Factors Affecting The Development of High-Quality Human Resources in Plastic Enterprises in Hai Phong

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Abstract: The purpose of this study is to evaluate the influencing factors and propose policies for developing high-quality human resources in plastic manufacturing enterprises in Hai Phong in the context of integration. This workforce plays a crucial role in improving productivity, increasing workers' income, and boosting the national economy. The survey focuses on plastic manufacturing enterprises in the city, examining the core factors of human resources. The theoretical model includes six factors: quantity, structure, physical fitness, intelligence (knowledge), skills, and mental capacity of the workforce. The authors combined qualitative and quantitative research methods through in-depth direct interviews with enterprise leaders. Simultaneously, the authors collected and analyzed survey data from 328 managers and workers. The empirical results indicate that skills (intelligence), personnel structure, and knowledge (intelligence) are the groups with the greatest direct influence. Meanwhile, the remaining three factors—physical fitness, mental fitness, and the number of human resources—only show indirect impacts. This finding provides important scientific arguments to help businesses in the plastics industry develop appropriate and employee-friendly human resource management policies. This is a core foundation for continuously improving labor productivity, enhancing product quality, and increasing competitiveness in the current process of economic integration..

Keywords: Human resource development, high quality, plastic manufacturing enterprises.

INTRODUCTION

Hai Phong is a centrally-governed port city located in the heart of the Northern key economic region. The 17th Party Congress of Hai Phong City set the goal of transforming it into a modern, civilized, and sustainable industrial city of regional significance in Southeast Asia by 2030. Strategically positioned as the main gateway to the sea for both the Northern region and southern China via the Lach Huyen deep-water port system, the coastal highway, and the establishment of two important special economic zones – Cat Hai and Bach Long Vi – the city aims to become a sustainable international tourism and marine economic center. The development strategy focuses on three breakthrough pillars:.

marine economy, high-tech industry, and international tourism, with a determination to maintain double-digit GRDP growth

The year 2025 marks a historic turning point as the economic space is expanded through mergers with Hai Duong province, increasing the population to over 4.6 million people and the area to 3,194.72 km2. The city recorded a GRDP growth rate of 11.81% – the 11th consecutive year maintaining double digits, bringing the size of the economy to the 3rd largest in the country, reaching approximately 30 billion USD. Per capita income reached 194.5 million VND, and the city officially announced that there are no longer any poor households according to the multidimensional poverty standard.

In the overall picture, the plastics manufacturing industry has seen a strong breakthrough with an Industrial Production Index (IIP) growth rate of 17%, thanks to a shift towards supplying components for the electric vehicle and electronics industries. The green transition roadmap, replacing 100% of non-biodegradable plastic bags in shopping malls, also opens up significant opportunities for the bioplastics sector. To meet this trend, the city's trained and qualified workforce has reached 39%, along with a "red carpet" policy offering generous rewards of up to 500 million VND for talented individuals.

To provide arguments for sustainable development, this study comprehensively explores the theoretical and practical foundations related to the development of high-quality human resources in Hai Phong. The research delves into establishing evaluation criteria, analyzing achievements, limitations, and root causes during the 2021–2025 period. From this, the article presents key policy implications for the city's international integration process in the period up to 2030, with a vision to 2050.

This study focuses on analyzing six factors that directly and indirectly affect the workforce in plastic manufacturing businesses in Hai Phong, including: quantity, structure, physical fitness, intellectual capacity, intelligence, and mental fortitude. The results of the field survey provide a scientific basis for plastic manufacturing businesses to develop appropriate human resource policies. This successful model is expected to be effectively replicated for the plastic manufacturing business community in Hai Phong in particular and throughout Vietnam in general.

THEORETICAL FRAMEWORK

2.1. High-quality human resources

In the digital age and the Fourth Industrial Revolution, high-quality human resources play a crucial strategic role in determining the position of each nation and enterprise. This is an elite workforce, not only mastering modern technology but also possessing creative thinking to lead change. Investing in people is the most sustainable investment in building strong internal capabilities, promoting comprehensive modernization, and achieving rapid development in a volatile environment.

In Vietnam, domestic studies have pointed out institutional bottlenecks and a shortage of key human resources, particularly in the semiconductor chip industry. Authors Pham Sy Long, Ha Dieu Linh (2024) and Le Tien Dung (2024) emphasize the importance of the model linking the State, schools, and FDI enterprises, while affirming that talent must have practical innovation capabilities instead of relying solely on academic qualifications. At the macro level, Phung Quoc Hien (2025) positions high-quality human resources as a strategic breakthrough for the nation to escape the middle-income trap through the combination of artificial intelligence and human intelligence.

Globally, the trend of developing high-quality human resources is closely linked to adaptability and sustainability. According to the OECD (2025), workers must bridge the digital skills gap and acquire additional green skills. Sharing this view on flexibility, Gholamhossein Mehralian et al. (2025) argue that modern human resource management systems need to create self-adaptation mechanisms to promote the self-learning and discovery abilities of the workforce, thereby helping businesses withstand the continuous changes in the global market.

2.2. Developing high-quality human resources

In the knowledge economy and the explosion of artificial intelligence, high-quality human resources are a vital factor determining the fate of both nations and businesses. These are individuals possessing deep expertise, innovative thinking, and the ability to master complex technologies. Developing this elite workforce requires a well-structured training strategy, a humane work environment, and a commensurate compensation policy to transform intellectual capital into a sustainable growth engine.

Author Tran Huu Ha (2021) warned about the paradox of unreasonable resource allocation and affirmed that strong incentive mechanisms and a suitable working environment are the key to retaining talent, helping to transform the economic model from labor-intensive to knowledge-based [5] . In the same view, Norhasni Zainal Abiddin and colleagues (2021) emphasized that in the context of Industry 4.0, synchronizing skills between the education system and the actual needs of the market is a key factor in forming an elite workforce.

From a technology and systems perspective, Dang Thai Binh (2023) analyzed the impact of the Fourth Industrial Revolution in Vietnam, requiring workers to possess digital thinking and new technological skills to optimize performance. From the perspective of learning from regional experiences, Nguyen Thi Thu Huong and Truong Quang Hoan (2025) compared the strategies of Singapore and Malaysia, thereby proposing that Vietnam needs to build a lifelong learning ecosystem and closely connect universities and businesses at the international level.

Looking broadly at global trends, Shahrul Azuwar Abdul Aziz and Norhasni Zainal Abiddin (2025) focus on the urgent need to enhance readiness for the new industrial revolution. The authors assert that the combination of smart technology and retraining of workers is the core driver of socio-economic development. In this context, leadership capacity and workforce readiness are positioned as two solid pillars for maintaining global competitiveness.

2.3. Factors influencing the development of high-quality human resources

Developing high-quality human resources in enterprises is a systematic process, strongly influenced by the intrinsic factors of the employees and the organization's management strategy. In terms of individual capabilities, physical and mental strength play a core role. Author Nguyen Thi Loan (2022) affirms that physical health is a prerequisite for meeting high work intensity, while Gartner (2024) emphasizes that mental engagement and professional ethics will help employees maintain sustainable creative motivation.

Professionally, technical skills and technological operational capabilities are direct factors determining productivity. Authors Aziz and Abiddin (2025) and Dang Thai Binh (2023) share the same view, pointing out that in the context of digital transformation and Industry 4.0, workers must shift their mindset from manual operations to the ability to control automated systems. To address the gap between training levels and practice, Nguyen Thi Thu Huong and Truong Quang Hoan (2025) propose a core solution: an experimental cooperation model between schools and businesses.

From an organizational perspective, the quantity, quality, and structure of human resources form the framework for development. Tran Huu Ha (2021) warns that an irrational structure will waste resources, while Phung Quoc Hien (2025) emphasizes that a performance-based compensation mechanism is key to optimizing workforce quality. From an international perspective, the OECD (2025) positions flexible adaptability as helping businesses withstand market shocks, while Deloitte Insights (2026) predicts that management trends based on skill networks will replace traditional departmental structures.

For the plastics manufacturing industry, the green transformation wave and Industry 4.0 in the period 2021–2026 are placing very specific skill requirements on the industry. According to the Vietnam Plastics Association (VPA) (2025), workers not only need to master highly automated injection molding and film blowing lines, but also need to be capable of mastering the technical parameters for processing recycled plastic resins (PCR) and bioplastics. These are new materials with much more complex thermal and mechanical properties than traditional virgin plastic resins.

Despite significant achievements, there is currently no comprehensive research on this activity in Vietnamese plastic manufacturing enterprises; existing solutions are mostly isolated, lacking coordination, and difficult to replicate. Therefore, the goal of this article is to clearly identify the influencing factors and propose a comprehensive system of solutions. This will help manufacturing enterprises in general, and the plastics industry in particular, build a successful model for developing high-quality human resources that can be disseminated and sustained.

In summary, the research author argues that the factors influencing the development of high-quality human resources in plastic manufacturing enterprises in Hai Phong to meet international integration requirements include changes in quantity, improvement in quality, and restructuring of human resources in accordance with international practices regarding qualifications, knowledge, skills, professional ethics, and physical fitness, in order to ensure the structure of industries, sectors, and regions when integrating into the international economy.

RESEARCH METHODS AND RESEARCH MODEL

3.1. Research Methodology

Table 1. Scales and their origins

No.	Symbol	Observed variables and scales	The origin of the scale
1	SL	Number of human resources	Le Quy Anh (2023); Tran Huu Ha (2021)
2	CC	Human resource structure	Tran Huu Ha (2021); Deloitte Insights (2026)
3	SK	Physical fitness of human resources	Nguyen Thi Loan (2022); Le Quy Anh (2023)
4	KT	Intellectual capacity (Knowledge)	Dang Thai Binh (2023); OECD (2025)
5	KN	Intelligence (Skill)	Nguyen Thi Thu Huong & Truong Quang Hoan (2025); Aziz and Abiddin (2025)
6	TEM	Mental strength (Attitude/Mindset)	Gartner (2024)

(Source: Compiled by the author)

In this study on the development of high-quality human resources , the author uses a combination of qualitative and quantitative research methods to understand the factors influencing the development of high-quality human resources . To ensure the validity and reliability of the study, the scales for all variables in the research model were adapted from scales used by previous researchers and adjusted based on the results of the qualitative research. The author uses one dependent variable: the development of high-quality human resources in plastic manufacturing enterprises in Hai Phong city (HRD), which is measured by six observed variables (from HRD1 to HRD6). These variables were constructed from criteria for evaluating the development of high-quality human resources based on research results on the quantity of human resources, the structure of human resources, the physical fitness of human resources, intellectual capacity through the knowledge of human resources, intelligence through the skills of human resources, and the mental capacity of human resources according to Benjamin Bloom's ASK model, which was studied using the DACUM method to analyze and quantify work.

Each variable was evaluated using multiple indicators on a 5-point Likert scale (1 - strongly disagree; 5 - strongly agree), with descriptive statistical results using SPSS 2.6.0 software and reliability test results of the quantitative scale including the factors of human resources quantity, human resource

structure, physical fitness of human resources, intelligence through human resources knowledge, intelligence through human resources skills, and mental capacity of human resources according to Cronbach's Alpha coefficient, as presented here (Table 1).

3.2. Research Model

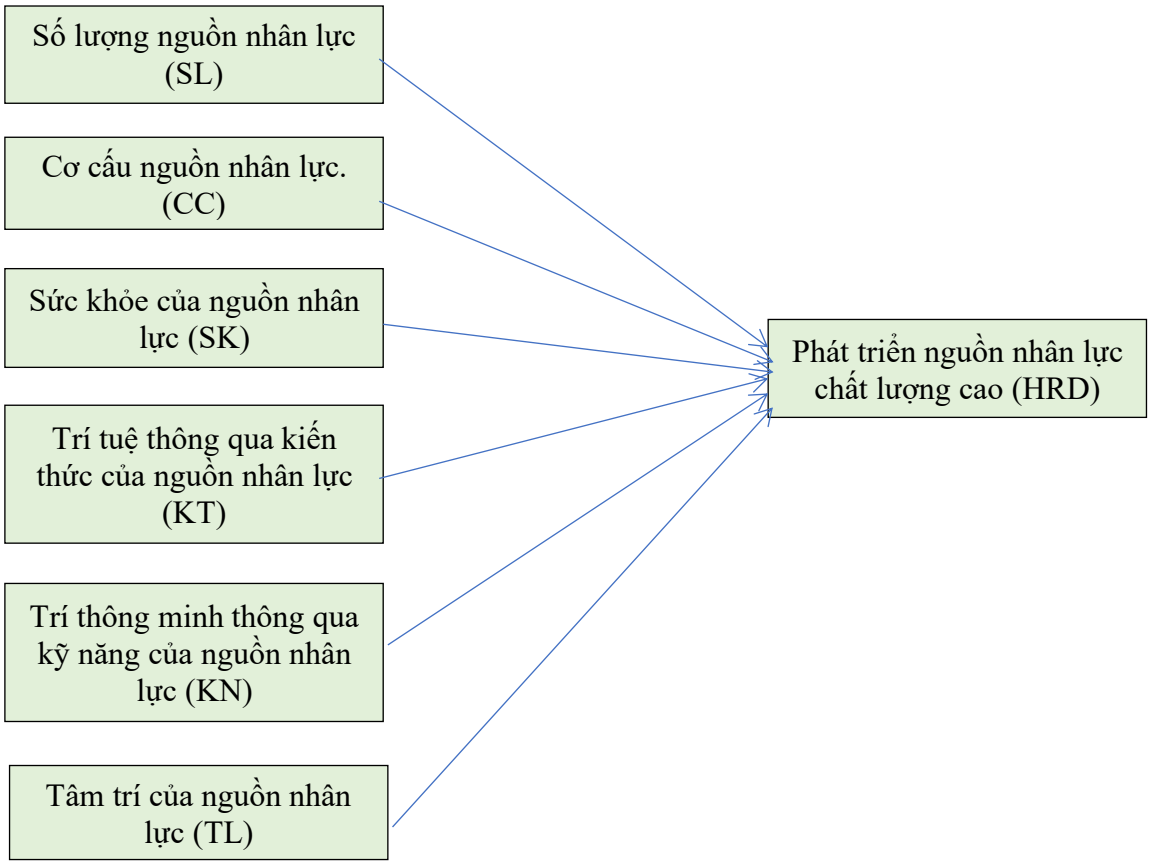
The research model includes 7 Variables are divided into two groups (independent variables and dependent variables):

Dependent variable: High-quality human resource development (HRD)

The group of independent variables reflects the factors influencing the development of high-quality human resources in plastic manufacturing enterprises in Hai Phong, including:

- SL: Number of human resources.
- CC: Human resource structure.
- SK: Physical fitness of the workforce.
- Knowledge: Intelligence through the knowledge of human resources.
- KN: Intelligence through the skills of human resources.
- TL: The mental strength of human resources.

Model 1. Research Model



(Source: Author's suggestion)

First, the author conducted a literature review and established theoretical frameworks, from which an initial research model was developed along with preliminary hypotheses and scales. To test the model's suitability, the author chose to conduct in-depth interviews with 24 experts and leaders at plastic manufacturing companies. These interviews helped clarify unsuitable variables and adjust the model to better suit the specifics of the research problem.

Next, the author finalized the formal model and developed a scale for the variables. To test the reliability of the scale, the author conducted a small-scale pilot survey. After evaluating and adjusting based on feedback from the pilot survey, the author conducted a large-scale survey, distributing questionnaires to plastic manufacturing companies. The objective was to survey stakeholders involved in developing high-quality human resources in plastic manufacturing companies, ensuring that the selection criteria for the survey were met. Due to the small and known sample size, the sample size was determined based on the given plastic manufacturing companies, using the following formula:

$$n = \frac{N}{1 + N \times e2} = \frac{1845}{1 + 1825 \times (0,05)2} = 328 \text{ phiếu}$$

n: Number of research samples

N: Total quantity

e: Error (using 95% accuracy, error e = 5%)

N = 1845; e = 0.05 (95%)

Thus, the study required a sample size of 328 questionnaires , surveyed 340 questionnaires, and obtained 328 valid questionnaires, ensuring a sufficiently large sample for statistical analysis using a 5-point Likert scale .

Table 2. Structure of the research sample

No.	Nature	Characteristic	Number (people)	Percentage (%)
1	Sex	Male	183	55.79%
		Female	145	44.21%
2	Job position/title	Board of Directors	20	6.10%
		Department/Team Leader	42	12.80%
		Employees, workers	266	81.10%
3	Educational level	At university	24	7.32%
		University	42	12.80%
		College	98	29.88%
		Intermediate level, unskilled labor	164	50.00%
4	Years of service	Under 5 years	72	21.95%
		From 5 to 9 years	150	45.73%
		From 10 to 20 years	68	20.73%
		Over 20 years	38	11.59%
		Total	328	100.00%

(Source: Results of data processing on SPSS software, issue 26, 2026)

The survey results were cleaned and processed by the author using SPSS 26 software with techniques such as reliability testing of the scale using Cronbach's Alpha coefficient; exploratory factor analysis (EFA), correlation analysis, and linear regression.

RESEARCH RESULTS

4.1. Checking the reliability of the scale using Cronbach's Alpha coefficient.

The reliability test results of the scale using Cronbach's Alpha coefficient show that all research variables meet the reliability requirements. The dependent variable, High-Quality Human Resource Development (HRD), has a Cronbach's Alpha coefficient of 0.945, indicating acceptable reliability with 6 questions. The independent variables are as follows: the quantity of human resources (SL) has a coefficient of 0.887 from 4 questions; the structure of human resources (CC) has a lower coefficient of 0.813, indicating very high reliability with 5 questions; the physical fitness of human resources (SK) has a coefficient of 0.777, indicating fairly good reliability with 5 questions; the intelligence through knowledge of human resources (KT) has a coefficient of 0.842 from 5 questions; and the intelligence through skills of human resources (KN) has a coefficient of 0.793, indicating reliability. The results were quite good across the five questions, and finally, the human resource confidence (TL) variable also had a coefficient of 0.849, indicating that this scale has good and very high reliability.

In addition, the total item correlation coefficients were all greater than 0.3. These results suggest that the scales can be reliably used in subsequent analyses.

4.2. Exploratory Factor Analysis (EFA)

Table 3. Rotation Factor Matrix

Pattern Matrix [a]						
	Factor					
	1	2	3	4	5	6
SL2	0.813					
SL4	0.803					
SL1	0.772					
SL3	0.665					
CC2		0.735				
CC1		0.699				
CC4		0.684				
CC5		0.653				
CC3		0.639				
SK2			0.927			
SK3			0.919			
SK5			0.813			
SK4			0.762			
SK1			0.631			
KT1				0.823		
KT2				0.801		
KT5				0.678		
KT3				0.666		
KT4				0.654		
KN1					0.886	

KN3					0.837	
KN2					0.729	
KN4					0.708	
KN5					0.628	
TL2						0.881
TL3						0.852
TL4						0.839
TL1						0.762
TL5						0.751
Extraction Method: Principal Axis Factoring.						
Rotation Method: Promax with Kaiser Normalization.						

(Source: Results of data processing on SPSS software 26, 202 5)

The exploratory factor analysis (EFA) results showed a KMO value of 0.904, indicating that the data were suitable for factor analysis. The Bartlett test results were statistically significant (Sig. = 0.000), confirming the correlation between the variables. The original data, with 29 observed variables based on the Eigen value criterion > 1, explained 62.362% of the total variance. Specifically, factor 1 explained 39.216%, factor 2 explained 8.019%, factor 3 explained 4.693%, factor 4 explained 4.642%, factor 5 explained 3.260%, and factor 6 explained 2.531%.

After rotating the Varimax , the factors are redistributed according to variance, increasing clarity and significance. The rotated component matrix table shows the relationship between the observed variables and the factors:

Factor 1 includes variables SL2, SL4, SL1, SL3, reflecting that plastics companies have a sufficient number of engineers, which is a factor contributing to the development of high-quality human resources; Factor 2 includes variables CC2, CC1, CC4, CC5, CC3, reflecting the structure of trained qualifications that determine the development of high-quality human resources; Factor 3 includes variables SK3, SK2, SK5, SK4, SK1, related to the physical health of the workforce; Factor 4 includes variables KT1, KT2, KT5, KT3, KT4, related to understanding material properties, operating principles, and understanding the quality standards of the enterprise; Factor 5 includes variables KN1, KN3, KN2, KN4, KN5, representing the operational skills of the workforce; and Factor 6 includes variables TL2, TL3, TL4, TL1. TL5 relates to compliance with regulations and technical procedures, which determine the quality of the enterprise's high-quality human resources. The results of the factor analysis help to draw conclusions. The data from 29 observed variables was condensed into 6 principal factors, retaining most of the important information to support subsequent analyses such as model testing or scale construction.

4.3. Correlation Analysis

Table 4. Results of correlation analysis between variables

Correlations								
		F_SL	F_CC	F_SK	F_KT	F_KN	F_TL	F_HRD
F_SL	Pearson Correlation	1	.646 **	.501 **	.485 **	.459 **	.558 **	.768 **
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.005
	N	328	328	328	328	328	328	328

F_CC	Pearson Correlation	.646 **	1	.708 **	.626 **	.464 **	.731 **	.855 **
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.002
	N	328	328	328	328	328	328	328
F_SK	Pearson Correlation	.501 **	.708 **	1	.724 **	.533 **	.680 **	.844 **
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.003
	N	328	328	328	328	328	328	328
F_KT	Pearson Correlation	.485 **	.626 **	.724 **	1	.528 **	.681 **	.825 **
	Sig. (2-tailed)	.000	.000	.000		.000	.000	.004
	N	328	328	328	328	328	328	328
F_KN	Pearson Correlation	.459 **	.464 **	.533 **	.528 **	1	.522 **	.869 **
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.001
	N	328	328	328	328	328	328	328
F_TL	Pearson Correlation	.558 **	.731 **	.680 **	.681 **	.522 **	1	.852 **
	Sig. (2-tailed)	.000	.000	.000	.000	.000		.002
	N	328	328	328	328	328	328	328
F_HRD	Pearson Correlation	.768 **	.855 **	. 844 **	.825 **	.869 **	.852 **	1
	Sig. (2-tailed)	.005	.002	.003	.004	.001	.002	
	N	328	328	328	328	328	328	328
**. Correlation is significant at the 0.01 level (2-tailed).								

(Source: Results of data processing on SPSS software, version 26, 2026)

The correlation analysis results show the relationship between the variables of human resource quantity (SL), human resource structure (CC), human resource physical strength (SK), human resource intelligence through knowledge (KT), human resource intelligence through skills (KN), and human resource mental strength (TL). The Pearson correlation coefficient shows that the human resource intelligence through skills variable has the strongest and most positive relationship with HRD (r = 0.869, Sig. = 0.001), indicating that the operational capacity and skill level of workers have a significant impact on the development of high-quality human resources . Similarly, the human resource structure variable (CC) also has a positive impact on HRD (r = 0.855, Sig. = 0.002), suggesting that a suitable placement structure plays a crucial role in the development of high-quality human resources . Conversely, the remaining variables such as TL, SK, KT, and SL had a weaker relationship with HRD (correlation coefficients were r = 0.852, r = 0.844, r = 0.825, and r = 0.768, with Sig. 0.002, 0.003, 0.004, and 0.005, respectively).

The results show that focusing on factors such as the skill level of workers and the structure of the workforce has a greater impact on the development of high-quality human resources than factors such as mental capacity, health, knowledge, and workforce size. Although the impact of mental capacity, health, knowledge, and workforce size is lower, they are still significant in developing high-quality human resources , aiming to continuously increase productivity and product quality for plastic businesses. This indicates that businesses need a comprehensive strategy for developing high-quality

human resources by considering both factors with weak impacts such as the quantity, knowledge, mental capacity, and physical fitness of the workforce, and factors with strong impacts such as workforce capacity and appropriate structure, in order to continuously improve the production and business efficiency of plastic businesses.

4.4. Linear Regression

In the regression model, the independent variables include the quantity of human resources (SL), the structure of human resources (CC), the physical strength of human resources (SK), the intelligence through knowledge of human resources (KT), the intelligence through skills of human resources (KN), and the mental capacity of human resources (TL) . The Enter method is used, ensuring that all independent variables are considered simultaneously without any exclusions.

Table 5. Results of linear regression analysis

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.992 [a]	.985	.984	.06765	1,825
a. Predictors: (Constant), F_KN, F_CC, F_SK, F_TL, F_SL, F_KT					
b. Dependent Variable: F_HRD					

(Source: Results of data processing on SPSS software version 26, 2026)

The analysis results show a strong correlation between these factors and the development of high-quality human resources, with a correlation coefficient R = 0.992. The R-squared value is 0.985, indicating that 98.5% of the variation in the development of high-quality human resources can be explained by the variables in the model. After adjustment, the adjusted R-squared value is 0.984, which shows that the model is a good fit. The standard error value is 0.06765, reflecting the accuracy in predicting the development of high-quality human resources in plastic manufacturing enterprises.

The Durbin-Watson index is 1.825, which is within the acceptable range (1.5 to 2.5), indicating no autocorrelation between residuals, ensuring the model's accuracy. The ANOVA table tests the model's fit with an F-value of 4.106 and a significance level of p = 0.03, demonstrating that the linear regression model is statistically significant. The total variance (95,437) is split into two parts: regression variance (93,963) and residual variance (1,474), showing that the model explains most of the variance in the data.

Standardized and unstandardized regression coefficients provide deeper insight into the influence of each independent variable. The variable for the quantity of human resources (SL) has a standardized Beta = 0.195 and p = 0.003, indicating that the quantity of human resources has a small but significant impact on the development of high-quality human resources . The variable for the structure of human resources (CC) has a Beta = 0.258 and p = 0.002, showing that the structure of human resources has a significant influence on the development of high-quality human resources . The variable for the intelligence through skills of human resources (KN) is the most influential factor with a Beta = 0.271 and p = 0.001, confirming the important role of the skill level of workers in determining the development of high-quality human resources in plastics enterprises. The variable for the physical fitness of human resources (SK) The Beta value is 0.222 and the p value is 0.003, indicating that the physical strength of the workforce has significantly contributed to the development of high-quality human resources in plastic manufacturing enterprises. The intellectual variable (KT) has a Beta value of 0.246 and a p value of 0.002, showing that the knowledge of the workforce is a major determining factor in the development of high-quality human resources, and the mental strength of the workforce (TL) is also a key factor. With Beta = 0.208 and p = 0.003, it indicates that the mental capacity of human resources is a decisive factor in the development of high-quality human resources in current plastic manufacturing enterprises. The intercept coefficient (Constant B = 3.829) reflects the development of high-quality human resources without the influence of independent variables.

Table 6. Regression coefficients

Coefficients [a]								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	3,829	0.528		16,044	0.001		
	F_KN	0.235	0.031	0.271	7,635	0.001	0.552	1,813
	F_CC	0.219	0.056	0.258	3,984	0.002	0.379	2,636
	F_SK	0.191	0.042	0.222	1,206	0.003	0.368	2,777
	F_KT	0.212	0.039	0.246	4,017	0.002	0.431	2,321
	F_SL	0.185	0.067	0.195	2,438	0.003	0.643	1,555
	F_TL	0.198	0.027	0.208	5,614	0.003	0.538	1,876
a. Dependent Variable: F_HRD								

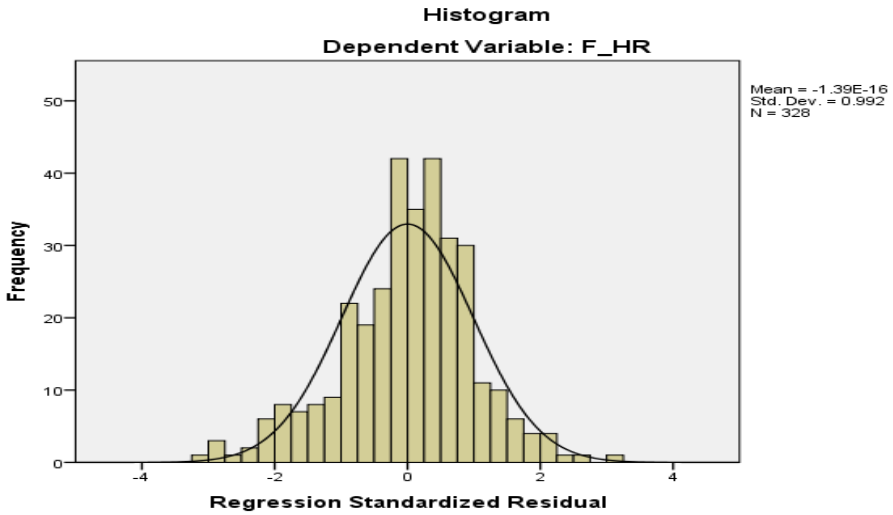
(Source: Results of data processing on SPSS software version 26, 2026)

From there, the standardized regression equation is established:

HRD = 0.271 KN + 0.258 CC + 0.246 KT + 0.222 SK + 0.208 TL + 0.195 SL + ε

Figure 1 shows that the standardized residuals confirm the assumption of normality of the residuals in the regression model. Most values are clustered around the mean of 0, with a small standard deviation (Std. Dev = 0.992). This confirms that the model fits the assumption of linear regression, increasing the reliability of the conclusions drawn from the analysis.

Figure 1. Residual distribution diagram



4.5. Testing for differences in high-quality human resource development variables according to the characteristics of the research subjects.

The One-Way ANOVA test results showed no statistically significant differences in the development of high-quality human resources by gender, job title, and seniority. Specifically, by gender, the Levene test confirmed the relatively homogeneity of the variance (Sig. > 0.05), the ANOVA value was 0.082, and the Welch test gave p = 0.088, indicating that although women may be slightly weaker than men, they are more diligent and hardworking in jobs such as printing, packaging, and operating automated machinery; while men are stronger and capable of performing strenuous tasks

requiring high physical strength such as mixing plastic granules, designing and adjusting molds, controlling production lines, transportation, and warehousing.

Regarding job titles, Levene (Sig. > 0.05), ANOVA (p = 0.578), and Welch (p = 0.682) all showed slight differences, such as management focusing on strategic development of plastic products and operational management of plastic production, while employees and workers focus on production, creating high-quality, environmentally safe products with rapid decomposition, reducing errors in the production process, and operating the production line.

Regarding seniority, Levene (Sig. > 0.05), ANOVA (p = 0.378), and Welch (p = 0.425) also confirmed that there were differences in the results: those with less than 5 years of experience had just reached a certain skill level and needed further training in efficient production; those with 5-9 years of experience had mature skill levels and produced high-quality products, but also needed further training in ISO 9001, ISO 14000, Kaizen, 5S, and KPI-based training to motivate employees and achieve productivity targets; and those with 10-20 years of experience had a high-quality workforce and professional production skills, requiring additional training in AI, efficient production, and KPI-based training. With over 20 years of experience and excellent skills, the workforce needs to acquire additional knowledge in modern technology, equipment operation, and AI utilization to further improve production efficiency .

We observe that the characteristics of the research subjects differ significantly between groups in the development of high-quality human resources in plastic manufacturing enterprises.

5. DISCUSSION OF RESEARCH FINDINGS AND POLICY IMPLICATIONS

5.1. Discussion of research results

This study empirically investigates the factors influencing the development of high-quality human resources in plastic manufacturing enterprises. The results indicate that all six core factors—quantity, structure, physical fitness, knowledge, skills, and mental fortitude—have a significant impact. Among these, employee skills have the strongest impact, followed by personnel structure, specialized knowledge, physical fitness, mental fortitude, and finally, the quantity of human resources.

Regarding the skills factor, this finding is consistent with the research of Aziz and Abiddin (2025) and Nguyen Thi Thu Huong and Truong Quang Hoan (2025), which emphasizes flexibility in the digital environment. Workers in the plastics industry today not only need to be proficient in traditional techniques such as injection molding, extrusion, and film blowing, but also need to have the skills to communicate with machines via digital interfaces and think critically about optimizing new materials. At the same time, self-management skills and adherence to ISO, 5S, or Kaizen processes have become mandatory standards.

Regarding the structure of human resources, the research results are consistent with Deloitte Insights' (2026) forecast of a shift from administrative decentralization to skill-based management (green skills, digital skills). The emergence of AI and automation does not eliminate human resources but changes the proportion of personnel, increasing the technical workforce operating intelligent systems. This creates new highly collaborative job positions such as specialists coordinating the relationship between humans and machines in the production line.

Regarding knowledge, the study agrees with Dang Thai Binh (2023) in affirming that knowledge does not stop at academic qualifications but is the ability to master technology to create added value. For the plastics industry, personnel must have a thorough understanding of the physical and chemical properties of polymers, while also updating their knowledge of AI applications, production management software, and green production processes. This is the core foundation that helps businesses increase the knowledge content in their products and avoid being excluded from the global supply chain.

In terms of physical fitness, this result supports the research of Le Quy Anh (2023) which identifies physical health as the foundation for all skills and mental capacity in a high-intensity, shift-based production environment. Due to the specific nature of the plastics industry, which involves exposure to high temperatures, noise, waste products, and chemical odors, businesses are under

significant pressure from stakeholders regarding occupational safety. The commitment of management through investment in ventilation systems, protective equipment, and regular health check-ups is key to protecting the physical fitness of the workforce.

Regarding mental fortitude, research proves Gartner's (2024) argument about a human-centered management model, where attitude, dedication, and commitment to common goals are the core of development. In a harsh factory environment, strong mental fortitude helps workers overcome production pressure and physical fatigue to maintain creativity. When employees possess good mental fortitude, they will always be ready to acquire new knowledge and proactively adapt quickly to any technological changes.

Regarding the quantity of human resources, this finding reaffirms Tran Huu Ha's (2021) theory that an industry wanting to achieve breakthroughs must first reach a minimum threshold in terms of the size of its qualified workforce. If there is a shortage in numbers, especially of core engineers and technicians, the system will become overloaded. Therefore, ensuring sufficient numbers is the key to enabling businesses to unleash resources, thereby successfully implementing training, improvement, and sustainable development activities.

5.2. Policy Significance

To effectively develop high-quality human resources in plastic manufacturing enterprises, management needs to implement a comprehensive system of solutions that address all six core factors. Focusing on these factors helps transform the inherent capabilities of the workforce into a long-term and sustainable competitive advantage in the integration process.

Firstly, developing skills through a structured training policy helps employees master automation technology, AI, and proficiently practice lean manufacturing models such as Kaizen, 5S, and ISO. Complete skills are the link between individual goals and strategic vision, helping businesses adapt flexibly to the pressures of the global market.

Secondly, developing a human resource structure helps optimize the organizational chart, balancing the ratio between core technology experts and direct operational workforce. A rational structure will promote knowledge transfer between generations, minimize resource waste, and quickly meet the requirements of green manufacturing and digital transformation.

Thirdly, knowledge development should be achieved by equipping personnel with expertise in new materials technology, digital transformation, and the circular economy to shift the model from a labor-intensive to a knowledge-based economy. A solid theoretical foundation will enable personnel to proactively solve complex technical problems and overcome stringent international standards.

Fourth, physical fitness is developed through investment in nutrition, occupational safety and hygiene, and regular health check-ups in the high-intensity, harsh environment of a plastics factory. Strong physical health is essential for minimizing occupational diseases, maintaining stable performance, and enabling workers to maximize their intellectual potential.

Fifth, develop and inspire employee morale through humane policies aimed at building pride, a positive attitude, and long-term commitment. When morale is prioritized, employees will voluntarily contribute initiatives, share production pressures, and create a culture of empathy and mutual trust between management and staff.

Secondly, developing a sufficient number of highly skilled personnel is crucial to achieving operational scale, avoiding system overload, and creating a reserve for technological innovation projects. Reaching an adequate workforce is a strategic step to stabilize production lines, provide a foundation for specialized labor allocation, and realize the vision of market expansion.

In summary, these recommendations not only help plastic manufacturing businesses improve the development of high-quality human resources but also create high-quality, high-value products, enhance competitiveness, and thereby develop national technological capabilities, cultivate a high-quality workforce with increasingly professional skills, creativity, and innovation in the production process, contributing to Vietnam's progress.

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