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RESEARCH ON SOLUTIONS FOR HUMAN RESOURCE MANAGEMENT FOR SEAPORT OPERATING ENTERPRISES

NGHIÊN CỨU XÂY DỰNG GIẢI PHÁP QUẢN LÝ NHÂN SỰ CHO DOANH NGHIỆP KHAI THÁC CẢNG BIỂN

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Abstract

This study aims to optimize human resource management operations in port enterprises by applying modern technologies such as AI, IoT, Blockchain, and Big Data Analytics. Through an analysis of the current situation, the paper evaluates the challenges in human resource management at Vietnamese ports, including skill shortages, difficulties in retaining talent, and inefficient administrative processes. The research proposes an integrated human resource management model utilizing AI, IoT, and Blockchain to enhance labor productivity, reduce costs, and optimize human resource management operations in the port industry.

Keywords: *Human Resource Management, Port Industry, AI, IoT, Blockchain, Big Data.*

Tóm tắt

Nghiên cứu này nhằm tối ưu hoá hoạt động quản lý nhân sự trong các doanh nghiệp khai thác cảng biển bằng việc ứng dụng các công nghệ hiện đại như AI, IoT, Blockchain và Big Data Analytics. Thông qua phân tích thực trạng, bài báo đánh giá những thách thức trong việc quản lý nhân lực tại các cảng biển Việt Nam, bao gồm sự thiếu hụt kỹ năng, khó khăn trong giữ chân nhân tài, và quy trình hành chính kém hiệu quả. Nghiên cứu đề xuất mô hình quản lý nhân sự tích hợp AI, IoT và Blockchain nhằm nâng cao năng suất lao động, giảm chi phí và tối ưu hoá hoạt động quản lý nhân sự tại cảng biển.

Từ khóa: *Quản lý nhân sự, cảng biển, AI, IoT, Blockchain, Big Data.*

1. Introduction

1.1. The urgency of the topic

The seaport operation industry plays an important role in the global supply chain, ensuring the circulation of goods and promoting economic development. However, the increase in cargo volume along with the requirement for efficient operations poses a major challenge to human resource management in the industry (UNCTAD, 2020). Currently, many seaport enterprises in Vietnam are facing difficulties in recruiting, training, and retaining high quality human resources, especially professional technical positions (Logistics Skills Advisory Council, 2024).

In addition, the strong digital transformation is directly impacting the way human resources are managed. The application of AI, IoT, Blockchain, and Big Data in HRM not only helps optimize the recruitment process and supervise labor, but also improves management efficiency and minimizes operational risks (McKinsey & Company, 2023). However, the level of application of technology in human resource management at Vietnamese seaports is still limited, leading to labor productivity that has not been fully exploited (Vietnam Maritime Corporation, 2023).

Therefore, this study aims to assess the current situation of HRM at seaport operators, thereby proposing modern technology solutions to help improve the efficiency of human resource management, optimize resources, and increase competitiveness in the context of Industry 4.0 (ICT Vietnam, 2023).

1.2. Theoretical overview

Human Resource Management (HRM) is an important area of business management, covering activities such as recruitment, training, performance evaluation, and compensation (Vu, 2023). According to Vu (2023), HRM in seaport operating enterprises not only concerns labor division but also involves

optimizing work schedules, ensuring labor safety, and enhancing overall performance.

Recent studies have proposed several frameworks suitable for HRM in technologically evolving environments like ports. One such model is Strategic Human Resource Management (SHRM), which emphasizes aligning HR practices with long term business goals to enhance innovation and adaptability especially crucial in dynamic sectors such as maritime logistics (Bella et al., 2023; Afsar et al., 2023).

To assess readiness for technological adoption, the Technology Acceptance Model (TAM) remains relevant, as it evaluates user perceptions of system usefulness and ease of use essential for understanding acceptance of digital HRM platforms (Schorr, 2023; Guo et al., 2022).

The application of Human Resource Information Systems (HRIS) has become increasingly vital, particularly in integrating digital tools for payroll, employee records, and performance tracking. Recent literature emphasizes not only the benefits but also implementation challenges that port organizations must navigate (Bangura, 2024; Valcik et al., 2023).

Lastly, the emergence of Digital HRM focusing on AI, IoT, Blockchain, and Big Data offers new opportunities to automate HR processes, enhance transparency, and support data driven workforce planning. These technologies play an essential role in increasing employee engagement, reducing operational errors, and improving overall HR responsiveness (Alan, 2023; Liu et al., 2023).In particular, Talley (2017) confirmed that using AI and IoT in HRM helps improve workplace safety and optimize staff scheduling, while Sithole (2022) emphasized the role of Big Data in performance monitoring and workforce forecasting. In Vietnam, although major enterprises like SNP, Gemadept, and Hai Phong Port have begun applying digital HRM systems, adoption remains limited due to cost and workforce adaptability issues (Vietnam Maritime Corporation, 2023).

Therefore, this study proposes a technology integrated HRM model tailored to the operational characteristics of Vietnamese seaports, aiming to enhance workforce productivity and improve the overall HRM process in the context of digital transformation.

2. Research methods

This study employs a multidimensional approach to ensure practical relevance. The main methods include:

Literature Review: Analyzing existing research, reports, and publications from domestic and international organizations on HRM in the port industry to identify key trends and challenges.

Surveys and Interviews: Conduct an online survey (from Feb to Mar 2024) with 27 participants from port enterprises and indepth interviews with senior managers to gather insights on HRM tools, needs, challenges, and readiness for technology adoption.

Technology Analysis: Comparing features of existing HRM software solutions to assess their strengths and weaknesses, helping define criteria for an HRM system tailored to port operations.

Case Studies: Examining successful applications of HRM technologies in both Vietnamese and international ports to extract lessons and evaluate realworld effectiveness in improving workforce management and transparency.

Table 1. Workforce working at some seaports in Vietnam

Seaports/Port Enterprises	Number of Employees	Cargo throughput (as in 2023)
Hai Phong Port Joint Stock Company	3.052	29.59 million tons 1,312 million TEUs
Saigon Newport Corp	7.400	9.75 million TEUs
Saigon Port Joint Stock Company	1.550	8.6 million tons
Da Nang Port Joint Stock Company	500–999	12.20 million tons
Quy Nhon Port Joint Stock Company	~ 800	9.6 million tons

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3. Research Results

3.1. The current situation of personnel at Vietnamese seaport operating enterprises

The seaport operation industry plays an important role in the international supply chain and transportation of goods. To ensure effective exploitation activities, seaport enterprises need a diverse workforce, operating continuously in shifts.

According to a report by the Vietnam Seaport Association (VPA, 2023), personnel in seaports can be divided into three main groups:

• Direct labor group: Loading and unloading workers, forklift drivers, crane operators,...

• Indirect labor group: Dispatching staff, maintenance technicians, counting staff,...

• Senior management team: Port operation manager, head of operation department,...

According to research, the development of smart seaport technology, automation, and artificial intelligence (AI) in the period 2024-2028 will have a strong impact on labor demand in the industry. Specifically, the actual survey at Vietnam's seaports shows:

Unskilled workers tend to decrease, especially manual loading and unloading workers and operators of traditional operating vehicles The demand for hightech personnel has increased sharply, especially in the positions of automated system operation, maintenance of technological equipment and port data analysis. Skills related to digital technology, artificial intelligence and remote control have become essential requirements for new human resources.

In the period of 2024-2028, seaports may cut forklift operators, manual supervisors, and loading and unloading workers, while the demand for automated system maintenance technicians, shore crane control personnel, and port data analysts is high. Key skills include the use of port dispatching software, remote control of equipment, automated system programming, and logistics data analysis. Therefore, it is necessary to retrain workers and change recruitment models, prioritizing candidates with technology skills and automation management.

3.2. Application of technology in seaport personnel management in Vietnam

The application of technology in human resource management at Vietnamese seaports is still limited compared to the world. According to the VPA report (2023), only 45% of Vietnamese seaport enterprises use professional HRM software, while 55% still manage manually using Excel or paper records, which is timeconsuming and errorprone. Processes such as payroll, timekeeping, and employee case management still rely heavily on traditional methods, resulting in low performance and inefficiency.

In particular, 45% of large seaport enterprises in Vietnam use technology software to manage their personnel. Prominent are VIMC, Da Nang port, Hai Phong port,... have had remarkable technologies (Table 2). The driving force for port operators to increase the application of technology in their operations comes from policies related to promoting technology application from the Government, including: National Digital Transformation Program to 2025: Goal: Putting Vietnam in the top 50 leading countries in information technology (ICT), focusing on 3 pillars: Digital Government, Digital Economy, Digital Society (Prime Minister, 2020); Policies to encourage investment in information technology infrastructure such as Decree 10/2024/ND-CP issued on March 25, 2024 provide incentives and support for

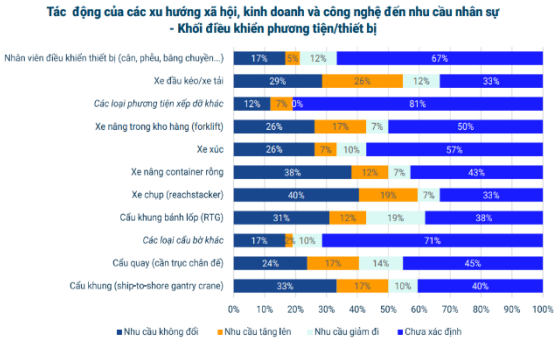

Figure 1. Impact of social, business, and technological trends on HR needs - Vehicle and equipment control block

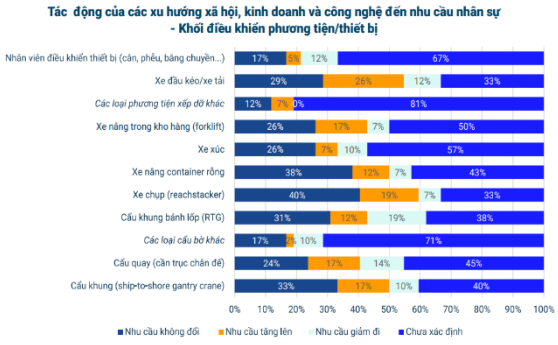

Figure 2. Impact of social, business and technological trends on HR needs - Loading and unloading technology

Table 2. Technology application in HRM at Vietnamese seaport enterprises

Business	HRM software	Implementation functions
VIMC	HR Humax MIS G3 Software	Data integration for 600 employees; Manage personnel, salary, social insurance; Internal portal, staff training.
Da Nang Port, Quy Nhon Port	Fast Business Online (ERP - FAST)	ERP system integrates human resource management, accounting, and operation; Automate HR and payroll processes; Data connection with port operation software.
Saigon Newport	HiStaff	Manage personnel records, timekeeping, payroll; Recruitment, training, and evaluation of KPIs; ERP integration, e-Banking, HR process automation.
Gemadept Corporation	Workday HCM	Digital workforce management; Talent optimization, performance evaluation; Payroll, benefits administration, and financial HR planning.

investment in hightech parks, including land rent exemption and support for state credit loans. In addition, the application of technology to help improve operational efficiency and cut operating costs is also a key factor for businesses to consider. In addition, there are many challenges that make seaport operators in Vietnam difficult to apply technologies to human resource management as follows:

a) High investment costs: HRM systems require large capital sources (500 million - 2 billion VND), becoming a barrier for small and mediumsized enterprises. 65% of seaport enterprises do not have enough budget to deploy.

b) Limited human resources: 70% of port employees lack the skills to use HRM software, while only 20% of enterprises have specialized IT departments, leading to difficulties in training and implementation.

c) Unsynchronized technological infrastructure: Only 30% of seaports have a network system that meets IoT connectivity, many businesses still use outdated technology, causing a loss of 15-20% of labor productivity.

d) Data security and safety: 40% of businesses are concerned about the risk of data leakage and cyberattacks due to the lack of effective security measures.

e) System integration: 35% of businesses have difficulty integrating HRM with ERP systems, accounting and warehouse management software, which is timeconsuming and costly to operate.

f) Fear of change: 10% of seaport leaders still believe in traditional management methods, slowing down the digital transformation process and applying HRM technology.

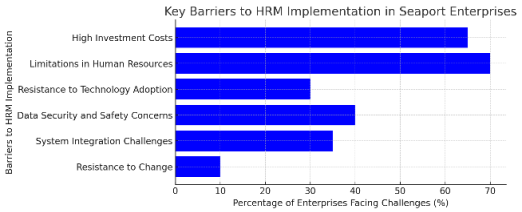

Figure 3. Key challenges in implementing HRM in Vietnam

3.3. Demand for human resource management software of seaport operating enterprises

The research team conducted a survey with port operators in Vietnam to find out their needs for human resource management software. 27 responses were collected, reaching a rate of 90%, from senior managers, HR managers, administrative staff, and direct workers.

53.7% of seaport enterprises still use manual methods in personnel management, while 34.7% have developed inhouse software to optimize processes. Only 11.6% choose thirdparty software, indicating that the popularity of professional HRM solutions is low. This reflects the fact that many businesses are not ready for digital transformation, but also opens up great opportunities to apply technology to improve theefficiency of human resource management.

The survey found that 33.3% of seaport businesses face difficulties with HRM software, including frequent updates, poor performance, lack of features, and reporting difficulties. 40% have personnel problems such as data entry errors, and employees who are not familiar with it or have not been well trained. 15.6 percent had trouble integrating the system with other software, and 11.6 percent said the software did not meet the size of the business.

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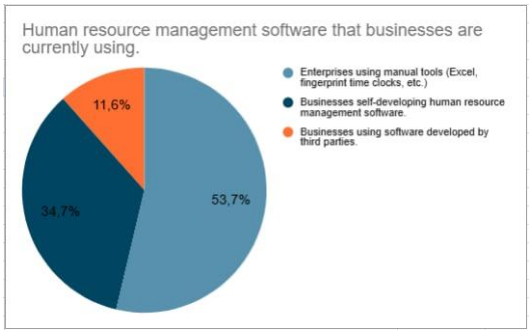


Figure 4. Forms of human resource management at some seaport enterprises in Vietnam

Survey results indicate that seaport enterprises have a high demand for personnel record management (85%), payroll calculation & compensation (80%), and timekeeping & shift management (75%). Additionally, insurance & benefits management (65%) and training & development (70%) are key priorities to enhance workforce quality. Furthermore, reporting & data analysis (60%) and integration with other systems (55%) are crucial for optimizing HRM processes. These findings highlight the necessity of comprehensive, flexible, and technology integrated HRM software to meet the human resource management needs of seaport enterprises.

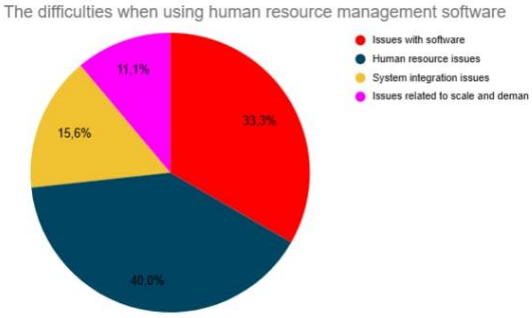


Figure 5. Difficulties in applying HR management software

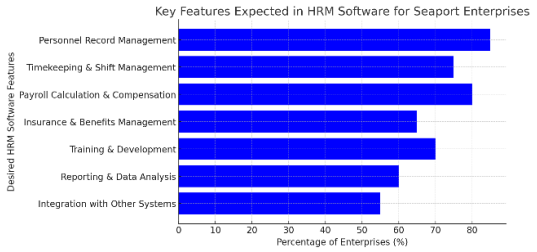


Figure 6. Key Features Expected in HRM Software for Seaport Enterprises

3.4. Proposed functions of the seaport labor management software

a) Problems

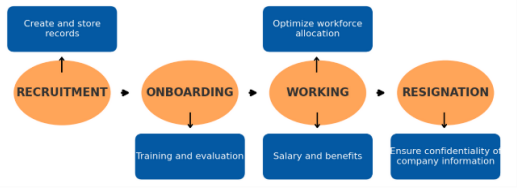


Figure 7. An author-adapted version of the Employee Lifecycle model with problems

The proposed seaport labor management software will solve the 5 problems (Figure 7) indicated by seaport enterprises throughout the employment length of a port labor as below:

Problem 1: Create and store record. The application of an electronic data storage system helps optimize the data entry process, reduce errors and ensure compliance with labor laws.

Problem 2: Training and evaluation. Building a modern onboarding process, combining online training, competency assessment and integrating internal communication systems to improve work performance.

Problem 3: Salary and benefits. Integrate an automated payroll system, monitor employee benefits, and apply data analysis to ensure transparency in performance evaluation.

Problem 4: Optimize workforce and allocation: Apply smart scheduling and task assignment tools to balance workloads, reduce redundancy, and improve labor efficiency.

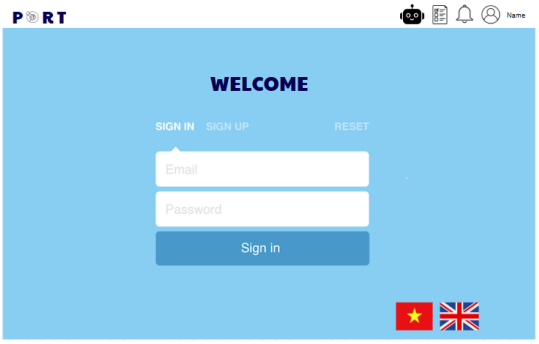
Problem 5: Ensure confidentiality of company information (or exit processes). Applying a digital storage system, supporting quick lookups and ensuring the management of personnel data in accordance with legal regulations.

b) Functions of the software:

In order to solve these problems, research team proposes the following functions provided by this software:

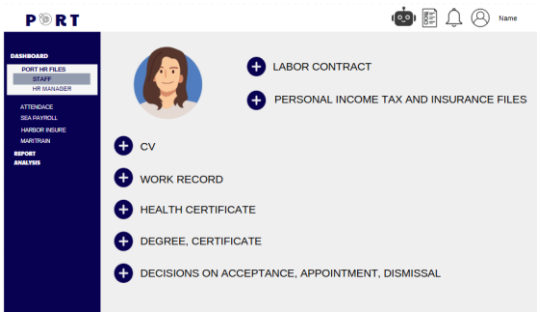
The software, illustrated in Figures 8 to 13, includes several key functions: recruitment and personnel record management (HR File), training (MariTrain), timekeeping and payroll, and shift scheduling (Attendance and Sea Payroll). Among them, MariTrain enables the development of training roadmaps tailored to each job group or function (e.g.,

English skills, professional certifications, customer service, management, and planning). It allows tracking of the training progress of each employee over time and position level and displays visual alerts (via color coding) for any missing or overdue content. The system also integrates automated posttraining assessments.



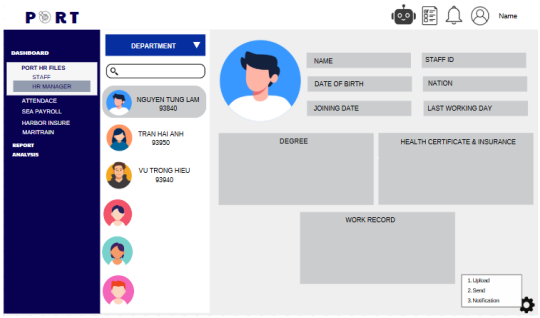
Simulated interface created by the authors

Figure 8. Interface when logging in to the software



Simulated interface created by the authors

Figure 9. Employee profile management interface



Simulated interface created by the authors

Figure 10. Employee profile management interface by department

Furthermore, the software integrates AI technology to support data synchronization across systems, analyze HR trends, and generate realtime reports on attendance, performance, and training effectiveness. This improves accuracy, reduces manual processing time, and enhances decision making efficiency for HR departments A builtin chatbot further enhances user interaction by enabling employees to access HR information, submit routine requests, and receive realtime assistance.

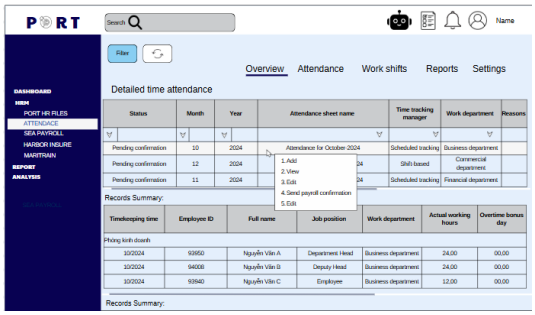


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Figure 11. Monthly attendance report interface

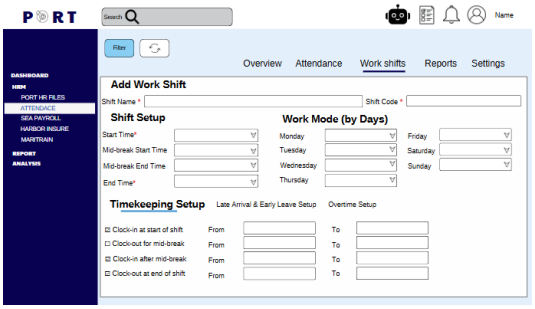

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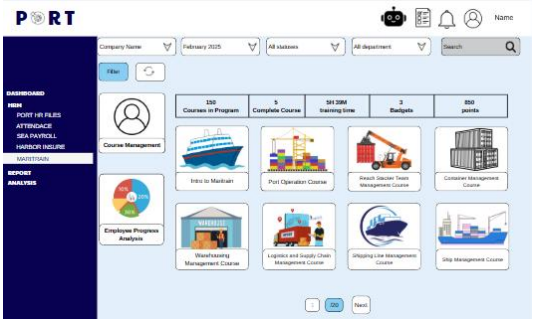
Figure 12. Shift registration interface



Simulated interface created by the authors

Figure 13. Course interface for employees

c) Illustrative interface

The following images illustrate the web interface of our proposed HRM software for seaport enterprises in Vietnam.

Simulated interface created by the authors.

d) Proposed Implementation Roadmap

To ensure practical feasibility, the authors propose a three phase implementation roadmap for the integrated HRM software: (1) conducting initial surveys, collecting

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operational data, and deploying a pilot version at a midsized port branch to test system stability; (2) training internal users, updating real data into the system, and running controlled tests to detect and fix possible errors; and (3) official rollout across the organization, accompanied by continuous monitoring using indicators such as time - to - hire, payroll error rate, training effectiveness, and employee retention. This process allows for a smooth transition, as the software will already contain validated operational data, enabling the organization to discontinue the old system without disruption. The proposed roadmap is aligned with international best practices recommended by SHRM and AIHR two globally recognized authorities in human resource management and digital transformation.This roadmap helps ensure that the software aligns with realworld needs and allows flexible adjustments before fullscale deployment.

4. Conclusion

In the context of Industry 4.0 and increasing global integration, digital transformation in human resource management (HRM) is essential for enhancing the competitiveness of Vietnam's seaport enterprises. This study identifies key challenges in traditional HRM practices and proposes an integrated software solution featuring digital personnel records, automated payroll, smart scheduling, performance evaluation, and secure data management. By applying technologies such as AI, IoT, and Blockchain, the system improves efficiency, reduces administrative burdens, and supports fair, transparent workforce management. These features are not only practical and aligned with current digital trends but also feasible for gradual implementation across port operations, contributing to both business efficiency and longterm industry sustainability.

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