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STRATEGY OF HUMAN RESOURCE DEVELOPMENT IN THE SHIPPING AND LOGISTICS SECTOR TO FACE INDUSTRIAL ERA 4.0

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ABSTRACT

The Industry 4.0 era, driven by Artificial Intelligence (AI), the Internet of Things (IoT), automation, and big data analytics, has significantly transformed the shipping and logistics sector. While digitalization improves efficiency, it also presents challenges in workforce adaptation. According to a 2023 World Economic Forum report, 50% of employees will require reskilling by 2025, yet only 30% of logistics companies have fully embraced digital workforce transformation strategies. This research analyzes human resource (HR) development strategies to equip workers with skills aligned with Industry 4.0 demands. This study uses a qualitative approach, utilizing peer-reviewed journals, industry reports, and government publications. Data analysis follows Miles and Huberman's interactive model, consisting of data reduction, data presentation, and conclusion drawing, ensuring structured and comprehensive insights. Findings indicate that HR development strategies in the shipping and logistics sector require three key approaches: (1) Enhancing digital competencies through technology training and online learning platforms; (2) Developing adaptive skills, such as problem-solving, critical thinking, and agility, to navigate technological shifts; and (3) Implementing HR technology for recruitment, training, and performance management. Additionally, collaboration with industries and policymakers is essential to accelerate workforce digital transformation. By applying these strategies, the shipping and logistics sector can build a competent, agile workforce, ensuring long-term sustainability and competitiveness in the Industry 4.0 landscape.

Keywords: *human resources; industry 4.0; logistics sector; shipping sector*

INTRODUCTION

The Industry 4.0 era has brought significant changes in various sectors; digital transformation driven by the adoption of technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), Big Data, and automation has fundamentally changed the way the industry works (Xing & Xiaofeng, 2021). Organizations that do not adopt digital technologies risk falling behind regarding operational efficiency, productivity, and customer satisfaction. The application of digital technology is important in improving industry competitiveness and performance in the Industry 4.0 era (Nugroho et al., 2024). Adopting these technologies has become essential in the shipping and logistics sector to meet increasing global trade demands, streamline distribution processes, and improve operational efficiency. However, despite these advancements, many companies face challenges in workforce readiness, as the rapid pace of technological innovation requires new digital competencies and adaptive skills. Johari et al. (2019) report highlights that 50% of employees worldwide will require reskilling by 2025, yet only 30% of logistics companies have fully embraced digital workforce transformation strategies. This skills gap poses a critical issue for organizations striving to remain competitive in an increasingly digitized economy. Addressing this gap requires a structured human resource (HR) development strategy that aligns workforce capabilities with evolving industry demands. This study aims to explore HR strategies that support the digital adaptation of employees, ensuring that the shipping and logistics sector remains resilient in the face of technological disruption.

One of the key challenges facing companies in this sector is improving operational efficiency, ensuring on-time delivery, and optimizing supply chains to compete in the global market (Chen et al., 2024; Kajwang, 2022; Meng et al., 2023; Sierra & Suárez-Collado, 2021). In addition, changing consumption patterns and increasing market demands further complicate operational processes. Demand for more personalized products, shorter innovation cycles, and customer expectations for faster and higher-quality services are shortening product lifetimes (Akdogan et al., 2021; Besley & Persson, 2023; Neilson & Wang, 2019). These conditions are exacerbated by an expanding supply chain,

smaller shipment sizes, and high market fluctuations, making logistics management even more complex (Malagón-Suárez & Orjuela-Castro, 2023). In the face of these challenges, using technology is an effective solution.

However, rapid technological developments in the shipping and logistics industry present opportunities and challenges, particularly in human resource (HR) management (Azzahra et al., 2024). The sector is increasingly dependent on digital tools, yet many workers lack the necessary skills to operate automated systems, AI-driven logistics management platforms, and data analytics software. A study by Riani (Savandha & Fitriyani, 2025) highlights that over 60% of logistics employees struggle to meet digital competency requirements, making it difficult to adapt to automation and data-driven decision-making processes. The transition towards smart logistics, cloud-based tracking, and AI-driven optimization requires technical proficiency and soft skills such as critical thinking, problem-solving, and adaptability (Alqudah et al., 2022). However, traditional workforce training models in the logistics sector often fail to keep pace with these changes, resulting in a widening skills gap. Additionally, many small and medium-sized enterprises (SMEs) struggle implementing digital workforce development programs due to limited resources and resistance to change (Pertiwi, 2023). Without effective HR development strategies, companies risk reduced efficiency, lower competitiveness, and workforce obsolescence in the face of Industry 4.0. This study, therefore, seeks to analyze strategic HR development approaches that can bridge this skills gap and ensure that the workforce in the shipping and logistics sector is future-ready.

Previous research conducted by Savandha (2024) analyzed HR development strategies in the Industry 4.0 era through a prospective analysis approach at Bappedalitbang. The analysis results, which combine theory and input from various stakeholders, show that three main factors must be considered in HR development. Two factors come from the theoretical dimension: managing technology integration in the workplace and building an agile and personalized learning culture. Meanwhile, the third factor comes from the stakeholder dimension: implementing modern e-learning. Implementing these three factors is considered important to ensure sustainable HR development in Bappedalitbang Riau Province in the era of Industrial Revolution 4.0.

Despite these contributions, urgent challenges remain unaddressed. The logistics sector is at a turning point, with global supply chains becoming increasingly digitized. According to the World Economic Forum (2023), 50% of employees will require reskilling by 2025, yet most logistics firms lack structured HR development plans to keep pace with this transformation. Companies risk a widening skills gap, workforce inefficiencies, and declining competitiveness without immediate action. This study aims to fill this gap by providing a comprehensive HR development framework tailored to the unique digital transformation needs of the shipping and logistics sector. This research contributes to ensuring long-term industry resilience and sustainability by critically analyzing workforce challenges and proposing adaptive strategies.

Another study by Marisya et al. (2023) highlighted HR development strategies using interview and observation techniques in the Industrial Revolution 4.0 era. Based on the study's results, the strategies used include competency testing, external and internal training, collaboration and cooperation, application of technology, and awarding. These measures aim to improve the quality of the workforce to be better prepared to face the challenges of digitization and automation in the world of work. Based on previous research, innovative measures are needed to improve workforce competencies, especially in the face of changes in the shipping and logistics sector. Technological advancements in the Industry 4.0 era demand a workforce that not only has technical skills but is also able to adapt to digital transformation. Therefore, the right strategy is needed so that the workforce in this sector can face challenges while taking advantage of the existing opportunities.

This research analyzes human resource (HR) development strategies in the shipping and logistics sector to better prepare for the industrial era 4.0. From understanding the problems faced by the current workforce and formulating effective solutions, it is hoped that the results of this research can contribute to developing policies and best practices. The right strategy will improve the workforce's competitiveness and strengthen the shipping and logistics industry in Indonesia to be more competitive globally. The research is also expected to be a reference for stakeholders in designing innovative strategies to improve the workforce's quality in the shipping and logistics sector so that human resources can continue to develop and adapt to the changes that occur in the industrial revolution 4.0.

METHOD

The research method used in this study is a qualitative method. Qualitative research aims to deeply understand social phenomena, culture, or human behavior through non-numerical data. This method helps researchers investigate, discover, describe, and explain the qualities or idiosyncrasies of social influences that quantitative approaches cannot explain (Muzari et al., 2022). The qualitative approach was chosen due to its flexibility in adapting the analysis to policy changes or the latest technological developments in the sector under study. In addition, this method helps in-depth exploration of the challenges, opportunities, and strategies used by industry players in developing human resources in the shipping and logistics sector. The data collection technique was conducted through a literature study, which is a method used to collect data and information by reviewing various relevant written sources (Mezmir, 2020). Some of the documents used include books written by trusted authors or academics, accredited scientific journals, and student research results in various forms, such as theses, dissertations, and practicum reports.

This research employs a qualitative approach, which is well-suited for exploring complex social phenomena such as human resource (HR) development in the logistics sector. A literature study was conducted to gather relevant data, focusing on peer-reviewed journal articles, industry reports, government publications, and books authored by experts in the field. To ensure credibility and relevance, the selection criteria for literature included three key aspects. First, the publication time frame was limited to the last 10 years (2015–2025) to ensure the use of up-to-date and relevant findings. Second, relevance was determined by selecting literature that directly addresses HR development, digital transformation, Industry 4.0, and workforce challenges in the logistics sector. Lastly, source credibility was ensured by prioritizing indexed journals (Scopus, Web of Science), reports from reputable international organizations (ILO, World Economic Forum), and government policy documents, which offer authoritative insights into the topic.

Once the data was collected, it was analyzed using an interactive approach. The first stage in this analysis is data reduction, which is the process of selecting and simplifying data to focus on the most relevant information and eliminating less important data. The next stage is data presentation, where the data that has been reduced is organized and presented in a form that is easier to understand, such as tables or matrices, to facilitate analysis and identification of patterns. The last stage is conclusion drawing, where researchers analyze the data that has been presented in order to draw conclusions, identify main themes, and explain the phenomenon being studied.

RESULTS AND DISCUSSION

The shipping and logistics sector has an important role in a country's economic system, which includes the delivery, receipt, storage, and distribution of goods that are an integral part of the global supply chain (Mouschoutzi & Ponis, 2022). To improve efficiency and transparency in logistics services, the Directorate General of Sea Transportation continues to carry out digital optimization, in line with the industrial era 4.0, which encourages digitalization in various sectors, including ports and logistics. This effort aims to create more transparent, efficient, and accountable services to accelerate the flow of goods and improve economic competitiveness (Humaira Ninvika et al., 2023).

This development becomes relevant in Industry 4.0, which brings innovations in transportation technology, communication, and information management. In the past, sailing ships were the main mode of maritime trade, facilitating the rapid distribution of goods, but also facing challenges such as storms, theft, and risk of damage. Along with the industrial revolution in the 19th century, various technological breakthroughs brought significant changes in maritime logistics management, creating a more modern and reliable system to support global trade (Barasa & Purba, 2024).

Advances in the shipping transportation sector have significantly impacted the efficiency and speed of shipping goods. Loading and unloading processes have become faster, the reach of container stacks has expanded, and maritime logistics management has undergone a major revolution. Based on improvements in the logistics management system, shipments can be made faster, while logistics costs can be effectively reduced. In addition, the development of information and communication technology (ICT) and innovation also play a crucial role in improving maritime logistics management. Through computerization and information systems, industry players can manage and track the flow of goods more efficiently, improve coordination with business partners, and provide stakeholders with more accurate and timely information (Barasa & Purba, 2024).

Thus, in facing global challenges, digitization in the shipping and logistics sector is an absolute necessity to improve the services and competitiveness of this sector. However, in addition to the

technological and infrastructure aspects, human resources remain a major factor in the success of businesses in this sector. Companies that want to have a competitive advantage must place human resources in a strategic position and should not be ignored. The workforce's ability, skills, and adaptation to technological changes are key in facing competition in the increasingly dynamic maritime industry (Pertiwi, 2023).

Human Resources (HR) is the main element in an organization that plays an important role in achieving predetermined goals. HR is not only a workforce but also a valuable asset that cannot be replaced. In every company, the existence of competent human resources is a determining factor for success in achieving the business goals that have been designed (Marisya et al., 2023). Therefore, companies must ensure that HR has smart and appropriate individuals in carrying out their duties because without quality HR, the sustainability and growth of the business can be hampered.

HR development is essential for companies to increase work productivity and effectiveness. Every employee needs to be encouraged to continue to improve performance so that the company can more quickly achieve the desired target (Pertiwi, 2023) So, the company's ability to create and implement the right strategy in HR development is a very important aspect. A well-designed strategy will have a positive impact, not only in the short term but also for long-term business sustainability. Therefore, investment in HR development should be a top priority for companies in order to adapt to changes and remain competitive in a dynamic market.

The importance of HR development is a crucial factor in ensuring the sustainability and competitiveness of the company. In addition, HR development also plays a role in driving innovation and strengthening the company's competitiveness. Through a workforce with up-to-date skills and knowledge, companies can more easily create innovative solutions that improve internal efficiency and provide an advantage over competitors. On the other hand, improving the quality of customer service is one of the main benefits of HR development. Employees who are skilled and have a deep understanding of customer needs are able to provide better service, increase satisfaction, and build customer loyalty.

Then, HR development aims to prepare a workforce that is ready to face change. Providing relevant training and opportunities for continuous learning enables companies to ensure that their employees are able to adapt to new technologies and rapidly evolving industry challenges. High-quality human resources not only generate competitive value but are also able to create comparative, generative, and innovative value, which will contribute significantly to the company's growth amid increasingly fierce global competition (Wongsansukcharoen & Thaweepaiboonwong, 2023).

Several strategies for developing relevant human resources in the digital era cover various aspects, including digital competency enhancement and adaptive skills development. In the shipping and logistics sector, companies must focus on developing employees' skills to prepare them for rapid technological change. One of the main steps that can be taken is to provide appropriate technology training so that employees are able to operate and utilize new technologies effectively (Al Muharrir et al., 2024). This training could include understanding the Internet of Things (IoT), big data, artificial intelligence (AI), and blockchain, which play an important role in improving the efficiency and security of logistics systems. In addition, data analysis skills, automation systems management, and cybersecurity are becoming increasingly important in the face of increasingly complex industry challenges.

In addition to in-person technology training, companies can also utilize digital learning platforms to improve the accessibility and effectiveness of training for employees. E-learning, webinars, and simulations allow for a more flexible and accessible learning process at any time, so employees can continue to develop their skills without being limited by time and location. This approach also encourages a culture of self-directed and continuous learning through various digital resources, ultimately improving workforce capabilities in the long run (Ferdianto & Anindita, 2023).

The second strategy for developing adaptive skills is also an important aspect of the HR development strategy. In the ever-changing world of work, employees need to be equipped with multiskilling capabilities, which are skills that cover various fields beyond their main specialization. Mastery of various skills helps the workforce be more flexible and adapt quickly to technological changes and market demands. This flexibility is an advantage for companies in facing dynamic business challenges. Furthermore, improving problem-solving and critical thinking skills is also a priority in HR development. Employees need to be trained to be able to identify complex problems, analyze information carefully, and make the right decisions in situations that demand speed and accuracy. By

thinking critically and innovatively, employees can provide more effective solutions and create innovations supporting company growth amid global competition (Al Muharrir et al., 2024).

The next strategy is to implement technology in HR management. One approach that can be applied is utilizing big data and artificial intelligence (AI) in recruitment and workforce skills development. This technology allows companies to analyze prospective employee data more accurately, identify the best talent, and adjust training programs based on individual needs and industry trends. The application of AI also helps automate the initial selection of candidates, making the recruitment process more efficient and objective (Pratama et al., 2023).

However, implementing technology in HR management depends on adopting digital tools and the organization's readiness in the face of digital transformation. Therefore, a change management strategy becomes a crucial factor in ensuring that all employees can accept this transformation well without feeling threatened by potential changes in job security. Companies must build a more flexible and data-driven work culture, where decisions are made based on objective analysis, and employees are given space to adapt to technological changes (Al Muharrir et al., 2024). Leadership that understands the importance of digital transformation is also a key element in managing this change. Company leaders must be able to direct and support workforce teams in adopting new technologies and create a work environment that encourages innovation and collaboration.

In addition to internal transformation, increased collaboration with the industrial sector is an important strategy for supporting HR digitization. Collaboration between shipping and logistics companies and technology startups can accelerate digital adoption and improve industry competitiveness (Al Muharrir et al., 2024). This collaboration helps companies such as Small and Medium Enterprises (SMEs) access technology at a lower cost through leasing schemes or long-term cooperation. Collaboration can also take the form of research and development (R&D) to produce more effective and innovative digital solutions. Thus, by implementing these strategies in an integrated manner, the shipping and logistics sector can build competent human resources, be ready to face challenges and be able to take advantage of opportunities that exist in the Industry 4.0 era. Rapid adaptation to technological developments will be the key to creating a more advanced, efficient, and highly competitive industry.

CONCLUSION

Human Resources (HR) development strategies in the shipping and logistics sector are crucial in improving operational efficiency and productivity, encouraging innovation, and strengthening company competitiveness. High-quality human resources provide competitive value and can create comparative, generative, and innovative value for the industry. This research shows that HR development strategies can be carried out through several key approaches, such as increasing digital competencies through technology training and digital learning platforms, developing adaptive skills, and implementing technology in HR management, including recruitment. In addition, organizational transformation to encourage digital adaptation and increased collaboration with the industrial sector are strategic steps in facing changes in the Industry 4.0 era. Through implementing these strategies, the shipping and logistics sector can build a more competent and adaptive workforce so as to be able to answer challenges and take advantage of opportunities that arise in the rapid technological development in the Industry 4.0 era.

Despite its contributions, this study has limitations, primarily relying on secondary data without empirical validation. Future research should include case studies, expert interviews, and comparative analysis across regions and company sizes to refine HR strategies. Investigating government policies and industry collaborations could provide deeper insights into effective workforce transformation. This study lays a foundation for further research and practical applications to develop a digitally competent and adaptive workforce in the shipping and logistics sector by acknowledging these challenges and research gaps.

REFERENCES

Akdogan, L., Durucu, A., & Durmaz, Y. (2021). Cultural Factors Affecting Consumer Behavior: Social Class. *International Journal of Research Publications*, *79*(1). https://doi.org/10.47119/ijrp100791620212033

Al Muharrir, K., Marvin, E. A., Ariyani, D., Zidan, M., Romadhon, M. A., Sugiyo, Q. N., Ayuningtias, M. D., & Widodo, M. S. (2024). *Transformasi Digital Dalam Pengembangan Jasa Logistik: Peluang Dan Tantangan*.

Alqudah, I. H. A., Carballo-Penela, A., & Ruzo-Sanmartín, E. (2022). High-performance human resource management practices and readiness for change: An integrative model including affective commitment, employees' performance, and the moderating role of hierarchy culture. *European Research on Management and Business Economics*, *28*(1). https://doi.org/10.1016/j.iedeen.2021.100177

Azzahra, A., Savandha, S. D., Ridzki, M. M., & Amelia, A. (2024). Balancing Seniority Rewards and Performance: Challenges and Solutions in Human Resource Management. *Cakrawala Repositori IMWI*, *7*(4), 1217–1227. https://doi.org/10.52851/cakrawala.v7i4.712

Barasa, L., & Purba, D. (2024). Management Logistics Maritime: A Literature Review. *Kapal: Jurnal Ilmu Pengetahuan Dan Teknologi Kelautan*, *21*(1), 47–60. https://doi.org/10.14710/kapal.v21i1.59736

Besley, T., & Persson, T. (2023). The Political Economics of Green Transitions. *Quarterly Journal of Economics*, *138*(3). https://doi.org/10.1093/qje/qjad006

Chen, W., Men, Y., Fuster, N., Osorio, C., & Juan, A. A. (2024). Artificial Intelligence in Logistics Optimization with Sustainable Criteria: A Review. *Sustainability*, *16*(21), 9145. https://doi.org/10.3390/su16219145

Ferdianto, S., & Anindita, R. (2023). Reinforcing learning organization by self-directed learning through massive open online courses: a lesson learned from Covid-19 pandemic. *Cogent Business and Management*, *10*(2). https://doi.org/10.1080/23311975.2023.2213968

Humaira Ninvika, D., Junitasari, Y., Apsari, I., Nurfitriani, A., Aulia, E., Sahara, S., Studi, P., Pelabuhan, M., Maritim, L., & Teknik, F. (2023). Dampak Perubahan Teknologi Sistem Logistik di Pelabuhan. *Jurnal Ilmiah Wahana Pendidikan, Juli*, *2023*(14).

Johari, J., Mohd Shamsudin, F., Fee Yean, T., Yahya, K. K., & Adnan, Z. (2019). Job characteristics, employee well-being, and job performance of public sector employees in Malaysia. *International Journal of Public Sector Management*, *32*(1), 102–119.

Kajwang, B. (2022). GLOBAL CHALLENGES AND THEIR ROLE IN TALENT MANAGEMENT CRISIS FACING INSURANCE INDUSTRY. *International Journal of Business Strategies*, *7*(1). https://doi.org/10.47672/ijbs.921

Malagón-Suárez, C. P., & Orjuela-Castro, J. A. (2023). Challenges and Trends in Logistics 4.0. *Ingenieria (Colombia)*, *28*. https://doi.org/10.14483/23448393.18492

Marisya, R., Maisharah K, S., & Sugiarto, I. (2023). Human Resources (HR) Development At The Employee Level Ethos. *Jurnal Ekonomi*, *12*(02). https://doi.org/10.54209/ekonomi.v12i02.1683

Meng, L., Ge, H., Wang, X., Yan, W., & Han, C. (2023). Optimization of ship routing and allocation in a container transport network considering port congestion: A variational inequality model. *Ocean and Coastal Management*, *244*. https://doi.org/10.1016/j.ocecoaman.2023.106798

Mouschoutzi, M., & Ponis, S. T. (2022). A comprehensive literature review on spare parts logistics management in the maritime industry. *Asian Journal of Shipping and Logistics*, *38*(2). https://doi.org/10.1016/j.ajsl.2021.12.003

Neilson, J., & Wang, J. H. Z. (2019). China and the changing economic geography of coffee value chains. *Singapore Journal of Tropical Geography*, *40*(3). https://doi.org/10.1111/sjtg.12279

Nugroho, F., Fauzi, A. A., Firdaus, R., & Marna, M. (2024). The Role of Digital Transformation in Enhancing Organizational Performance in Multisectoral Industries. *Jurnal Syntax Transformation*, *5*(11), 1263–1272. https://doi.org/10.46799/jst.v5i11.1022

Pertiwi, T. (2023). *Implementation of human resource management strategy in improving organizational performance*.

Pratama, A. S., Sari, S. M., Hj, M. F., Badwi, M., & Anshori, M. I. (2023). Pengaruh Artificial Intelligence, Big data dan otomatisasi terhadap kinerja SDM di Era digital. *Jurnal Publikasi Ilmu Manajemen*, *2*(4), 108–123.

Savandha, S. D. (2024). Bridging the Urban-Rural Divide: Leveraging Technology for Development and Connectivity in Small Village, Indonesia. *Journal of Village Development Innovation*, *1*(1), 15–28.

Savandha, S. D., & Fitriyani, D. R. (2025). The Impact of Agile Leadership on Talent Retention in Fast-Paced Industries. *Leadership and Talent Management Global Research*, *1*(1), 35–48.

Sierra, J., & Suárez-Collado, Á. (2021). Understanding economic, social, and environmental sustainability challenges in the global south. *Sustainability (Switzerland)*, *13*(13). https://doi.org/10.3390/su13137201

Wongsansukcharoen, J., & Thaweepaiboonwong, J. (2023). Effect of innovations in human resource practices, innovation capabilities, and competitive advantage on small and medium enterprises' performance in Thailand. *European Research on Management and Business Economics*, *29*(1), 100210. https://doi.org/10.1016/J.IEDEEN.2022.100210

Xing, H., & Xiaofeng, L. (2021). Agricultural labor market equilibrium based on FPGA platform and IoT communication. *Microprocessors and Microsystems*, *80*. https://doi.org/10.1016/j.micpro.2020.103332