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Technological Level of Mechanical Firms

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Abstract

The aim of this study is to measure, analyze, and compare the assessment results of the survey subjects about the technology level of mechanical firms. The theoretical framework sheds light on the conceptual aspects of technology level and the objectives of mechanical firms. The inductive method was relied upon in defining the research problem by observing that the contents of technology level. We use qualitative research methods and quantitative research methods. The interview technique is used in the qualitative research method, whereas primary data collected through a survey is used in the quantitative research method. The sample size includes 200 survey forms from mechanical firms in Hanoi and neighboring provinces. We conducted the survey from February 2024 to May 2024. SPSS was utilized to measure, analyze, and conduct a comparative evaluation of the technology level of mechanical firms between respondents. Multiple statistical techniques were employed for data analysis, including SPSS via descriptive statistics, analysis of scale reliability through Cronbach's alpha coefficient, the independent t-test, and ANOVA. The study's results indicate that the technology level of mechanical firms is highly rated; there is no difference in assessing the technology level of mechanical firms between different subjects in terms of genders and career seniority. This study offers theoretical and practical implications for improving technology levels. Based on this result, the study proposes some recommendations for mechanical firms.

Keywords: *Technology Level, Business Administration, Economics, Business Performance, Accounting*

JEL codes: M10, L21, M40

INTRODUCTION

Technological innovation plays an increasingly prominent role in the growth of leading industrial economies. Models of the technological innovation process have evolved over time and now take into account many factors external to the firm that influence innovation capability (Branscomb, 2001).

As the world recovers from the COVID-19 pandemic, improving manufacturing technology is an important factor in helping firms adapt to change and enhance competitiveness (Le et al., 2023).

According to preliminary forecasts, the total demand for mechanical products in Vietnam from now until 2030 may reach more than 300 billion USD. However, the current Vietnamese mechanical industry only meets about 1/3 of the domestic demand for mechanical products. According to the Department of Industry (Ministry of Industry and Trade), with about 25,000 mechanical enterprises in operation, accounting for nearly 30% of the total number of processing and manufacturing enterprises in Vietnam, the domestic mechanical industry has gradually mastered and increased the localization rate, creating a driving force to promote the development of other industries and economies, thereby directly and indirectly creating jobs for millions of workers (https://moit.gov.vn/tin-tuc/phat-trien-cong-nghiep/nganh-co-khi-viet-nam-lam-gi-de-huong-toi-thi-truong-hon-300-ty-usd-.html).

The Vietnam Association of Mechanical Industry (VAMI) also believes that over the past years, a series of limitations and weaknesses from management mechanisms and policies as well as from the enterprises themselves have caused the mechanical industry to develop rather dimly, failing to meet the requirements. Even in the domestic market, the mechanical industry does not have much market share and has to mobilize and develop on its own without receiving effective support from the state's policy system to have many orders from

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public investment like other countries. This leads to mechanical enterprises that are already lacking orders being disadvantaged right at home. There are many large projects in construction, transportation, irrigation works, oil and gas, marine economy, shipbuilding, automobiles, motorbikes, etc. that still mainly use imported mechanical products or are undertaken by FDI enterprises (https://moit.gov.vn/tin-tuc/phat-trien-cong-nghiep/nganh-co-khi-viet-nam-lam-gi-de-huong-toi-thi-truong-hon-300-ty-usd-.html).

The mechanical industry in general and mechanical enterprises in particular are the main driving force for economic growth in the export-based growth strategy, contributing to the country's integration into the global value chain. Enterprises in this industry are the nucleus in building the material foundation for the economy, producing new inventions and new technologies that play an important role in the country's economic future. In that context, improving the technological level of mechanical enterprises is necessary and meaningful both scientifically and experimentally.

LITERATURE REVIEW & THEORETICAL BASIS

According to OECD (2005), technological innovation includes new products and processes and significant technological changes in products and processes. An innovation has been made if it has been introduced into the market. Technological innovation is inevitable for companies that want to develop and maintain competitiveness or achieve the goal of entering new markets (Souitaris, 2002).

According to Cancino et al. (2018), technological innovation is considered as a means to optimize the efficient use of critical resources in socio-economic and bio-systems.

The level and capacity of production technology is the level of achievement of the current state of technology, the ability to organize and exploit existing technology, and the ability to absorb, master, research, and develop and innovate production technology of enterprises, industries, and fields (Ministry of Science and Technology, 2019). Assessment of the level and capacity of production technology of enterprises is the analysis and determination of the current state, efficiency of use and exploitation of production technology, and assessment of the ability to organize and exploit existing technology, the ability to absorb, master, research, and develop and innovate production technology of enterprises (Ministry of Science and Technology, 2019).

According to Quan (2021), the level and capacity of production technology are assessed through the analysis and synthesis of 5 groups of component factors, including (i) the group of current technology and production equipment (group T); (ii) the group of technology exploitation efficiency (group E); (iii) the group of organizational and management capacity (group O); (iv) the group of research and development capacity (group R); and (v) the group of innovation capacity (group I), combined with the assessment results of the synchronization coefficient of production technology level and capacity. On that basis, the level and capacity of production technology of enterprises are assessed and classified into 4 levels: (a) backward level and capacity of production technology; (b) average level and capacity of production technology; (c) advanced average level and capacity of production technology; (d) advanced level and capacity of production technology. Most of the seafood processing enterprises in Kien Giang province are assessed and classified as having an average level of technology and production capacity, with only a very small percentage having an outdated and advanced average level.

Do (2023) measured the factors affecting the business results of small and medium enterprises in Thanh Hoa province. The research results showed that the technological level of enterprises is one of the factors that positively affect the business results of enterprises. Accordingly, the technological level of enterprises includes 4 component attributes (scales): (i) enterprises regularly update and apply new technology to production and business activities; (ii) enterprises apply modern technology in marketing and brand promotion; (iii) enterprises always attach importance to investing in research and deployment of new technology; and (iv) the technological level in production of enterprises is high compared to the average.

Inheriting the results of previous studies and the opinions of interviewed experts, we built scales for measuring the technological level of mechanical firms (see Table 1).

Table 1: Scale of technological level of mechanical firms

Code	Description
TL1	The mechanical firm that I am working for regularly updates and applies new technology to its production and business activities.
TL2	The mechanical firm that I work for applies modern technology in marketing and brand promotion.
TL3	The mechanical firm that I work for always values investment in research and development of new technologies.
TL4	The technological level in production of the mechanical firm that I am working for is high compared to the average.

RESEARCH METHODS

The research implemented a method combining secondary data, in-depth interviews, and mechanical firms in Hanoi and neighboring provinces surveys. 100 mechanical firms in Hanoi and neighboring provinces were selected for the survey using a convenient method. This sample size meets the minimum sample size of Hair et al. (2009). Each enterprise selects a member of the board of directors, a head or deputy head of the sales department, a head or deputy head of the production department or the Human Resources Administration department, and a chief accountant or general accountant, who are in charge of issues related to technology level after answering the questionnaire (see table 1).

The technology level scale includes TL1-TL4, which has been compiled from comprehensive research and in-depth interviews with five technical managers and sales managers of mechanical firms to check the scale for compatibility with reality. In-depth interviews also aim to learn about the successful experiences and challenges of mechanical firms when implementing measures to improve technology level.

SPSS 22 software was used to process the analyses in this study. Analytical tools, including descriptive statistics, analysis of scale reliability through Cronbach's alpha coefficient, the independent T-test, and ANOVA analysis, were performed to measure, analyze, and compare the assessment results of the technology level of mechanical firms among survey subjects.

Table 1. Respondents by genders, career seniority and ages

	Frequency	Percent	Cumulative Percent
Genders			
Female	71	35.5	35.5
Male	129	64.5	100.0
Ages			
From 22 to 30 years old	56	28.0	28.0
From 30 to 35 years old	52	26.0	54.0
From 35 to 45 years old	47	23.5	77.5
45 years old or older	45	22.5	100.0
Career seniority			
Less than 5 years	46	23.0	23.0
From 5 to 10 years	101	50.5	73.5
10 years or older	53	26.5	100.0
Total	**200**	**100.0**	

Information on the data collected is shown in Table 1. It shows that among the respondents, 35.5% were female and 64.5% were male. Of these, 56 participants are from 22 to 30 years old, accounting for 28.0%; 52 participants are from 30 to 35 years old, accounting for 26.0%; 47 participants are from 35 to 45 years old, accounting for 23.5%; and the remaining respondents are 45 years old or older, accounting for 22.5%. There were 46 participants (23.0%) who have career seniority less than 5 years, 101 participants (50.5%) who have career seniority from 5 to 10 years, and the remaining have career seniority 10 years or older.

RESULTS

Descriptive Statistics

Table 2 indicates that the respondents agree with the independent variables (technology level) of mechanical firms in Hanoi and neighboring provinces, where four attributes were quite high. All four attributes were rated at an average of 3.92 or higher.

Table 2. Descriptive analysis of attributes

Code	N	Mini	Max	Mean	Std. Deviation	Skewness		Kurtosis	
						Statistic	Std. Error	Statistic	Std. Error
TL1	200	1	5	3.97	0.841	-0.855	0.172	0.991	0.342
TL2	200	1	5	3.93	0.856	-0.874	0.172	1.365	0.342
TL3	200	1	5	4.02	0.871	-0.905	0.172	1.075	0.342
TL4	200	1	5	3.92	0.853	-0.877	0.172	1.166	0.342
Valid N (listwise)	**200**			**3.96**					

Source: Prepared by the authors (2024) and SPSS software

Cronbach Alpha

To evaluate the internal reliability of the scales, we rely on the Cronbach alpha coefficient. The statistical results in Table 3 show that Cronbach alpha values in the range of 0.839 to 0.847 are higher than the significance level of 0.7 (Nunnally & Bernstein, 1994), confirming the reliability of the scale used in the study. All observed variables on the scales have an item-total correlation greater than 0.3. Therefore, the scales all meet the requirements, thus qualifying for exploratory factor analysis (Hoang & Chu, 2008; Hair et al., 2009; Hair et al., 2014).

Table 3. Results of Cronbach's alpha testing of attributes and item-total statistics

Cronbach's Alpha	N of Items
.877	4

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
TL1	11.86	5.096	0.725	0.847
TL2	11.90	4.995	0.739	0.841
TL3	11.81	4.959	0.732	0.844
TL4	11.91	4.991	0.745	0.839

Source: Prepared by the authors (2024) and SPSS software

Independent T-test: Different Genders

A comparison of the results of the evaluation of the differences in the technology level of mechanical firms in Hanoi and neighboring provinces with participants of different genders (male and female) can be seen in Table 4. According to the results shown in Table 4, sig Levene's test is 0.483, which is more than 0.05. The variance between males and females is not different. Moreover, the sig value t-test is 0.324, which is more than 0.05, which means that there is no statistically significant difference in the technology level of mechanical firms in Hanoi and neighboring provinces between these different genders (Hoang & Chu, 2008; Hair et al., 2009; Hair et al., 2014).

Table 4. Differences in the technology level of mechanical firms in Hanoi and neighboring provinces with participants of different genders - Independent Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
TL	Equal variances assumed	0.494	0.483	-0.989	198	0.324	-0.10686	0.10807	-0.31999	0.10626
	Equal variances not assumed			-0.955	130.283	0.341	-0.10686	0.11193	-0.32830	0.11457

Source: Prepared by the authors (2024) and SPSS software

ANOVA – Career Seniority

An ANOVA test was needed to make a comparison of the results of the evaluation of the differences in the technology level of mechanical firms in Hanoi and neighboring provinces between the three subjects, including

participants who have career seniority less than 5 years, participants who have career seniority from 5 to 10 years, and participants who have career seniority 10 years or older. Table 5 shows that the sig Levene statistic of 0.673 is greater than 0.05, which means that the hypothesis of homogeneity of variance among the variable value groups (career seniority) has not been violated. Table 6 shows that sig. is 0.666, which is more than 0.05, which indicates that there is no statistically significant difference in the technology level of mechanical firms in Hanoi and neighboring provinces between the mentioned three groups of career seniority (Hoang & Chu, 2008; Hair et al., 2009; Hair et al., 2014).

Table 5. Test of Homogeneity of Variances

Descriptions	Levene Statistic	df1	df2	Sig.
TL				
Based on Mean	0.398	2	197	0.673
Based on Median	0.401	2	197	0.670
Based on Median and with adjusted df	0.401	2	187.597	0.670
Based on trimmed mean	0.387	2	197	0.680

Source: Prepared by the authors (2024) and SPSS software

Table 6. ANOVA

	Sum of Squares	Df	Mean Square	F	Sig.
TL					
Between Groups	0.439	2	0.219	0.408	0.666
Within Groups	105.991	197	0.538		
Total	106.430	199			

Source: Prepared by the authors (2024) and SPSS software

The relationship between the technology level of mechanical firms in Hanoi and neighboring provinces - Career seniority

Next, the line graph shows the relationship between the technology level of mechanical firms in Hanoi and neighboring provinces and each respondent's career seniority (Figure 1). Figure 1 shows that this line tends to go down when the respondents' career seniority is from 5 to 10 years old. But this line tends to slope up when the respondents' career seniority is 10 years or older.

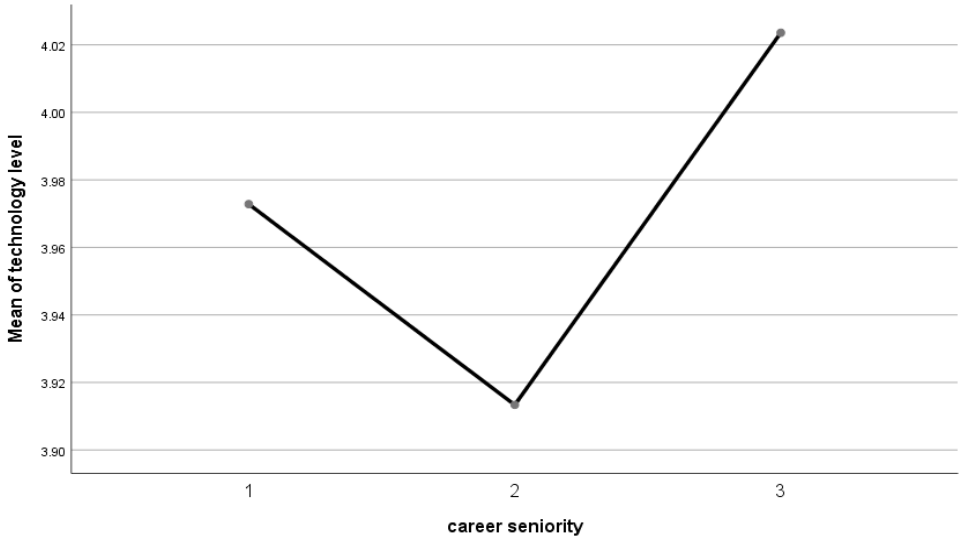

Figure 1: The line graph shows the relationship between the technology level of mechanical firms in Hanoi and neighboring provinces (career seniority) and each respondent's career seniority.

DISCUSSION AND IMPLICATIONS

The Prime Minister has approved the Strategy for the Development of the Vietnamese Mechanical Industry to 2025, with a vision to 2035. The general goal of this strategy is that by 2035, the Vietnamese mechanical industry will be developed with the majority of specialized fields having advanced technology, product quality meeting international standards, participating more deeply in the global value chain, using energy economically and effectively, and competing equally in international integration; the workforce will be professional, disciplined, and highly productive, proactive in the stages of research, design, and manufacturing of mechanical products, basically meeting the needs of mechanical products in the domestic market (https://moit.gov.vn/tin-tuc/phat-trien-cong-nghiep/nganh-co-khi-viet-nam-lam-gi-de-huong-toi-thi-truong-hon-300-ty-usd-.html).

Mr. Dao Phan Long, Chairman of VAMI, said that Vietnamese mechanical engineering wants to have more orders and participate in the export chain. It is necessary to innovate equipment, technology, science, and technology levels to be able to manufacture spare parts, components, and machine parts according to orders of foreign partners with diverse types. In the future, the mechanical engineering industry requires development in raw materials, molds, processing, and manufacturing, not just simple cutting and machining, so firms are forced to connect and go deeper into the global value chain (https://moit.gov.vn/tin-tuc/phat-trien-cong-nghiep/nganh-co-khi-viet-nam-lam-gi-de-huong-toi-thi-truong-hon-300-ty-usd-.html).

To develop production to promote the development of the mechanical sector of enterprises, some mechanical enterprises have proactively promoted modern technology platforms and a complete value chain from research, product development to production and supply, which is an important basis for improving product quality, reducing costs, and creating competitive advantages.

Mechanical enterprises should improve the level of science and technology in all stages, from firm organization and management to workshops and production teams; improve the level of technology in the production, distribution, and consumption processes; and focus on applying scientific and technological advances in production and business.

Mechanical firms should clearly define their position in the value chain and build and choose the orientation, goals, and strategies for technology development. In addition, mechanical firms should promote specialization and actively participate in global processing and manufacturing chains to improve management skills as well as technology application capacity.

Mechanical firms should invest in new and upgraded production workshops to ensure modern technology, high-value products, competitiveness, a scale suitable to the raw material area, and environmental protection.

Mechanical firms should innovate equipment, processing, and manufacturing technology towards modernization: invest in and upgrade modern factories; focus on promoting mechanization and automation to increase productivity, reduce production costs, and protect the environment; promote the application of quality management programs according to international standards; manage quality and labor safety; invest in modern equipment and technology to develop new products, high-value products, and added value from the province's available raw materials and fuels to participate in the domestic and international production value chain.

On the side of the Ministry of Industry and Trade, in order to support mechanical firms in 2022 and the coming years, the Ministry will continue to strengthen and improve the operational efficiency of the two Technical Centers for Industrial Development Support in the North and South. Currently, these two centers have had activities to support mechanical industrial enterprises in a number of localities across the country, such as supporting training on production management systems and business management systems and improving capacity to meet international standards. The Centers are actively cooperating with multinational corporations present in Vietnam, such as Toyota, Mitsubishi, and Canon, to find suitable suppliers to participate in the value chains of these corporations (https://moit.gov.vn/tin-tuc/phat-trien-cong-nghiep/nganh-co-khi-viet-nam-lam-gi-de-huong-toi-thi-truong-hon-300-ty-usd-.html).

Ethical Considerations

Not applicable.

Conflict of Interest

The authors declare that they have no conflict of interest.

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