Impact of Digital Transformation in Human Resource Management on Resource Utilisation Efficiency in Vietnamese Garment Manufacturing Enterprises

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ABSTRACT:

The era of rapidly advancing digital technology, digital transformation has become a global inevitability, and Vietnam is actively participating in this trend. The digital transformation of human resource management is not only a necessity but also a key factor in optimizing human resources and enhancing labor productivity. According to PwC's 2022 report, the digital transformation of human resource management is a critical step in improving the competitiveness of businesses amid constantly evolving technological landscapes. Garment businesses are facing a revolution in digital human resource management. This study aims to analyze the impact of digital transformation in human resource management on the efficiency of human resource utilization in garment businesses in Vietnam, with managers acting as mediating variables. Quantitative research was conducted through a survey of 300 production managers, supervisors, and especially line team leaders in Ho Chi Minh City and Dong Nai. The research model analysis used Partial Least Squares (PLS) with SMART software version 3.0.

Experimental results indicate that digitalizing recruitment processes and implementing real-time performance management have a profound impact on resource optimization. Digital training has not yet had a direct impact on resource optimization. An organization's digital agility is a lever for applying digital transformation in human resource management to maximize resources. The findings of this study have managerial implications: suggesting solutions for garment businesses that need to optimize recruitment, ensure data transparency, and provide timely rewards to motivate and encourage employees to increase productivity, thereby contributing to resource

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optimization for the business. Therefore, support from the government and financial institutions, and proactive efforts from businesses themselves, are needed to invest in technology and improve management capabilities to promote digital transformation in human resource management, to develop Vietnam's textile and garment industry.

Keywords: Digital transformation, HRM, Resource optimization, Garment industry, Real-time performance

1. Introduction

The garment manufacturing industry in Vietnam is a traditional sector that attracts a large workforce. While the garment industry benefits from cheap labor, digital transformation has impacted almost all industries, the economy, and society in recent years. Under the influence of the digital economy, garment manufacturing businesses that rely solely on manual methods, fragmented spreadsheets, and the intuitive experience of production line supervisors will be at a disadvantage and fall behind in the economic landscape. Although the garment industry employs the most workers, its understanding of actual capacity and its human resource optimization is the weakest. The question is no longer whether we should adopt digital transformation, but how we will digitize manufacturing businesses to avoid being eliminated from the global supply chain.

The shift from traditional management to digital human resource management is not simply about equipping a timekeeping software or electronically filing insurance and tax returns… Garment manufacturing businesses need to revolutionize data by enabling production managers to immediately identify productivity declines on production lines due to equipment or worker skill deficiencies; the human resources department needs to predict turnover rates; and assess employee satisfaction with their jobs, income, and the behavior of their superiors… Applying digital transformation in human resource management is the key to optimizing resources: assigning the right person to the right job at the right time at the most reasonable cost. However… The application of digital transformation in Vietnamese garment businesses remains weak because they believe it will replace human labor, leading to job losses…

Although digital transformation in businesses has been studied across many fields, in-depth research on its application in human resource management in Vietnamese garment manufacturing enterprises remains limited. In particular, there are few studies specifically evaluating the impact of digital technology on human resource optimization, such as labor productivity, turnover rates, or employee satisfaction. Furthermore, the psychological and cognitive barriers to digital transformation among employees have not been fully analyzed. In addition, building a digital human resource management model that ensures both production efficiency and the development of human value along the garment manufacturing chain remains an issue that has not been comprehensively researched. Therefore, this study aims to fill these gaps by analyzing the impact of digital transformation on human resource optimization in Vietnamese garment manufacturing enterprises.

The authors focuses on the practical situation in garment manufacturing businesses to clearly analyze the impact of digital technology on resource optimization, implying that digital transformation in human resource management is not about replacing people but about redefining individual value within the production chain. Digital transformation is a springboard for recognizing and scientifically exploiting the value of each individual in the production chain.

2. Review of literature

2.1. Digital transformation

This review is organised around three thematic pillars: (i) digital transformation enablers (policy and infrastructure), (ii) digital HRM functions (recruitment, training, performance, communication), and (iii) sector-specific evidence from the garment/apparel industry.

Digital transformation is an integral part of Vietnam's development strategy, especially as the government has implemented numerous policies to promote digitalization in businesses. The Vietnamese government has issued the National Digital Transformation Program to 2025 and a vision to 2030, aiming for 90% of public organizations and businesses to successfully achieve digital transformation (Chinh phủ, 2020). Notably, Vietnam's policy framework for digital transformation focuses not only on businesses but also on promoting digital skills training for the workforce. According to OpenGov Asia (2024), training programs in digital technologies such as artificial intelligence, cloud computing, and blockchain are expanding at universities, with the goal of building a digitally skilled workforce to meet market demands.

The application of digitalization in human resource management can significantly improve productivity and efficiency for organizations. Research by HRM Asia (2022) highlights the use of artificial intelligence to support HR in recruitment, training, and performance management, enabling businesses to make more accurate and data-driven decisions. The research results show that technology has changed job requirements across many industries, placing increasingly complex, demanding, and proficient demands on the professional qualifications and digital skills of the workforce to ensure efficient and sustainable operations for organizations (Sương. HTT &Hien. NTT) .

Although digital transformation offers many benefits, Vietnamese businesses still face several major challenges. First, the initial investment cost for digital human resource management systems is quite high, making it difficult for small and medium-sized enterprises (SMEs) to implement advanced technology (Vietnam Digital Readiness Report, 2022). Next, Vietnam faces a serious shortage of digitally skilled labor, necessitating digital skills training programs to enhance the workforce's adaptability to new technologies (OpenGov Asia, 2024). Furthermore, data security is also a critical issue in the digital transformation of human resource management. With the increasing collection and storage of digital human resource data, businesses face security and privacy risks, especially when adequate protective measures are not yet in place (PwC, 2022).

Given this context, it is necessary to research and apply leading global research models to the Vietnamese situation. This article applies a theoretical synthesis method to analyze and propose research directions and related management implications regarding the digital transformation of human resource management in Vietnam.

2.2. Optimizing human resource management processes

Human Resource Information Systems (HRIS) are a comprehensive set of software, data, and processes that support human resource management using information technology. HRIS can help organizations store employee data, conduct performance analysis, and improve human resource efficiency. Numerous studies have shown that HRIS significantly impacts human resource management performance (Wahyoedi et al., 2023), as shown in Table 1.

Table 1. Efficiency of human resource management with HRIS application

Criteria	Traditional Human Resource Management	Human Resource Management with HRIS
Processing Speed	Slow, manual data entry	Fast, automated
Accuracy	Prone to errors due to manual operations	High accuracy due to synchronized data

Cost Savings	High costs due to manual operations	Cost reduction through automation
Supports human resource management decisions	Limited, dependent on past data	Analysis based on standardized data, accurate trend forecasting

Source: Author's suggestion

The implementation of HRIS has proven remarkably effective in optimizing human resource management processes. One study found that organizations implementing HRISs can reduce time spent on daily administrative tasks by up to 30% (Bashir et al., 2023).

Furthermore, HRIS has become even more effective in the post-COVID-19 pandemic context. According to research by Nazir Khan and Ashraf (2024), these digitized human resource management systems have helped organizations optimize recruitment and personnel management processes, thereby improving employee retention. In addition, the application of HRIS also facilitates the storage and management of human resource data, enabling managers to easily monitor and evaluate performance indicators, predict employee turnover, and improve employee retention (Qawasmeh et al., 2024)

2.3. Improving the Efficiency of Internal Information Management in Human Resource Management

In addition to optimizing processes, information technology significantly improves internal communication and information management within organizations. Platforms such as Microsoft Teams, WhatsApp, and Google Workspace have enabled employees to communicate and work together effectively, regardless of geographical location. IBM is a prime example of the successful application of digital tools to internal management. The use of communication platforms helped IBM reduce the time spent on in-person meetings by 30%, while simultaneously increasing collaboration efficiency between teams (Lin & Wu, 2024). This demonstrates that technology not only saves time but also creates a flexible work environment where employees can easily access the information and resources needed to complete their work. (Table 2)

Table 2: The impact of digital tools on the effectiveness of internal communication.

Digital Tools	Main Functions	Impacts
Microsoft Teams	Supports meetings and remote work	Increases work efficiency
Social networking, messaging	Supports networking, recruitment, and internal information exchange	Increases information exchange speed
Google Workspace	Online office suite	Easy document access, saves time
Zoom	Online meeting platform	Reduces travel costs and time

Source: Author's suggestion

Furthermore, the use of digital tools helps improve human resource management in employee recruitment (Afzal et al., 2023) and recruitment quality (Jeelani & Hussain, 2023).

2.4. Application of Artificial Intelligence in Human Resource Management

Artificial intelligence has made a significant difference in human resource management, particularly in data analysis for strategic HR decisions. According to Abbasi and Esmaili (2024), AI can analyze data from millions of employees, thereby identifying trends in turnover rates, training needs, and other factors affecting individual performance. (Table 3)

Table 3: Applications of artificial intelligence in human resource management.

Human Resource Management	Artificial Intelligence Application Methods	Benefits
Recruitment	Candidate evaluation based on big data	Selecting the most suitable candidates for recruitment needs
Training and Development	Forecasting training needs based on performance and job size changes	Continuous development tailored to each employee's specific needs
Employment Turnover Prediction	Analyzing trends and forecasting employee turnover	Reducing turnover rates and retaining talent
Optimizing salaries	Analyzing data to optimize salary structure and salary scales by job title	Increasing employee satisfaction and commitment

Source: Author's suggestion

According to previous studies, artificial intelligence helps improve all aspects of human resource management. Zhang and Chen (2023) showed that AI can improve the accuracy of salary and bonus decisions, thereby enhancing employee satisfaction and commitment to the organization. Regarding employee training and development, artificial intelligence can be used to provide online training courses, virtual classes, and teaching materials that are accessible anytime, anywhere (Qawasmeh et al., 2024). Additionally, virtual assistants can help measure the effectiveness of training programs and employee progress (Afzal et al., 2023).

In payroll, many businesses have automated processes, thereby minimizing human error in payroll calculations (Li et al., 2021). Furthermore, information technology can also help store employee records and payroll data, and track employee performance in real time through online performance management systems (Li et al., 2021). This allows managers to provide feedback and rewards quickly and promptly.

Human resource management was a topic of interest and in-depth analysis for researchers in the early 20th century, with the "Scientific Management" theory (Taylor, 1911), which considered garment workers as merely an extension of a sewing machine. At the end of the 20th century, Resource-Based Theory (Barney, 1991) marked a turning point. Resource-Based Theory asserts that while machines can be purchased and processes can be replicated, management capabilities and employee engagement are the strategic assets that create differentiation.

In recent years, the concept of digital human resource management has emerged as an inevitable consequence of the Fourth Industrial Revolution (Bondarouk & Ruël, 2009). Research indicates that digital transformation in human resources is no longer limited to the computerization of files. It is the extensive integration of big data, artificial intelligence, and cloud computing that changes how businesses recruit, train, and evaluate performance.

Author Le Dinh Thanh, in his research paper "The Current Situation and Solutions for Human Resource Management in the Context of Digital Transformation in Vietnam" (LE DINH), studies the current situation and solutions for human resource management in Vietnam in the era of digital transformation. The author points out that although technology helps optimize processes and increase productivity, domestic businesses still face barriers in leadership thinking and a shortage of highly skilled human resources. This document emphasizes the importance of digitizing data, automating recruitment, and training to enhance competitive advantage. Through this, the paper proposes a roadmap for change that starts with leaders' awareness, combined with policy support from the State. The ultimate goal is to build a modern management system that helps businesses adapt flexibly to the Fourth Industrial Revolution. This

is a useful reference document for managers in connecting business strategy with digital technology.

The study “Integration of Industry 4.0 Technologies to Overcome Lean Manufacturing Barriers in Sri Lanka’s Apparel Sector” by Silva et al. (2026) identifies a four-step roadmap for integrating Industry 4.0 technologies into Sri Lanka’s apparel industry: establishing a Lean foundation, strengthening strategic management, developing human resources, and seeking external support to ensure that existing Lean practices are not disrupted. Integrating Industry 4.0 with Lean increases transparency, improves defect detection, reduces downtime, and minimizes non-value-adding activities when properly implemented. The study also recommends that managers prioritize investments in IoT monitoring, predictive maintenance, and digital visibility management systems, as well as implement training programs to enhance workforce readiness and change management. However, it lacks clear guidelines for integrating Industry 4.0 technologies into a Lean environment.

The study "The Current State of Vietnam's Textile and Garment Industry and the Challenges Facing the Fourth Industrial Revolution" (Nghi, 2022) analyzes the current state of development and the industry's important position in the national economy, particularly the changes since the Covid-19 pandemic. The author emphasizes the major challenges businesses face in the Fourth Industrial Revolution, including pressure to innovate and a shortage of highly skilled human resources. The author assesses in detail the readiness of sub-sectors such as yarn, weaving, dyeing, and garment manufacturing for automation and smart management. The study proposes strategic solutions, including investing in research and development, partial digital transformation, and upgrading the vocational training system. This helps textile and garment businesses orient their modernization roadmaps to maintain competitiveness in international markets.

The study "Skill Needs of Vietnamese Textile and Footwear Enterprises in the Context of Digital Transformation" (Dang & Nguyen, 2025) examines the skill needs of Vietnamese textile and footwear enterprises amid the digital transformation. The study indicates that the current workforce meets only average requirements, leading to a shortage of personnel for high-tech operations and management. New competencies, such as digital skills, automated machinery operation, and problem-solving, are becoming essential to maintaining competitiveness. However, businesses still face many financial and time barriers in retraining employees. The study emphasizes the importance of building a proactive human resource strategy and of government policies supporting the development of human capital. Therefore, the article affirms that improving technical skills is a key factor for this industry to adapt to the Fourth Industrial Revolution.

Various research studies confirm that each author explores digital transformation in human resource management and resource optimization in different ways. Each study has highlighted the strengths of applying digital transformation in human resource management. However, no study has yet used quantitative methods to compare the investment costs of digital human resource management technology with those of human resource optimization in the garment industry. Business owners are still worried that digitalization will increase operating costs, and employees are not yet mentally prepared to implement digital transformation due to the fear of job loss. Therefore, the author chose the topic "Digital Transformation in Human Resource Management and Resource Optimization in Garment Manufacturing Enterprises" to propose solutions for applying digital transformation to garment manufacturing enterprises to optimize resources.

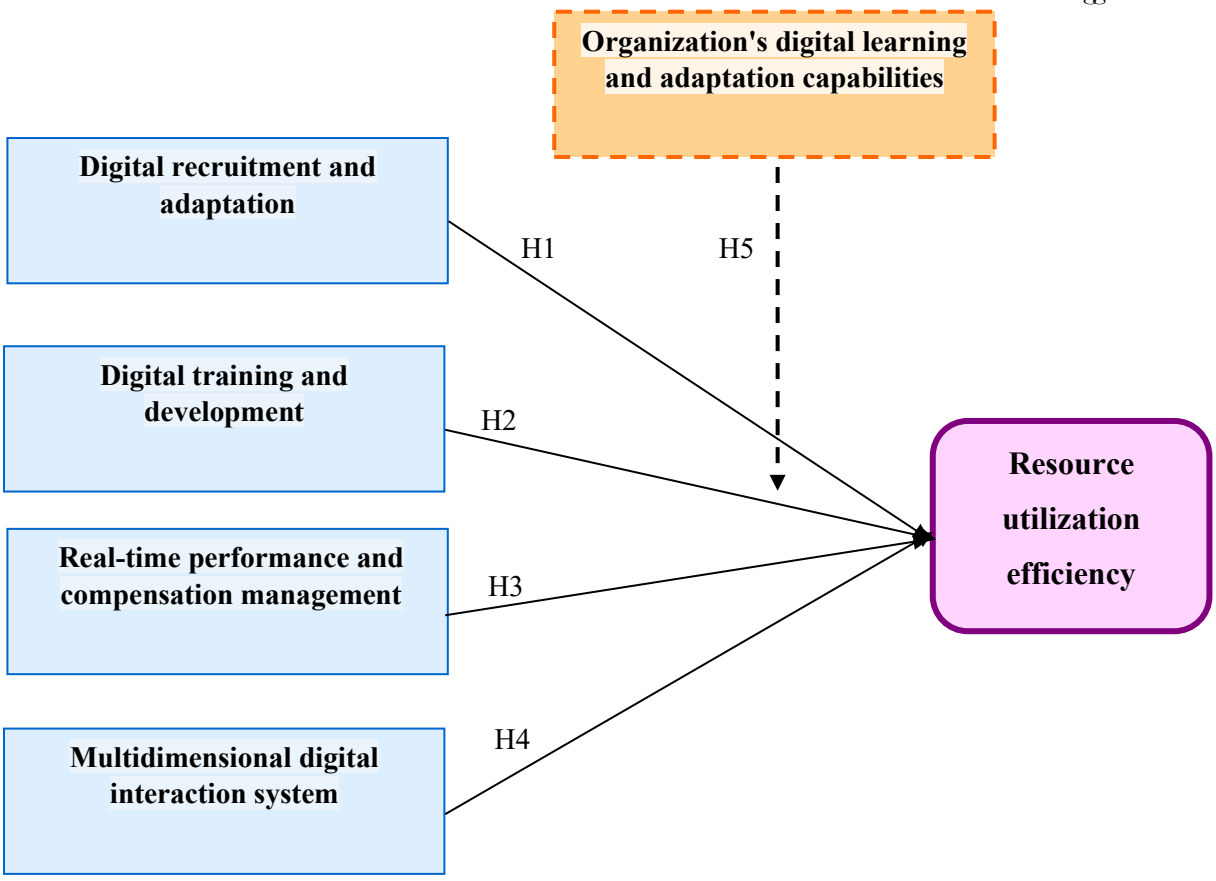
3. Hypotheses development

To optimize human resources in the garment industry, the author does not approach digital technology in isolation but instead develops a model that leverages the synergy among

technology, the employee lifecycle, and operational efficiency. This model is designed to assess whether the digitalization of human resource management actually affects productivity in garment manufacturing enterprises.

Figure 1. Research Model

Source: Author's suggestion



The model has 4 independent variables:

X1: Digital recruitment and rapid adaptation measure the effectiveness of using AI to screen skills from the outset, and digital integration training processes that help workers understand and operate automated machinery in the shortest time.

X2: Visual training and micro-learning focus on short videos or AR/VR training platforms right at the machine table. Workers learn new pattern-making techniques directly on electronic screens, minimizing apprenticeship time and technical errors.

X3: Real-time performance management and rewards are core elements of digital transformation. Production data is recorded from machine head sensors and displayed instantly on electronic boards or personal apps. When effort is recognized and rewarded, labor motivation will change completely.

X4: Multidimensional digital interaction platforms use mobile applications to replace loudspeakers or paper bulletin boards. This variable measures the connection between workers and factory management, allowing for quick feedback on machinery malfunctions or welfare requests.

Y: The dependent variable is resource optimization performance, including: Production performance, focusing on actual labor productivity and first-time pass rate; Business performance, which is order fulfillment speed and the ability to flexibly switch product codes; Financial performance, which is the ability to

control labor costs per product and minimize waste from excessive overtime.

Moderating variable: Digital learning and adaptation capacity explain the difference between success and failure. A factory may buy the same software, but the results will differ depending on the organizational culture. This variable measures the readiness of middle management and the ability of general workers to absorb technology. If learning capacity is low, technology will become a burden rather than a lever.

Based on the above arguments, the study has developed the following main hypotheses:

H1: Digital recruitment helps reduce the time to fill job vacancies, ensuring the continuity of production lines.

H2: Visual training helps reduce defect rates and material waste.

H3: Real-time performance management stimulates increased intrinsic worker productivity.

H4: Effective digital interaction helps reduce turnover rates and retain skilled workers.

H5: Organizational learning capacity moderates the effectiveness of all digital human resource management activities.

The author used quantitative methods to test the hypotheses through data collected from garment manufacturing companies. The primary data collection tool was a 5-point Likert-scale survey questionnaire, based on studies by Bondarouk and Thite (Thite, 2018). The core difference in scale design lies in the use of industry-specific questions rather than questions about general digital transformation concepts. The questions focus on workers' ability to interact with real-time output data and the flexibility of the digital skills matrix on each sewing line.

The data collection process was conducted in Ho Chi Minh City and Dong Nai, which have the highest concentration of textile and garment enterprises and are pioneers in adopting digital transformation to maintain and expand international orders and partnerships. The study surveyed 300 respondents, primarily production managers, supervisors, and especially line leaders. These individuals directly operate the technology and have the most comprehensive understanding of productivity variations when digital management tools are implemented.

To conduct the quantitative analysis, the authors used SmartPLS software (Fong & Law, 2013). The analysis process was rigorously carried out by evaluating the measurement model to determine reliability and convergence validity through AVE, CR, and HTMT criteria; and evaluating the structural model using Bootstrapping techniques to test the path coefficients (Fornell & Larcker, 1981). This approach ensures that each conclusion about the relationship between technology and performance is grounded in a reliable mathematical foundation.

4. Results

4.1. Evaluation of the Measurement Model

4.1.1. Reliability and Validity

In a PLS-SEM, evaluating the measurement model requires assessing reliability and validity. This assessment is performed based on Cronbach's Alpha, rho_A, and composite reliability indices.

Table 4: Results of reliability and validity analysis

Variable	Variable name	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
X_1	Digital recruitment and adaptation	0,885	0,888	0,921	0,745
X_2	Digital training and development	0,869	0,896	0,919	0,790

X_3	Performance and compensation in real time	0,772	0,846	0,854	0,661
X_4	Digital interaction via mobile devices	0,856	0,959	0,899	0,692
Y	Optimizing human resources	0,900	0,901	0,938	0,834
Z_1	Digital agility of the organization	0,910	1,042	0,921	0,746

Source: Data processing using the Smart PLS model

Based on the criteria proposed by Fong, Hair, and colleagues, coefficients with values of 0.70 or higher are required to ensure that the scale has good reliability. According to the results presented in Table 4, all research variables exceed the standard Cronbach's Alpha threshold, ranging from 0.772 to 0.910, while composite reliability ranges from 0.854 to 0.938. The dependent variable shows a high reliability coefficient of 0.938, indicating that the criteria for measuring factory optimization are well established. Real-time performance and compensation exhibit the lowest coefficient, at 0.772; however, this value still exceeds the acceptable threshold and accurately reflects the variability in productivity and income data at the production level.

Average Variance Extracted (AVE) is an index used to assess convergent validity. According to the criteria proposed by Fornell and Larcker, an AVE value greater than 0.50 indicates that the latent construct explains most of the variance in its observed variables. Based on the data in Table 1, all variables in the model fall within the range of 0.661 to 0.834, thereby meeting the required criterion. The variable related to resource optimization has the highest AVE value, indicating strong convergence among productivity, quality, and labor costs within the dependent variable (Y).

Based on the model results, each independent variable plays a specific role in influencing the dependent variable. Variable X1 has a confidence level (CR) of 0.921, confirming that personnel is stable from the initial stage, minimizing wasted time on retraining when recruitment is digitized from the start. Variable X2, with an AVE of 0.79, indicates that visual training helps standardize workers' skills, reducing error rates on sewing lines.

Variable X3, with an AVE of 0.661, indicates that transparency in production data boosts labor productivity on the lines.

Digital interaction via mobile devices has a reliability coefficient of 0.899, demonstrating that this is a very important channel for maintaining engagement between workers and management, helping workers feel satisfied and thus reducing turnover rates.

With Cronbach's Alpha reliability coefficients of 0.910 and 0.921, organizational flexibility has driven the adoption of digital technology in the business. The more flexible the organization, the greater the effectiveness of digital transformation in human resource management.

4.1.2. Discriminant Validity

After assessing reliability and validity, the authors evaluated the model's discriminant validity using the Fornell-Larker criterion.

Table 5: Measurement results according to Fornell-Larker

Variable	Variable name	X1	X2	X3	X4	Y	Z1
X_1	Digital recruitment and adaptation	0,863					
X_2	Digital training and development	0,592	0,889				

X_3	Performance and compensation in real time	0,115	0,300	0,813			
X_4	Digital interaction via mobile devices	0,313	0,698	0,229	0,832		
Y	Optimizing human resources	0,547	0,562	0,470	0,472	0,913	
Z_1	Digital agility of the organization	0,364	0,422	0,208	0,256	0,453	0,864

Source: Data processing using the Smart PLS model

Table 6: Measurement results according to HTMT ratio

Variable	Variable name	X1	X2	X3	X4	Y	Z1
X_1	Digital recruitment and adaptation						
X_2	Digital training and development	0,655					
X_3	Performance and compensation in real time	0,236	0,341				
X_4	Digital interaction via mobile devices	0,371	0,775	0,217			
Y	Optimizing human resources	0,610	0,612	0,513	0,496		
Z_1	Digital agility of the organization	0,323	0,360	0,249	0,231	0,385	

Source: Data processing using the Smart PLS model

According to this criterion, the square root of the Average Variance Extracted (AVE) for each variable, shown on the diagonal, must be greater than all correlation coefficients between that variable and the others in the model. The data in the table indicate that all these values are significantly higher than the corresponding correlation coefficients in both rows and columns. The AVE values range from 0.813 to 0.913, demonstrating that discriminant validity is established for all constructs.

In addition, the author employs the Heterotrait–Monotrait ratio (HTMT) to further assess discriminant validity. According to the threshold suggested by Henseler, Ringle, and Sarstedt (2015), HTMT values should be below 0.85 or 0.90. Based on the results in Table 3, all HTMT values are below the stricter threshold of 0.85. Although variables X2 and X4 exhibit relatively higher HTMT values than the others, they remain within the acceptable range, thereby confirming the discriminant validity of the constructs in the model.

The data table shows that the digital training and development variable has a strong correlation with variable Y. When skills and techniques are systematically trained in line with the digital platform's standards, labor productivity will increase. Variable X1, with a correlation coefficient of 0.547, confirms the importance of applying digital transformation in recruitment. Given the nature of the garment manufacturing business, employing a large workforce is essential. Therefore, applying digital transformation helps the business select the right people, assign them to the right jobs, reduce training time, and stabilize production lines.

Variables X4 and X3 have almost identical correlations with the dependent variable, demonstrating that a transparent work environment and seamless mobile data connectivity create a comfortable work environment for employees, motivating them and contributing to employee retention. The mediating variable impacts the dependent variable Y with a correlation coefficient of 0.453, confirming that the adaptability of individuals and units within the garment manufacturing enterprise is a crucial factor in applying digital

transformation in the business, helping to optimize human resource efficiency.

The data table confirms that the measurement model has very good discriminatory power. The data not only ensures statistical accuracy but also reflects the relationship between the application of digital transformation in production and the improvement of production efficiency in the enterprise.

4.2. Structural Model Evaluation

To evaluate multicollinearity, we use the Variance Inflation Factor (VIF).

According to Hair et al., the standard in PLS-SEM analysis requires VIF coefficients to be less than 5.0. If the VIF exceeds the specified threshold, the estimated effect coefficients will be unreliable due to variable overlap.

Table 7: VIF value results

Variable	Variable name	VIF
X_{11}	Digital systems help businesses find the right skilled workers to fill vacant positions on the production line faster than before.	2,915
X_{12}	Video- and image-based onboarding training helps new workers grasp regulations and workplace safety more easily.	3,421
X_{13}	Technology significantly reduces the time new workers need to familiarize themselves with the machines before officially starting on the production line.	3,947
X_{14}	Recruitment data helps us forecast labor supply to plan production proactively.	1,862
X_{21}	Video tutorials on sewing collars, pockets, etc., on tablets/phones make it easier for workers to learn than paper documents.	2,468
X_{22}	Workers can proactively learn new techniques right at the machine when a new product code is introduced, without needing long-term training sessions.	1,986
X_{24}	Learning through visual aids significantly reduces common technical errors when changing product codes. Electronic display boards on the production line/tablets show actual production output, allowing workers to adjust their work pace accordingly. Workers feel more motivated knowing exactly how much in bonuses/productivity they earn during their shift.	2,765
X_{31}	Automated payroll and bonus systems eliminate questions and complaints about a lack of transparency in income.	2,817
X_{32}	Mobile applications allow workers to request leave or view payslips quickly without having to go to the HR office.	3,129
X_{33}	Notifications from factory management are communicated to workers immediately via the mobile application.	1,256
X_{41}	Workers feel more respected when they can contribute ideas or report machinery problems through the digital system.	2,186
X_{42}	Continuous connectivity via the app increases employee engagement and reduces the likelihood of quitting.	1,708
X_{43}	The application of digital transformation in human resource management has significantly increased the factory's overall productivity.	2,092

X_{44}	Product code changeover time is shortened thanks to the proper allocation of skilled personnel.	2,044
Y_{12}	Labor costs per unit are optimized by reducing unnecessary overtime.	4,339
Y_{13}	The team of supervisors and foremen is always open and supportive of adopting new management technologies.	2,987
Y_{14}	Workers at the factory adapt quite quickly to using tablets or mobile applications.	2,553
Z_{11}	The factory has a culture of knowledge sharing and mutual support when approaching new digital processes.	3,788
Z_{12}	The leadership is always decisive and prioritizes budget allocation to improve staff's technological capabilities.	2,365
Z_{13}	Digital systems help businesses find the right skilled workers to fill vacant positions on the production line faster than before.	2,456
Z_{14}	Video- and image-based onboarding training helps new workers grasp regulations and workplace safety more easily.	3,460

Source: Data processing using the Smart PLS model

Based on the data table, we see that all indices for the independent, moderating, and dependent variables are within the range of 1.256 to 4.339, all less than 5, indicating that the research model does not exhibit multicollinearity and that the variables do not overlap.

The variables for shortening machine familiarization time and video-based onboarding training have coefficients of 3.947 and 3.412, respectively, which are higher than those of other variables but still within acceptable limits. In production management, onboarding training and machine familiarization time are closely related; however, in this model, they are distinct concepts that do not overlap in meaning.

The variables X33 and X42 have very low VIF values, indicating that employees in the enterprise are highly satisfied with the transparency of the benefits they receive and the timely, efficient information exchange within the enterprise. This is the key factor driving resource optimization in the business.

The variable Y12 has the highest value but is still within the specified range. This confirms that the application of digital transformation in the garment industry is closely linked to other indicators while still ensuring measurement differentiation. The variable "Leadership assertiveness" has a VIF of 3.788, indicating that leaders consistently play a key role throughout the digital transformation process in the garment industry.

The VIF coefficients for the variables meet the standards, indicating that the structural model is not only mathematically significant but also captures the differentiation among factors such as digital recruitment and training, information transparency, and digital interaction. Each variable is distinct but forms a cohesive whole that helps retain employees, reduce unnecessary costs, and thus optimize resources for the garment industry.

Table 8: R-Square and R-Square Adjusted Coefficients

Variable	Variable name	R Square	R Square Adjusted
X_1	Digital recruitment and adaptation	0,133	0,130

X_2	Digital training and development	0,178	0,175
X_3	Real-time performance and compensation	0,043	0,040
X_4	Digital interaction via mobile devices	0,066	0,062
Y	Optimizing human resources	0,526	0,519

Source: Data processing using the Smart PLS model

The authors used the R^2 coefficient to assess the structural model's fit. This index indicates the proportion of the dependent variable's variation explained by the independent variables in the model. Based on the criteria of Hair et al., the R^2 value is divided into three thresholds: 0.75 is strong, 0.5 is medium, and 0.25 is weak. Based on the model's results (R^2 = 0.526, adjusted R^2 = 0.519), it is evident that digital transformation in human resource management explains 52.6% of the variation in resource optimization within the enterprise. This confirms that applying digital transformation to human resource management is a key factor in optimizing resources. The small difference between R^2 and the adjusted R^2 demonstrates the model's high stability, making the addition of independent variables entirely reasonable and avoiding variable overload.

The digital training and development variable has an R^2 of 0.178, indicating that when workers' skills are standardized through video tutorials and micro-learning, labor productivity is directly and significantly improved. The recruitment and adaptation variable has a lower R^2 but still demonstrates a certain role. Digital transformation applications help garment businesses select and assign the right skilled workers and shorten the time to familiarize themselves with modern machinery and technology. Variables X3 and X4 have lower R^2s than the two above, but their mediating role is not negated. Work performance and employee satisfaction are significant factors in optimizing resources.

With an average R^2, this confirms that the independent variables proposed by the authors all have an impact on resource optimization in textile and garment businesses. The factors presented in the authors' research model are all supported by scientific evidence..

4.3 Hypothesis Testing

To test the hypotheses, the study employs the bootstrapping technique. This approach helps determine how digital transformation in human resource management impacts resource optimization. According to the criteria proposed by Hair et al., the p-value must be less than 0.05 and the t-statistic must exceed 1.96 to be considered statistically significant.

Table 9: Hypothesis testing results

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
X_1 -> Y	0,398	0,400	0,061	6,505	0,000
X_2 -> Y	0,067	0,065	0,090	0,750	0,453
X_3 -> Y	0,354	0,355	0,056	6,360	0,000
X_4 -> Y	0,220	0,222	0,075	2,928	0,004
Z_1 -> X_1	0,364	0,371	0,055	6,572	0,000
Z_1 -> X_2	0,422	0,429	0,047	8,898	0,000
Z_1 -> X_3	0,208	0,208	0,078	2,659	0,008
Z_1 -> X_4	0,256	0,266	0,063	4,061	0,000

Source: Data processing using the Smart PLS model

Based on the data table, with the recruitment optimization variable (X1) having a β coefficient of 0.398, a T value of 6.505, and a P value of 0.000, this hypothesis is accepted. This variable has the strongest impact on optimizing enterprise resources. When applying digital transformation to recruitment, it helps businesses select skilled workers and adapt them to the job quickly, thereby reducing wait times between stages and optimizing production. However, with a β-coefficient of 0.067, a T-value of 0.75, and a P-value of 0.453, this hypothesis is rejected because the indicators have exceeded the prescribed standards. This means that digital training via video and micro-learning is necessary. Still, it does not directly optimize human resources because, given the specific characteristics of the garment industry, workers in these areas are often unskilled laborers accustomed to hands-on training and are unable to adapt to modern technology. This is also a noteworthy point for businesses in the garment industry. If processes are not yet standardized, the application of digital transformation is essential, but overuse should be avoided, as it can be counterproductive.

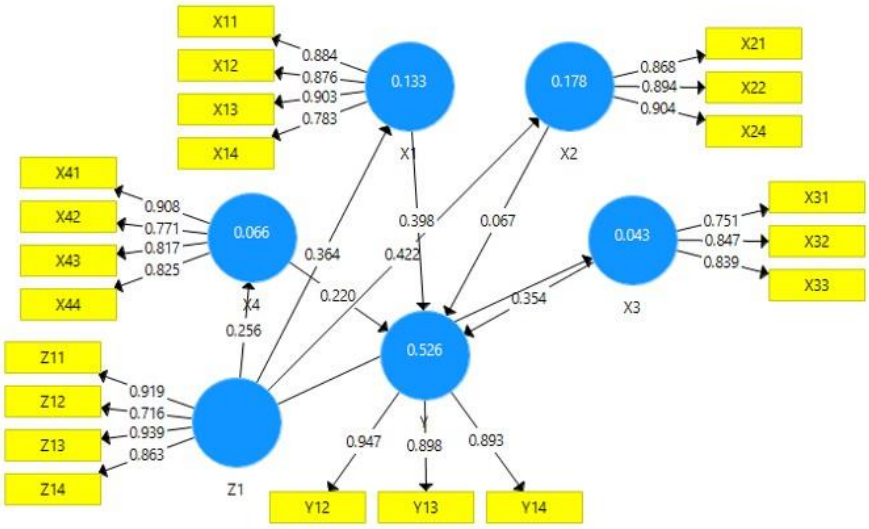
The accepted variables for performance and real-time compensation have a β coefficient of 0.354, a t-value of 6.36, and a p-value of 0.000. This confirms that garment workers are more efficient when their achievements are recognized immediately, especially when output and bonuses are displayed on electronic boards, eliminating disputes over income, boosting motivation, and contributing to resource optimization.

The variable for digital interaction via mobile devices (X4) is also accepted, with coefficients meeting standards, demonstrating its important role in employee retention. Connecting via smartphones helps reduce cumbersome administrative procedures, minimize direct contact between people, and reduce employee turnover, thereby optimizing resources.

The relationships from Z1 to X1, X2, X3, and X4 all show strong statistical significance, with P-values meeting the standard, demonstrating that Z1 is the foundation for promotion. Flexibility in digital thinking will facilitate smoother digital human resource management, thereby significantly improving resource optimization.

The hypothesis test results confirm that variables X1 and X3 have a direct impact on resource optimization. For variable X2 to be effective in textile and garment businesses, a specific approach and application, along with the ingenuity of textile and garment business managers in applying digital transformation, are needed.

Figure 2: Results of measuring the research model



Source: Data processing using the Smart PLS model

5. Discussion

The analysis results show that over 50% of the variation in resource optimization is explained by factors such as digital recruitment, transparent performance, and immediate rewards based on published results, which satisfy employees and motivate them to contribute their efforts and intelligence to the job. Textile and garment businesses are characterized by the use of many unskilled laborers, frequent downtime on production lines, and unclear data on the productivity and effort of each individual in each department. Applying digital transformation enables the selection of skilled workers and shows them their immediate income increase on an electronic display board, thereby boosting productivity. This is not just about optimizing machinery, but also about optimizing employee psychology. This is entirely consistent with modern human resource management theory.

The research results contradict the prevailing trend of evaluating online training. This outcome prompts textile and garment business managers to reconsider their approach. Applying digital transformation to training is essential, but it requires a method that suits the specific characteristics of the garment industry. The garment industry doesn't require highly specialized knowledge, but it does require skills, meticulousness, and dexterity. Training through images and videos cannot be separated from direct human instruction. Technology is only effective when it is compatible with human beings' specific skills.

Organizational flexibility is the foundation for promoting all digital human resource management activities. Implementing digital transformation is not simply about purchasing machinery and software; it also involves a shift in leaders' mindsets. When business leaders are willing to apply the superior advantages of digital transformation, it will help the business optimize resources more quickly.

6. Conclusion

The study shows that not all digitalization activities yield immediate results; the real power lies in combining smart recruitment with transparent performance data. The research contributes to filling the knowledge gap in Human Resource Management 4.0 in traditional manufacturing industries.

Garment businesses should focus their budget on digital recruitment systems and interactive performance boards on the production line. When these elements are prioritized, they will yield the fastest return on investment. Integrate technology directly into the machine rather than fragmented e-learning. Digital training should be a supporting tool, not a complete replacement for direct technical instruction. Garment business leaders need to be pioneers in using digital human resource management data to inform decisions rather than relying on subjective experience.

Besides the achievements, the study still has limitations regarding the sampling area and sample size. The analysis results are based solely on survey data and have not been combined with observations of actual factory data.

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Institutional Review Board Statement

Ethical review and approval were waived for this study due to its nature: it involved anonymous expert surveys and professional technical evaluations that did not collect sensitive personal data or pose any risk to participants. Under local institutional guidelines in Vietnam (Circular No. 04/2020/TT-BYT), formal IRB approval is not required for this type of anonymous expert survey.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The data presented in this study are available on request from the corresponding author. The data will be shared if a reasonable request is made for academic or research verification purposes.

Conflicts of Interest

The authors declare no conflict of interest.