritime logistics, shipping, and industrial fisheries sectors, which have begun adopting automation and data-driven operational systems (Jia et al., 2018).

A study by the Maritime and Port Authority of Singapore indicates that the "Job Redesign" program successfully enhanced organizational productivity and the appeal of maritime jobs by integrating automation technology, digital monitoring, and green operations into port and shipping operations (Caesar, 2023; Osman et al., 2022). Systems based on the Internet of Things (IoT), artificial intelligence (AI), robotics, and analytical dashboards are now beginning to replace various manual activities that previously dominated the maritime sector (Ivanov et al., 2019). Port terminal automation, for example, has been shown to improve workplace safety, reduce human error, and lower the physical workload of operational staff (Heilig et al., 2017). In addition to automation, maritime organizations are also beginning to develop more flexible career paths through reskilling and upskilling programs. This strategy enables seafarers to transition to shore-based jobs without losing the experience and competencies they have acquired. The literature indicates that career path transformation is crucial because younger generations tend to avoid traditional maritime jobs, which are perceived as high-risk, involving significant work pressure, and requiring long periods at sea. Consequently, maritime organizations are beginning to build more adaptive, digital, and work-

life balance-oriented job models to enhance the retention of young talent within the maritime industry.

Job transformation is also marked by the emergence of new competency requirements in the maritime sector. Whereas previously maritime workers were only required to possess technical sailing and navigation skills, today's workforce must also possess digital skills, data analysis capabilities, cybersecurity awareness, environmental knowledge, and technology-based decision-making skills (Caesar, 2023; Theotokas et al., 2024). This shift indicates that maritime human capital has evolved from vocational human capital toward a more complex and multidimensional digital and sustainable human capital (Caire, 1967).

The research findings also show that the transformation of maritime jobs is closely linked to the global sustainability agenda. Maritime organizations are beginning to incorporate green skills and environmental competencies into workforce development to support the decarbonization targets of the maritime industry and the blue economy (Jabbour & Sousa, 2016). Digital simulation-based training, the use of virtual reality (VR), and emissions monitoring systems are becoming an important part of the redesign of modern maritime sector jobs (Pace et al., 2023). However, the transformation of work has not yet occurred evenly across countries and organizations. Developed countries such as Singapore, Norway, and Japan have higher investment capacity in technology and digital infrastructure, allowing them to adopt job redesign more quickly than developing countries (Bennett et al., 2019). Conversely, small organizations and coastal communities in developing countries still face limitations in technology access, the quality of workforce education, and government policy support for maritime industry transformation (Chuenpagdee & Jentoft, 2018).

In addition to the technology gap, research also indicates the potential for workforce displacement due to automation. Some manual jobs in ports and shipping are beginning to decline as the use of automated systems and industrial robotics increases (Frey & Osborne, 2017). Therefore, HRM plays a strategic role in ensuring that technological transformation does not lead to social exclusion, but rather drives workforce capacity building through continuous training and the development of new competencies.

Overall, job redesign in the maritime sector can be understood as part of an organizational transformation strategy to enhance productivity, sustainability, and the attractiveness of the maritime industry in the digital age. This transformation demonstrates that HRM no longer functions merely as a workforce administrator but as a strategic actor in shaping an adaptive, sustainable maritime workforce ready to face the challenges of the global blue economy.

DISCUSSION

Bridging Strategic and Institutional Perspectives in Maritime HRM

The research findings indicate that the transformation of the maritime workforce cannot be understood solely through the internal managerial perspective of organizations, but must also be viewed in the context of institutional pressures, global regulations, and the socioeconomic dynamics of coastal regions. Bibliometric findings reveal that the keyword "human resource management" has a direct connection with "sustainable development," "fisheries," and "decision making," indicating that HRM in the maritime sector is evolving into a strategic mechanism that links organizational interests with global sustainability demands (Donthu et al., 2021). This reinforces the Institutional Theory's argument that maritime organizations do not operate independently but are embedded within regulatory systems, social norms, and international pressures that shape workforce management practices.

In the context of the coastal economy, the integration of formal and informal HRM systems poses a major challenge for labor transformation. Most coastal and small-scale fishing communities still operate within community-based work structures, kinship ties, and informal social mechanisms that are difficult to directly align with modern HRM models based on regulation and digitalization (Chuenpagdee & Jentoft, 2018). Therefore, maritime HRM requires a more flexible and

contextual approach to bridge the gap between the needs of modern organizations and the social realities of the coastal workforce (Bennett et al., 2019).

Research findings also indicate that Digital Human Resource Management (DHRM) serves as a bridging mechanism in the formalization process of the maritime workforce. The implementation of digital platforms, electronic workforce registration, and HR analytics-based data management systems enables organizations to enhance transparency, accountability, and institutional legitimacy in workforce management (Bondarouk & Brewster, 2016). From an Institutional Theory perspective, this digitalization can be understood as a form of institutional adaptation, where maritime organizations adjust their internal practices in response to global pressures regarding sustainability, workplace safety, and maritime industry governance (Brewster et al., 2016).

Furthermore, this study found that institutional transformation in the maritime sector does not occur linearly. Many coastal organizations still experience institutional drift—a condition where formal regulations fail to keep pace with rapid changes in technology and the dynamics of the maritime workforce (Theotokas et al., 2024). As a result, informal workers often find themselves caught between two systems: the demands of modern industrial formalities and the economic realities of coastal communities that remain traditional. These conditions explain why various modern HRM practices, including Green HRM and digital workforce management, have not yet been fully and uniformly implemented in the maritime sectors of developing countries (Jabbour & Sousa, 2016).

From a strategic perspective, research findings indicate that maritime organizations are shifting from a control-based HRM model toward a commitment- and collaboration-based model. This transformation is evident in the increasing use of digital work platforms, flexible work systems, and reskilling and upskilling programs to enhance the workforce's adaptability to technological changes (Stone et al., 2015). This shift indicates that maritime workers are no longer viewed merely as operational resources but as strategic human capital that determines organizational sustainability in the era of the global blue economy (Caire, 1967).

Leadership, Organizational Culture, and Workforce Sustainability

The results of the literature review indicate that the success of the maritime workforce transformation is significantly influenced by organizational leadership and a work culture that is adaptable to technological change and environmental sustainability. In the maritime industry, which is characterized by high risk, significant work pressure, and cross-border operational complexity, leadership plays a crucial role in fostering an organizational culture that supports innovation, workplace safety, and workforce well-being.

This study found that shared leadership and collaborative governance approaches are increasingly relevant in the context of modern maritime transformation. These approaches enable organizations to involve workers in decision-making, operational innovation, and the development of organizational sustainability practices (Bennett et al., 2019). These findings align with bibliometric results indicating the emergence of the keyword "decision making" as a key component within the maritime HRM network. This suggests that workforce transformation is not solely about technology but also involves organizational governance and worker participation in the change process (Donthu et al., 2021).

In addition to leadership aspects, this study also indicates that employee well-being is a strategic issue in modern maritime HRM. The high-pressure maritime work environment often leads to work-related stress, physical exhaustion, and burnout, particularly among workers in the shipping and fishing industries (Romsbotn et al., 2022). Therefore, sustainable HRM practices focused on workplace safety, mental health, and work-life balance are becoming increasingly important in supporting the productivity and sustainability of the maritime workforce (Karman, 2020). Organizational cultural transformation is also evident through the increasing integration of sustainability values into HRM practices. Maritime organizations are beginning to develop a work culture that supports energy efficiency, carbon emission reduction, and environmental responsibility through Green HRM programs and sustainability awareness training (Yong et al.,

2019). Thus, organizational culture is no longer solely focused on operational efficiency but also on social and ecological sustainability within the global blue economy (Elston et al., 2024; Pace et al., 2023).

Integration of the Sustainable Development Goals (SDGs) into Maritime HRM

Research findings indicate that the integration of the Sustainable Development Goals (SDGs) into maritime HRM practices is increasingly becoming a strategic necessity for organizations and governments. In the context of the blue economy, HRM contributes directly to the achievement of SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation and Infrastructure), SDG 12 (Responsible Consumption and Production), and SDG 14 (Life Below Water). Contributions to SDG 8 are evident through the implementation of workplace safety practices, the development of digital competencies, and the enhancement of social protection for maritime workers and small-scale fishermen (Nisa, 2022). Meanwhile, contributions to SDG 9 are reflected in increased investment in digital workforce transformation, Industry 4.0 training, and the development of technological competencies within the shipping and maritime logistics sectors (Sharma, 2023).

This study also indicates that Green HRM plays a crucial role in supporting SDG 12 and SDG 14 through the integration of sustainability practices into workforce management systems. Training on waste reduction, energy efficiency, marine conservation, and emissions monitoring forms part of HRM strategies to support the operational sustainability of the maritime industry (Jabbour et al., 2008). In the fisheries sector, this approach also supports the protection of fish stocks and the sustainability of coastal ecosystems by raising environmental awareness among workers and fishing communities (Ratner et al., 2012).

Nevertheless, research findings indicate that the integration of the SDGs into maritime HRM still faces various obstacles, particularly in developing countries. The high costs of digital and green skills training, limited technological infrastructure, and inconsistent regulations across regions pose major challenges to the implementation of Sustainable HRM in the coastal sector (Bennett et al., 2019). Furthermore, small businesses and traditional fishing communities often have limited financial and institutional capacity to adopt sustainability-based HRM practices (Chuenpagdee & Jentoft, 2018).

Overall, this study demonstrates that HRM plays a strategic role in bridging digital transformation, environmental sustainability, and the formalization of the maritime workforce. Therefore, the future development of maritime HRM requires a multidisciplinary approach that integrates technological, institutional, social, and ecological aspects to support inclusive and sustainable blue economy development.

CONCLUSION

This study demonstrates that the transformation of the maritime workforce in the blue economy era is influenced by the integration of digitalization, sustainability, and institutional change. The results of a systematic literature review show that Human Resource Management (HRM) has evolved from an administrative function into a strategic mechanism that bridges the transition of the informal workforce toward a more formal, digitized, and sustainable maritime labor system. The research findings confirm that Digital Human Resource Management (DHRM), Sustainable HRM, and Green HRM play a crucial role in enhancing labor transparency, developing digital competencies, ensuring workplace safety, and integrating sustainability into the maritime sector. Additionally, job redesign, reskilling, and upskilling are key strategies for building a maritime workforce that is adaptable to automation and the demands of a technology-driven industry.

Bibliometric analysis indicates that maritime HRM research remains dominated by the themes of fisheries and sustainability, while issues related to digital HRM, the transition of informal labor, and workforce transformation are still relatively limited. This situation underscores the novelty of this study in positioning HRM as a bridging mechanism between digital transformation, institutional governance, and sustainable coastal economic development. Practically, this study emphasizes that maritime organizations and policymakers need to develop more inclusive, contextual, and sustainability-based HRM models to support the sustainability of the global blue

economy. Further research is recommended to expand empirical studies on the implementation of digital HRM, Green HRM, and workforce resilience in coastal and small-scale fishing communities in developing countries.

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