

Factors affecting the quality of middle-level management personnel at Vietnam Coal and Mineral Industry Group

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Abstract: This study focuses on identifying factors influencing the quality of middle-level management personnel at the Vietnam Coal and Mineral Industry Group (VMC) in the context of the coal and mineral industry's ongoing innovation in management, mechanization, automation, and technological transformation. Based on human capital theory, competency-based approaches, and strategic human resource management, the study proposes six groups of factors: individual human capital; selection and placement; training and development; evaluation and compensation; organizational support and empowerment; and adaptability to technological transformation. The research results show that all six groups of factors play a positive role in the quality of middle-level management personnel, with training and development, adaptability to technological transformation, and individual human capital being the most prominent. Based on this, the study proposes several policy implications focusing on improving the training system, developing management capabilities, enhancing technological adaptability, innovating recruitment and placement processes, improving evaluation and compensation mechanisms, and strengthening appropriate decentralization. The research results contribute to supplementing the scientific basis for developing a middle management team to meet the requirements of innovation and sustainable development of the Group in the new phase.

Keywords: Human resource quality; middle management; human capital; training and development; technological transformation; Vietnam Coal and Mineral Industry Group

1. INTRODUCTION

In large organizations with multi-tiered governance structures, middle management holds a particularly important position because they are the link between the strategic direction of senior leadership and the implementation activities at various units, departments, and work groups. Research on strategic management shows that the involvement of middle management is not limited to communicating and organizing the implementation of decisions from above, but also includes synthesizing information from the lower levels, proposing initiatives, adjusting implementation methods, and promoting the organization's adaptability (Floyd & Wooldridge, 1997; Wooldridge et al., 2008). Therefore, the quality of this team can directly affect the effectiveness of coordination, the ability to implement strategies, and the organization's performance.

The role of middle management becomes increasingly prominent in organizations adapting to changes in technology, organizational models, and management requirements. Middle managers are both subjects affected by change and agents who interpret, communicate, and translate those changes into concrete actions at the unit level. Their ability to perceive, explain, and build consensus can either promote or hinder organizational change (Balogun & Johnson, 2004). Simultaneously, the ability to manage emotions, maintain employee stability, and foster commitment during the transition process is also a crucial competency of middle management (Huy, 2002). This shows that the quality of middle management personnel needs to be viewed from a multi-dimensional approach, not only based on professional qualifications or work experience, but also encompassing leadership skills, managerial thinking, adaptability, coordination, and people management.



Studies also emphasize that the effectiveness of middle management depends significantly on their relationships with senior leadership and subordinate units. The quality of interaction, level of trust, and clarity of roles among management levels can affect the quality of strategic decisions as well as the effectiveness of strategy implementation (Raes et al., 2011). Meanwhile, relationship capital, access to information, and the ability to exert influence both upward and downward have been shown to be related to the task performance of middle managers (Ahearne et al., 2014). These results imply that the quality of a manager is not entirely determined by personal characteristics but is also influenced by the organizational environment, delegation mechanisms, working relationships, and conditions under which the individual can develop their abilities.

For the coal and mineral industry, the requirements for managerial personnel have notable characteristics. This is a field with a complex production environment, stringent safety requirements, and is being strongly impacted by mechanization, automation, and digital transformation. An international overview of the transformation of the mining industry shows that new technologies are changing the structure of work and placing higher demands on the analytical, decision-making, interdisciplinary coordination, technological proficiency, flexibility, and continuous learning capabilities of the workforce (Lund et al., 2024). Besides technical competence, the requirements for human resource management, work organization, and leadership in a high-risk production environment are increasingly becoming important components of the quality of the management team.

Empirical evidence in mining enterprises also shows that the leadership behavior, working conditions, and occupational health of managers are related to the work environment and the state of their subordinates (Vinberg et al., 2023). More broadly, research on strategy implementation confirms that the leadership capacity and coordination abilities of middle managers positively impact the effectiveness of strategy implementation by work teams (Tawse et al., 2024). Thus, in large-scale industrial enterprises, improving the quality of middle management requires simultaneous attention to professional competence, leadership capacity, coordination ability, adaptability, and organizational conditions that support the performance of managerial roles.

The context of the Vietnam Coal and Mineral Industry Group makes this issue particularly relevant. The Group is continuing to promote mechanization, automation, the application of new technologies, and digital transformation in its production areas, while simultaneously pursuing organizational streamlining and improving the quality of its human resources. These changes place middle-level management personnel at the center of the transformation process, as they must simultaneously ensure production, safety, and efficiency targets, organize human resources, adopt new technologies, address emerging issues at the grassroots level, and translate the Group's management directions into concrete actions at each unit.

Although international studies have formed a relatively rich foundation on the strategic role, leadership behavior, adaptability, and connectivity of middle management, most studies focus on individual groups of factors or are conducted in different organizational and national contexts (Woldridge et al., 2008; Raes et al., 2011; Ahearne et al., 2014). Within the mining industry, research on management and the conditions affecting the quality of managerial performance remains relatively limited compared to research on technology, work environment, and production safety (Vinberg et al., 2023; Lund et al., 2024). This gap indicates the need for research that places the quality of middle management personnel in parallel with individual characteristics, human resource development activities, organizational environment, governance mechanisms, and industry transformation requirements.

Based on the above arguments, this study was conducted to identify and evaluate the factors affecting the quality of middle management personnel at the Vietnam Coal and Mineral Industry Group. The research results are expected to contribute to supplementing empirical evidence on the factors shaping the quality of middle management in mining and industrial enterprises, and to provide a scientific basis for the selection, placement, training, development, and building of a management team that meets the requirements of management innovation, technological transformation, and sustainable development of the Group in the new phase.

2. THEORETICAL FOUNDATION

Middle management personnel and their roles in the organization.

Middle management personnel are understood as the team holding management positions between strategic management and direct management or employees within the organizational structure. The defining characteristic of this group lies not only in their hierarchical position but also in their two-way connecting function: translating the direction and decisions of senior leadership into action programs at the unit level, while simultaneously synthesizing information, issues, and initiatives from the implementation level to provide feedback to the strategic level. Studies on the strategic process suggest that middle management simultaneously performs multiple roles such as organizing strategy implementation, synthesizing information, promoting new initiatives, and facilitating the organization's adaptation to change (Floyd & Wooldridge, 1997; Wooldridge et al., 2008).

The middle management position means that the quality of this team significantly impacts the ability to translate strategy into performance. The level of participation and strategic influence of middle management is related to organizational effectiveness, but that effectiveness depends on the ability to influence both upward on higher management and downward on employees, as well as the ability to leverage relationships and information sources within the organization (Ahearne et al., 2014). During periods of change, middle management also assumes the function of interpreting the meaning of change, creating consensus, and balancing the need for innovation with the need to maintain the stability of ongoing operations (Huy, 2002; Balogun & Johnson, 2004). Therefore, the quality of middle management personnel needs to be approached more broadly than just professional qualifications and must reflect the capacity to perform management roles in specific organizational conditions.

Quality of middle management personnel

According to the human capital approach, the quality of personnel is formed from the set of knowledge, skills, abilities, and personal characteristics capable of creating value in the performance of work. An organization's human capital originates from the knowledge, skills, abilities, and characteristics of each individual, but the value of this resource is only realized when individuals are appropriately assigned, coordinated, and utilized according to job requirements (Ployhart & Moliterno, 2011). Therefore, for middle-level management personnel, quality should not be assessed solely through educational qualifications, seniority, or experience, but should consider a comprehensive assessment of their ability to apply knowledge, management skills, leadership behavior, and the extent to which they fulfill the requirements of their position.

The competency-based approach complements the above perspective by viewing competency as a set of attributes necessary for individuals to produce effective job performance. The competency model is significant in translating organizational strategy into specific behaviors and requirements for job-specific individuals, thereby providing a basis for recruitment, training, evaluation, and development (Campion et al., 2011; Campion et al., 2020). For middle managers, competencies should include professional knowledge, planning and organizing skills, decision-making, problem-solving, people management, communication and collaboration, change leadership, as well as learning and adaptability.

Therefore, in this study, the quality of middle management personnel is approached as the extent to which the middle management team meets the requirements for knowledge, skills, management capabilities, qualities, and adaptability necessary to effectively perform management responsibilities, organize strategy implementation, and lead employees in the specific operating conditions of the enterprise. This approach allows for a multi-dimensional assessment of quality and is consistent with the view that leadership behavior should simultaneously focus on mission, human relations, and change to produce effective management results (Vinberg et al., 2023).

Human capital theory and competency-based approach

Human capital theory is one of the important foundations for explaining the formation of quality in the management team. According to this theory, education, training, experience, and learning processes are considered forms of investment that increase the knowledge and capabilities of individuals, thereby improving productivity and the ability to create value. Later human resource management studies continue to affirm that investing in human

development can create a high-quality workforce and contribute to the organization's results (Li et al., 2015). At the organizational level, the value of human capital also depends on the ability to combine, deploy, and transform individual knowledge and skills into resources serving common goals (Ployhart & Moliterno, 2011).

For middle management, a key implication of human capital theory is that quality is not a fixed attribute but can be accumulated and developed through management experience, training, rotation, on-the-job learning, and knowledge sharing. Both formal and informal forms of learning play a role in developing human capital and maintaining individual adaptability to new job requirements (Noe et al., 2014). Research in the mining sector also shows that management experience is positively correlated with certain leadership behaviors, highlighting the need for leadership training for managers in the context of the industry's rapidly changing technology and organization (Löw et al., 2024).

The competency-based approach concretizes human capital theory by identifying which knowledge, skills, and behaviors are truly necessary for a managerial position. An effective competency system must stem from strategic requirements and be linked to human resource management activities, rather than existing independently of the organization's actual operations (Campion et al., 2011). This is particularly significant for large-scale industrial enterprises, where middle managers need to possess expertise in production processes and safety, as well as the capacity to organize, manage labor, and implement change.

Factors from human resource management and organizational environment

The quality of middle management personnel depends not only on the initial human capital of the individual but also on the human resource management system. The strategic human resource management perspective emphasizes that organizations need to synchronize the skills and behaviors of employees with strategic requirements through a system of interconnected activities, rather than implementing individual human resource policies (Wright & Ulrich, 2017). Accordingly, the process of building a quality management team begins with selecting and placing the right people, and is further strengthened by training and development, performance evaluation, compensation policies, and opportunities for individuals to develop their abilities.

Selection and placement lay the initial foundation for management quality because this activity determines the degree of fit between individual characteristics, capabilities, and position requirements. A competency-based approach allows organizations to define specific standards and use them consistently in the selection, appointment, and development of management personnel (Campion et al., 2011; Stone et al., 2013). For middle management, appropriate placement also facilitates the accumulation of management experience, enhances understanding of unit operations, and fosters coordination across different areas.

Training and development are direct mechanisms for increasing human capital. On-the-job learning, formal training, knowledge sharing, and professional development experiences help individuals update their knowledge, develop new skills, and improve their ability to handle increasingly complex tasks (Noe et al., 2014). For managers, training is particularly important as its content not only focuses on expertise but also includes leadership skills, people management, strategic thinking, problem-solving, and change management capabilities. Evidence from the mining industry also shows that management experience and training are crucial for enhancing change-oriented leadership behaviors (Löw et al., 2024).

Furthermore, performance evaluation, compensation, and career development opportunities contribute to shaping behavior and motivating managers to continue investing in their own capabilities. An effective human resource management system not only increases employee capabilities but also impacts their motivation and opportunities to utilize those capabilities in their work; the combination of ability, motivation, and opportunity is a crucial basis for explaining the results of human resource management policies (Apascariței & Elvira, 2022). Therefore, clear evaluation mechanisms, appropriate recognition, and competency-based promotion opportunities can encourage managers to maintain continuous learning and improve the quality of their role performance.

Beyond human resource policies, support, delegation, and the work environment determine the extent to which managerial capabilities can be developed. Middle managers can only fully perform their strategic roles when they have access to information, appropriate scope of authority, and maintain necessary relationships with superiors and subordinates. Relationship capital and the ability to influence in multiple ways can enhance the effectiveness of middle management's strategic participation (Ahearne et al., 2014). Simultaneously, organizational conditions and the social environment in the workplace are related to leadership behavior and the ability to perform managerial roles, especially in high-demand industries (Vinberg et al., 2023).

Specific characteristics of the coal and mineral industry and the basis for identifying research factors.

In the coal and mineral industry, the requirements for middle management quality are constantly changing under the impact of mechanization, automation, digitalization, and the transformation of production organization methods. Technological transformation in mining not only changes equipment and processes but also alters job content, supervision methods, and competency requirements for workers and managers (Lund et al., 2024). Therefore, middle managers need to combine industry-specific expertise with the ability to utilize information, coordinate work, organize resources, manage safety, and adapt to new technologies.

On the other hand, mining is an industry with unique working conditions and safety requirements, making the leadership behavior and work environment of managers significant to both operational efficiency and the working conditions of subordinates. Research in international mining enterprises shows that relationship-oriented leadership behaviors, job structure, and change all play a role in the mining management environment; at the same time, the work pressure of managers is also a matter of concern (Vinberg et al., 2023). These characteristics suggest that evaluating the factors affecting the quality of middle management personnel at the Vietnam Coal and Mineral Industry Group needs to be considered in the context of individual human capital, selection and placement, training and development, evaluation and compensation, organizational support, and adaptability to technological transformation requirements.

3. RESEARCH METHODOLOGY

Approach

The research was conducted using a combination of qualitative and quantitative methods, with quantitative research playing the primary role. First, based on a theoretical overview and relevant studies, the research identified groups of factors that could influence the quality of middle-level management personnel. Next, preliminary qualitative research was conducted through discussions with several managers and experienced experts in human resource management to assess the suitability of the factors, adjust the wording, and refine the measurement scale to suit the specific characteristics of the Vietnam Coal and Mineral Industry Group.

Quantitative research was conducted through questionnaire surveys of management personnel and individuals with direct knowledge of middle management activities within the Group's units. Observed variables were primarily measured using a 5-point Likert scale, ranging from "strongly disagree" to "strongly agree". The collected data were cleaned, coded, and used to test the reliability of the scale, determine the structure of the factors, and assess the impact of each factor on the quality of middle management personnel.

This approach allows for the integration of theoretical frameworks with the practical context of mining enterprises, thereby ensuring the scientific validity of the research model while enhancing the relevance of the measurement scales when applied at the Vietnam Coal and Mineral Industry Group.

Research model

Based on human capital theory, competency-based approach, strategic human resource management perspective, and the overall results of previous studies, this research proposes a model in which the quality of middle-level management personnel is the dependent variable. Six groups of factors are considered as independent variables: individual human capital; selection and placement; training and development; evaluation and compensation; organizational support and empowerment; and adaptability to technological transformation.

The research model can be broadly represented as follows:

$$CL = \beta_0 + \beta_1 VL + \beta_2 TC + \beta_3 DT + \beta_4 DG + \beta_5 HT + \beta_6 CN + \varepsilon$$

In there:

- **CL:** Quality of middle management personnel;
- **VL:** Personal human capital;
- **TC:** Selection and Placement;
- **DT:** Training and development;
- **DG:** Performance evaluation and compensation;
- **HT:** Organizational support and empowerment;
- **CN:** Ability to adapt to technological changes;
- **β_0 :** Model constant;
- **$\beta_1 - \beta_6$:** Coefficients of impact of independent variables;
- **ε :** Random error.

In the above model, the quality of middle-level management personnel is reflected through the extent to which they meet requirements in terms of knowledge and expertise, management skills, organizational and operational capabilities, leadership ability, problem-solving, work coordination, and adaptability to change. The selection of six independent factor groups aims to simultaneously reflect factors related to the manager themselves, human resource management policies, and organizational conditions that impact the formation and development of management capabilities.

Research hypothesis system

Based on the research model, the following hypotheses are proposed:

- **H1:** Personal human capital has a positive impact on the quality of middle-level management personnel at the Vietnam Coal and Mineral Industry Group.
- **H2:** Selection and placement have a positive impact on the quality of middle-level management personnel at the Vietnam Coal and Mineral Industry Group.
- **H3:** Training and development have a positive impact on the quality of middle-level management personnel at the Vietnam Coal and Mineral Industry Group.
- **H4:** Performance evaluation and compensation have a positive impact on the quality of middle-level management personnel at the Vietnam Coal and Mineral Industry Group.
- **H5:** Organizational support and empowerment have a positive impact on the quality of middle-level management personnel at the Vietnam Coal and Mineral Industry Group.
- **H6:** The ability to adapt to technological transformation has a positive impact on the quality of middle-level management personnel at the Vietnam Coal and Mineral Industry Group.

Data analysis methods

The collected survey data was checked and processed before conducting quantitative analyses. The study focused on four main groups of analytical techniques.

Firstly, descriptive statistics are used to generalize the characteristics of the survey sample and to make a preliminary assessment of respondents' level of agreement with the observed variables through indicators such as frequency, proportion, mean, and standard deviation.

Secondly, reliability testing of the scale is performed through Cronbach's Alpha coefficient and the item-total correlation coefficient. Observed variables that do not meet reliability requirements are considered for removal before proceeding with further analysis steps.

Thirdly, exploratory factor analysis is used to determine the structure of the observed variable groups, assess the degree of convergence of the scales, and test the fit of the variables to the factors proposed in the research model.

Fourth, correlation analysis and multiple linear regression were performed to determine the direction, magnitude, and statistical significance of the impact of independent factors on the quality of middle-level management personnel. The regression results were also used to test hypotheses H1 to H6 and compare the relative impact between the factors. Before interpreting the model, the study examined several fundamental regression assumptions to ensure the reliability of the estimation results.

Through the above process, the study aims to identify the factors that truly influence the quality of middle-level management personnel, and to quantify the impact of each factor as a basis for discussing the results and proposing management implications for the Vietnam Coal and Mineral Industry Group.

4. RESEARCH RESULTS AND DISCUSSION

Characteristics of the research sample and descriptive statistics

After removing invalid questionnaires, the research data consisted of 287 observations. The sample relatively reflects the characteristics of middle management teams in units belonging to the Vietnam Coal and Mineral Industry Group. The descriptive results are presented in Table 1.

Table 1. Sample characteristics and descriptive statistics of the factors

Content	Group/Factor	Frequency	Percentage (%)	Medium	Standard deviation
Gender	Male	231	80.5		
	Female	56	19.5		
Age	Under 35	20	7.0		
	35-44	109	38.0		
	45-54	129	44.9		
	≥ 55	29	10.1		
Level	College/Other	14	4.9		
	University	177	61.7		
	Master's degree	91	31.7		
	Doctor	5	1.7		
Seniority	<5 years	53	18.5		
	5-10 years	106	36.9		
	11-15 years	77	26.8		

	>15 years	51	17.8		
Job title	Department Head/Deputy Head	109	38.0		
	Foreman/Assistant	92	32.1		
	Director/Deputy Director	57	19.9		
	Other	29	10.1		
Research factors	Personal human capital			3,734	0.574
	Selection & Placement			3,564	0.611
	Training & Development			3,662	0.575
	Reviews & Compensation			3,412	0.572
	Support & Permissions			3,476	0.564
	Adapting to technology			3,596	0.562
	Quality of management			3,674	0.612

(Source: Results of data analysis on SPSS 26.0, 2026)

Regarding sample characteristics, men account for 80.5%, consistent with the specifics of the coal and mineral industry. The majority age group is 35-54 (82.9%), indicating a relatively experienced management workforce. 95.1% hold a university degree or higher, reflecting the high demands for professional expertise. Over 80% have more than 5 years of management experience, ensuring the reliability of the collected information. The job title structure is relatively evenly distributed across management levels.

Regarding the research factors, all average values are above 3.4, indicating a fairly good rating. Among them, personal human capital has the highest score (3.734), followed by management quality (3.674) and training & development (3.662). Technological adaptation reached 3.596, reflecting a relatively high level of readiness for digital transformation.

Conversely, the lowest ratings & compensation (3,412) and support & empowerment (3,476) indicate that organizational factors are more limited than individual capabilities.

The standard deviation ranged from 0.562 to 0.612, indicating a relatively high degree of homogeneity in the responses. Overall, the data have sufficient reliability to warrant further analysis in subsequent validation steps.

Reliability testing of the scale

The reliability of the scales was assessed using Cronbach's Alpha coefficient and adjusted item-total correlation. The summary results in Table 2 show that all scales met the requirements and were retained for the factor analysis step.

Table 2. Results of reliability testing of the scale.

Scale	Number of observed variables	Cronbach's Alpha	Correlation of variables - minimum sum	Conclude
Personal human capital	4	0.789	0.565	Obtain
Selection and placement	4	0.818	0.583	Obtain
Training and development	4	0.785	0.568	Obtain
Performance evaluation and compensation	4	0.769	0.503	Obtain
Support and authorization	4	0.785	0.565	Obtain
Adapting to technological transformation	4	0.787	0.570	Obtain
Quality of middle management personnel	5	0.872	0.673	Obtain

(Source: Results of data analysis on SPSS 26.0, 2026)

The Cronbach's Alpha coefficients ranged from 0.769 to 0.872, higher than the generally accepted threshold of 0.7. The scale measuring the quality of middle-level management personnel showed the highest reliability with a coefficient of 0.872; followed by selection and placement with 0.818. The remaining scales all had coefficients approximately or higher than 0.78, reflecting a relatively good level of internal consistency among the observed variables.

Simultaneously, the smallest item-total correlation coefficients of the scales ranged from 0.503 to 0.673, all higher than 0.3. This indicates that each observed variable made a suitable contribution to reflecting the corresponding research concept. Notably, although evaluation and reward were the factors with the lowest average value in Table 1, the reliability of the scale still reached 0.769. Thus, the lower rating for this factor did not stem from inconsistency of the scale but reflected genuine differences in respondents' perceptions of the evaluation and reward mechanisms. No observed variables needed to be removed; therefore, all 29 variables were included in the factor analysis.

Factor analysis results

Exploratory factor analysis was performed separately for the independent and dependent variables. The results are presented in Table 3.

Table 3. Results of exploratory factor analysis

Content	Independent variables	Dependent variable
Number of observed variables	24	5
KMO coefficient	0.843	0.865
Bartlett's Test	2,340,647	650,725
Sig.	<0.001	<0.001
Number of factors extracted	6	1

Total variance extracted (%)	62,542	66,115
Factor loading coefficient range	0.691-0.807	0.795-0.830

(Source: Results of data analysis on SPSS 26.0, 2026)

The KMO coefficient for the independent variables was 0.843 and for the dependent variable was 0.865, indicating that the data is well-suited for factor analysis. The Bartlett test was statistically significant at levels below 0.001, confirming that there is a sufficiently strong correlation between the observed variables to form factor structures.

For the 24 independent variables, six factors were extracted correctly according to the original theoretical structure and explained 62.542% of the data's variability. The loading coefficients of the variables ranged from 0.691 to 0.807, all exceeding the threshold of 0.5, and no variable had excessively low factor loadings. This result shows that the groups of individual human capital, selection and placement, training and development, evaluation and compensation, support and empowerment, and adaptation to technological transformation are relatively distinct.

With the dependent variable, the five observed variables converged on a single factor, explaining 66.115% of the variance. Loading coefficients ranging from 0.795 to 0.830 indicate that indicators of professional knowledge, organizational management, human leadership, problem-solving, and adaptability relatively well reflect the concept of quality of middle-level management personnel. Thus, the empirical scale structure is consistent with the proposed research model and is sufficient to construct representative variables for correlation and regression analysis.

Correlation analysis between factors

Before estimating the regression model, the Pearson correlation coefficient was used to examine the direction and degree of relationship between the variables. The results are shown in Table 4.

Table 4. Correlation matrix between factors

Factor	VL	TC	DT	DG	HT	CN	CL
VL	1,000						
TC	0.290	1,000					
DT	0.169	0.319	1,000				
DG	0.231	0.360	0.276	1,000			
HT	0.279	0.276	0.363	0.327	1,000		
CN	0.328	0.170	0.271	0.160	0.239	1,000	
CL	0.471	0.465	0.510	0.448	0.485	0.459	1,000

Note: VL - Personal Human Capital; TC - Selection and Placement; DT - Training and Development; DG - Evaluation and Compensation; HT - Support and Empowerment; CN - Adaptation to Technological Change; CL - Quality of Middle Management Personnel. Correlations between CL and independent variables are significant at $p < 0.001$.

(Source: Results of data analysis on SPSS 26.0, 2026)

The correlation coefficients between the six independent variables and the quality of middle management personnel were all positive, ranging from 0.448 to 0.510. Training and development had the strongest correlation with the quality of middle management personnel ($r = 0.510$), followed by support and empowerment ($r = 0.485$) and personal human capital ($r = 0.471$). Selection and placement, technological adaptation, and evaluation-compensation also maintained a moderately positive correlation.

On the other hand, the correlation between the independent variables only ranges from 0.160 to 0.363. These values are relatively low, indicating that the factors have a certain correlation but do not reflect the same content. This result is consistent with the factor analysis above, and also reduces the risk of multicollinearity when including six factors in the regression model simultaneously. In particular, the preliminary correlation results suggest that the quality of middle management cannot be explained solely by individual competence but requires consideration of both human resource policies and organizational conditions.

Regression analysis and hypothesis testing

A multiple linear regression model was used to determine the impact of each factor while controlling for the simultaneous influence of the remaining variables. The estimation results are summarized in Table 5.

Table 5. Regression results and hypothesis testing.

Hypothesis	Factor	Standardized Beta	t	Sig.	VIF	Result
H1	Personal human capital	0.217	4,996	<0.001	1,240	Accept
H2	Selection and placement	0.175	3,948	<0.001	1,284	Accept
H3	Training and development	0.245	5,539	<0.001	1,283	Accept
H4	Performance evaluation and compensation	0.174	3,980	<0.001	1,255	Accept
H5	Support and authorization	0.178	4,002	<0.001	1,297	Accept
H6	Adapting to technological transformation	0.221	5,193	<0.001	1,195	Accept

$R^2 = 0.574$; $Adjusted\ R^2 = 0.565$; $F = 62.850$; $Sig. < 0.001$; $Durbin-Watson = 2.136$.

(Source: Results of data analysis on SPSS 26.0, 2026)

The model has an R^2 of 0.574 and an adjusted R^2 of 0.565, meaning that the six factors in the study explain approximately 56.5% of the variation in the quality of middle-level management personnel after adjusting for the number of independent variables. This level of explanation indicates that the model has relatively good empirical validity in the context of behavioral research and human resource management. The F-test reached 62.850 with a significance level below 0.001, confirming that the regression model is a good overall fit. The Durbin-Watson coefficient reached 2.136, close to 2, while the VIF only fluctuated between 1.195 and 1.297, thus not showing significant issues of residual autocorrelation or multicollinearity.

According to the standardized Beta coefficient, the decreasing order of impact is training and development (0.245), adaptation to technological change (0.221), personal human capital (0.217), support and empowerment (0.178), selection and placement (0.175), and evaluation and compensation (0.174). The standardized regression equation can be expressed as:

$$CL = 0.217VL + 0.175TC + 0.245DT + 0.174DG + 0.178HT + 0.221CN$$

This result shows that all six groups of factors have a positive impact on the quality of middle-level management personnel, but the level of contribution differs.

For hypothesis H1, individual human capital has a Beta = 0.217 and $p < 0.001$, therefore H1 is accepted. As managers' professional knowledge, experience, organizational skills, and learning ability improve, the quality of their managerial performance tends to improve. The results confirm that a strong foundation of individual competence remains a crucial condition for middle-level managers in industries with complex technical and organizational production requirements such as coal and minerals.

For hypothesis H2, selection and placement have a positive impact on the quality of middle-level management personnel with Beta = 0.175 and $p < 0.001$. H2 is therefore accepted. The results imply that correctly defining job title

standards, selecting personnel based on competence, and placing them appropriately according to expertise and experience will create conditions for managers to better utilize their existing capabilities. Although the impact level is not the highest, this is a fundamental factor because limitations in the selection and placement process cannot be completely overcome by post-appointment policies.

For hypothesis H3, training and development has a Beta coefficient of 0.245, the highest among the six factors and statistically significant at $p < 0.001$. H3 is accepted. This is a noteworthy finding of the study, reflecting that the quality of middle management can be significantly improved through updating knowledge, developing leadership skills, sharing experiences, and preparing for new job requirements. In the context of constantly changing mining technology and management methods, training therefore not only serves to supplement knowledge but also as a tool to maintain the long-term development capacity of the management team.

For hypothesis H4, evaluation and compensation have a Beta of 0.174 with $p < 0.001$, allowing H4 to be accepted. The lowest impact in the model does not mean this factor is unimportant. Combined with the descriptive statistical results showing that this is also the least valued factor, it is clear that there is considerable room for improvement in the mechanism of evaluating performance, recognizing contributions, and linking compensation to managerial responsibility. A transparent evaluation system and appropriate compensation can motivate middle managers to proactively improve their capabilities and maintain effective job performance.

For hypothesis H5, support and empowerment have a positive impact with Beta = 0.178 and $p < 0.001$, so H5 is accepted. This finding suggests that individual competence can only be fully translated into managerial quality when managers have appropriate authority, are provided with information and resources, and receive the necessary support from superiors. Especially in large-scale organizational structures, clearly defining responsibilities and decision-making authority helps reduce delays in work processing and enhances the proactiveness of middle managers.

Finally, hypothesis H6 was accepted when the ability to adapt to technological change reached Beta = 0.221 and $p < 0.001$. This is the factor with the second largest impact after training and development. The results reflect the increasingly clear requirement for middle managers to adopt new technologies, adjust work organization methods, use information, and support employees in adapting to change. In the context of increasingly widespread mechanization, automation, and digital transformation, technological adaptability is no longer a supplementary competency but is becoming an important component of the quality of managerial personnel.

The overall test results show that all six hypotheses H1-H6 are accepted. Notably, the two factors with the strongest impact are training and development and the ability to adapt to technological change, while individual human capital ranks next. This suggests that improving the quality of middle management at the Vietnam Coal and Mineral Industry Group needs to shift from an approach primarily based on existing qualities and experience to a continuous development approach, where capabilities are updated through training and transformed into effective management in a changing technological and organizational environment.

5. CONCLUSION AND POLICY IMPLICATIONS

This study aims to identify and evaluate the factors influencing the quality of middle management personnel at the Vietnam Coal and Mineral Industry Group. Based on human capital theory, competency-based approach, and strategic human resource management, the study constructs a model comprising six factors: individual human capital; selection and placement; training and development; evaluation and compensation; organizational support and empowerment; and adaptability to technological transformation. Analysis results show that all scales are reliable, the factor structure is consistent with the theoretical model, and all six factors have a positive impact on the quality of middle management personnel. The model explains approximately 56.5% of the variation in middle management personnel quality, indicating that the quality of this workforce is formed from a combination of individual capabilities, the human resource management system, and the organizational environment.

Among the factors considered, training and development have the strongest impact on the quality of middle-level management personnel, followed by adaptability to technological transformation and personal human capital.

This result shows that in the context of the coal and mineral industry's accelerated mechanization, automation, and application of technology in production, management quality no longer depends primarily on accumulated experience or existing professional qualifications. The ability to continuously update knowledge, develop leadership skills, adopt new technologies, and adjust management methods according to changes in the production environment is becoming a crucial requirement for middle-level management. Furthermore, selection and placement, evaluation and compensation, as well as organizational support and delegation, all have statistically significant impacts, thus confirming that improving management quality needs to be achieved through a comprehensive policy system rather than focusing on a single activity.

Based on the research findings, the Vietnam Coal and Mineral Industry Group should first consider training and developing middle-level management personnel as a central component of its human resource development strategy. Training programs should shift significantly from providing general knowledge to developing job-specific competencies, focusing on highly applicable skills such as production organization and management, human resource management, safety management, data-driven decision-making, problem-solving, change leadership, and digital environment management. Training activities should be linked to assessing the actual needs of each job title group and the production characteristics of each unit. Simultaneously, the Group should strengthen workplace development methods such as job rotation, challenging assignments, experience sharing between units, management mentoring, and succession planning. This approach ensures continuous competency development directly linked to job requirements.

Secondly, it is necessary to enhance the adaptability of middle managers to technological transformation. Besides the ability to use technology tools and systems for management, managers need to understand the impact of technology on production processes, labor structure, and work organization methods. Therefore, technology training should be combined with training in change management, data management, and leadership skills for employees during the transformation process. The level of readiness and ability to apply technology can be considered a criterion in evaluating the competence, planning, and appointing management personnel in the coming period. This is especially necessary when the digital competency gap between age groups, units, and work areas can slow down the implementation of the Group's overall transformation programs.

Thirdly, the selection, planning, and placement of managerial staff need to be further improved, focusing on competence and suitability for the position. Job title standards should be specified into assessable competency groups, limiting the overemphasis on seniority or professional experience without adequately assessing leadership, coordination, innovation, and adaptability. Rotation should be used as a planned tool for staff development, helping managerial personnel accumulate experience in various fields and improve coordination within the system. Simultaneously, a pool of future managerial talent should be developed earlier to reduce the risk of a shortage of competent personnel when experienced managers enter retirement.

Fourth, the research results show that evaluation and compensation are the factors with the lowest average ratings, therefore this is an area that needs priority improvement. The evaluation system for middle-level managers needs to be more closely linked to task performance, unit governance quality, team development capabilities, production safety, work improvement, and adaptability to new requirements. Evaluation results should be used effectively in decisions regarding training, appointments, rewards, and career development. Compensation policies should also relatively fully reflect the complexity, responsibilities, and results of the management position, thereby motivating employees to continue investing in their skills and improving the quality of their work.

Finally, it is necessary to strengthen support and appropriate delegation of authority to middle management. The corporation and its subsidiaries need to clearly define the scope of responsibility, decision-making authority, and coordination mechanisms between management levels, while ensuring access to necessary information and resources. Delegation must be accompanied by accountability and appropriate control systems, thereby encouraging proactiveness while ensuring governance discipline. When given appropriate authority and timely support, middle

managers are better able to translate their knowledge, experience, and personal capabilities into concrete management results.

Overall, improving the quality of middle management personnel at the Vietnam Coal and Mineral Industry Group (VMC) needs to be approached as a comprehensive development process, in which training and development, technological adaptation, and human capital enhancement are key focuses, while also being supported by appropriate selection, evaluation, remuneration, and delegation mechanisms. Consistent implementation of these policies will contribute to the formation of a middle management team with strong professional competence, leadership abilities, and adaptability, thereby enhancing management efficiency and meeting the Group's transformation requirements in the new phase.

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