MINISTRY OF EDUCATION AND TRAINING
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RESEARCH ON IMPROVING ECONOMIC - TECHNICAL EFFICIENCY OF PROP EQUIPMENT USING IN UNDERGROUND COAL MINING IN QUANG NINH AREA

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SUMMARY OF DOCTOR THESIS

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PREAMBLE

1. The need for thesis research

Prop equipment (PE) in underground mining has an important role with coal mining (CM) enterprise because PE using will bring better working conditions for employee base on the main stages in the technological process are done by equipment and mechanization. On the other hand, PE using will allow CM enterprise cut down on direct workers, increase labor productivity, achieve a level of economic - technical criteria that are much higher than those which using craftsman, thus, the produce cost can be reduced, economic effect could be raising, the rate of natural resource loss also decrease. This is fundamental to increasing the capacity oven as well as the capacity of the mine, increase productivity, reduce CM cost and improve the efficiency of business.

In order to create favorable conditions for business activities and ensure the CM efficiency, in recent time, Vietnam National coal - mineral industry holding corporation limited (TKV) and CM enterprises have studied the plans to innovate exploitation technology, in which designing and selecting PE plays an important role in ensuring favorable conditions for production management, ensuring the achievement of strategic output goals, artisanal resources and especially ensure safety workplace for human, being fundamental to increasing the capacity oven as well as the capacity of the mine, increase productivity, reduce CM cost and improve the efficiency of business.

According to TKV figure, in recent time, CM enterprises have reorganized production, invested in renewing mining technology, a number of ovens are gradual mechanization, avanced PE have been applied and got a great deal of possitive figure: in the oven which used PE from 2014 to 2018, the average growth rate of coal output reached 10% / year, productivity was increased, produce cost and coal loss were reduced, the level of safety in the mining process is higher than the fair oven previously which were not used PE [74]. Although the result of new technology is remarkable, in CM enterprise, in general, investment efficiency and technology equipment using and PE using in particular still shown drawbacks, many project have a large investment, but exploitation efficiency was not significant had to stop working. For example, the prop combination named 2ANSH at Mao Khe Coal Company, Hong Thai Coal Company, automatic prop name Vinaalta at Vang Danh Coal JSC... This led to waste investment, natural resource àn reduce business efficiency of enterprise. The fundamental result of this reality are: (1) Theoretically, economic-technical customs using machinery and equipment are mentioned relatively independently between the investment process and the process of using equipment. However, PE evaluation and choosing in CM enterprise have an important contribution to efficiency of economic - technical in PE using, therefore, it is necessary to have its own concept and criteria system to evaluate the efficiency of economic - technical in PE using in the relation with PE investment process; (2) CM

enterproses are concentrating on evaluating the efficiency of economic - technical in PE using in choosing investment process, not focus on evaluating the efficiency of economic - technical in PE using to ensure the PE work as well as the designed economic - technical criteria; (3) the analysis of the efficiency of economic - technical and proposing solutions which can increase the efficiency of economic - technical in using equipment just be done on the aspect of enterprises total property without doing in each section, especially with the equipments which is valuable and decided productivity and business efficiency such as PE using in exploitation; (4) sometopics of science research about apply technology for particular enterprise and recommend assessment criteria for economic - technical eficiency of new technology application, however, these topics have not generalized the system of criteria and analytical methods for businesses that can be applied also identified the realityors affecting economic - technical in applying new technology, as a basic for proposal solutions of increasing efficency of using new technology.

Coming from that reality, topic: ***"Research on improving economic - technical efficiency of Prop equipment using in underground coal mining in Quang Ninh area***" is choosed to create a theory framework which help the CM enterprises in Quang Ninh area apply easily when analyse economic - technical efficiency of PE using, besides, propose a system of increase efficiency of PE using solutions, help the enterprises improve efficiency of PE using and efficiency of using business fund.

2. Research purpose

Building basis of science and reality for economic - technical efficiency of PE using solutions in CM in Quang Ninh area, to make contribution to increase efficiency of coal production and coal business.

3. Object and scope of research

a. Object of research

Object of research of this topic economic - technical efficiency of PE using solutions in coal mining and others affected aspect.

b. Scope of research

- Content scope*:* This topic is mainly research on the content of economic - technical efficiency of PE using solutions in CM in Quang Ninh area. Inside, scope of PE using is consider to be PE using process, from mechanical design, PE choosing, shopping investment, íntalling, running and repair PE in CM.

- Space scope**:** The figure is used for thesis topic studying which is picked from CM enterprisesin Quang Ninh area.

- Time scope: Secondary data serving research thesis was collected during the period of 2014 - 2018, primary data were collected in 2018, increasing economic - technical efficiency of PE using solutions are applied in the period of 2020 – 2025.

4. Research mission:

- It is aiming to collecting, analysing and overviewing the study of theory and practice about PE and economic - technical efficiency of PE using in CM, then summarizing the research orientation and building the theory framework of economic - technical efficiency of PE using in CM;

- The thesis reviews the reality of economic - technical efficiency of PE using in CM in Quang Ninh area, then give conclusions for results and the limitation, the realityors affect economic - technical efficiency of PE using in CM;

- It also researchs and gives solutions to increase economic - technical efficiency of PE using in CM in Quang Ninh area to help enterprises impove mining production, make sure for safety workplace, increase productivity, reduce mining cost and rising business efficiency.

5. Thesis results

- **In theory:** Thesis has created overview of studies about economic efficiency in general, economic - technical efficiency of PE using in CM in particular, then research and complete rationales of economic - technical efficiency of PE using in CM such as:(1) Recommend economic - technical efficiency of PE using in CM notion;(2) Determine basic realityors affect choosing suitable PE in CM; (3) Complete a system of evaluation target and evaluation of economic - technical efficiency of PE using process.

- **In reality:** On the basis of analysing, evaluating the reality of PE using in CM in Quang Ninh area, the thesis made clear the achivements, the limitation and others realityor affect economic - technical efficiency of PE using in CM, then recommend some solution of economic - technical efficiency of PE using in CM through: (1) Complete analysis of method andPE choosing process; (2) Complete production organization on oven CM process; (3) Improve human labour quality... The system of solution recommened make sure for scientific, comprehensive, influencing from evaluation progess, PE choosing to organizing, PE using process with the aim to bring maximum economic - technical efficiency of PE using in CM.

6. New point of the thesis

- ***In theory*:** The thesis select and approach the concept economic - technical efficiency of PE using in CM from the perspective of resource utilization, however, the economic - technical efficiency of using resources is not only considered independent but also placed in relation with economic - technical efficiency of technology investment activities . According to this approach, economic - technical efficiency of PE using in CM is determined on the basis of integrated economic efficiency and technical efficiency during PE using process, basis for evaluating the effectiveness is the extent of the criteria Economic - technical customs are determined by investors when formulating investment plans. Realityors affecting economic - technical efficiency of PE

using include not only those realityors that directly affect the using process but also those related to the process of construction, evaluation and selection of an investment project. Therefore, the solution to improve the economic - technical efficiency of PE using will affect both investment activities and operations PE using, make a contribution to raising using investment fund efficiency and business efficiency for enterprises.

- *In reality*: The solutions to improve economic- technical The solutions to improve economic - technical efficiency of PE using in CM in Quang Ninh area are proposed based on the basis of results of consultations of experts are senior managers in CM enterprises in Quang Ninh Province and the results of quantitative analysis of the relationship between the economic efficiency and mechanic efficiency and the principal factors subjective affect economic - technical efficiency of PE using. On the other hand, the proposed system of solutions is in the direction of a comprehensive impact on activities related to the use of PE, from project development, evaluation, investment options to the use of PE, therefore, it will ensure scientific, systematic, realistic and feasible solution, not only bring economic- technical efficiency of PE using but also bring investment efficiency for PE in particular and business efficiency for enterprise in general

7. Thesis content

Chapter 1. Overview of the studies about prop equipment and improve economic - technical efficiency of Prop equipment using in underground coal mining

Chapter 2. Theory and practices basis of improve economic - technical efficiency of Prop equipment using in undergruond coal mining

Chapter 3: Reality of economic - technical efficiency of prop equipment using in underground coal mining in Quang Ninh area

Chapter 4: Enhancing economic - technical efficiency of using prop equipment in underground coal mining in Quang Ninh area

CHAPTER 1.
OVERVIEW OF THE STUDIES ABOUT PROP EQUIPMENT AND IMPROVE ECONOMIC - TECHNICAL EFFICIENCY OF PROP EQUIPMENT USING IN UNDERGROUND COAL MINING

1.1. Overview of the studies about prop equipment

Author Dang Vu Chi asserted the important of anti-retention work in underground CM to ensure productivity, artisanal resources and especially ensure the safe for workers and equipments.

Author Dam Hai Nam also analyzed the situation of PE using can keep underground mine in the country and the world; combining calculation theory and practical conditions in Vietnam, then selecting research, designing suitable PE to the conditions of Vietnamese underground coal mines.

Author Nguyen Tien Chinh and partners pointed out the necessity of mechanization and modernization of undergrond coal mining (including PE using) and made some achievements in the application in exploiting and PE using such as increasing the capacity of longwall oven, increasing labor productivity, improving working conditions and safety of workers, reducing resources loss.

In general, the studies about reality of PE using in underground CM in Quang Ninh area are quite fully, clear; however, these documents had not embrace all advantages and disadvantages of prop equipments yet as well as the comparison of PE using efficiency under the same applied conditions in order to have measures to optimize efficiency of PE using in the condition that underground coal mining is increasingly complicated today. Simultaneously, at the present time, there has not been any research project that has proposed the process of PE selecting to be kept in underground CM in accordance with the geological conditions of Quang Ninh area to ensure the improvement of PE using efficiency.

1.2. Overview of the studies about economic- technical efficiency of Prop equipment using in underground coal mining

1.2.1. Overview of the studies about economic efficiency of using equipment

* *Approach from an investment perspective*

Author Tu Quang Phuong & Pham Van Hung and author Nguyen Bach Nguyet believed that: economic efficiency of using equipment is understood as categories of economic expression comparative relations between the economic - social results and the cost of those results in a certain period. With views economic efficiency of using equipment as above, the author also said that the assessment criteria economic efficiency of using equipment of the project include: *(1) The net profit of the project (W_{IPV}); (2) Project's net income (NPV) (3) Return on investment capital; (4) Average income R; (5) Target of internal rate of return (IRR); (6) Return on investment (T); (7) Annual or average increase in labor productivity compared to the previous period investment (I_{EL}).*

Scholars Farell claim that it is necessary to be calculated on the basis of technical efficiency and allocation efficiency. While research on the theory of production efficiency, Farell has said that economic efficiency of an enterprise consists of two components: technical efficiency and allocation efficiency. When the enterprise achieves both technical efficiency and allocation efficiency, it will reach economic efficiency. Technical efficiency (TE): measured by the number of products that can be achieved on the number of resources used in production; Allocation efficiency (AE): is the ability to choose the optimal combination of the number of input types where businesses can produce the number of output products with the lowest cost. Economic eficiency (EE): Economic efficiency is defined as the integration of technical efficiency and allocation efficiency. The notion of economic efficiency asserted the essence of economic efficiency in product activity is reflection of economic activity quality, reflection level of using resource to reach the lastest target of product activity is maximize profit.

* *Approach from the perspective of mining assets in business*

When analyzing economic efficiency, enterprises often analyse it according to two aspects: totally economic efficiency and section economic efficiency.

Author **Ngo The Binh (2017**) in Industrial Economic Curriculum also believed that, review the economic efficiency using fixed property is necessary to be approach according to two aspect: the utilization of fixed assets and capacity utilization of fixed assets [5], whereby, targets identified include: *the index return (performance fixed capital)* is relatively target comparable number of products with the average fixed capital of enterprises in a period. This criterion shows how many products of a fixed capital produce or how many coins of output value. *Use ratio of fixed capital (ratio of capital raising)* is criteria inverse of criteria coefficient performance fixed capital, point out that to produce a unit of product or 1 copper output values need how much investment for fixed assets. *Capacity of the device in e* is entitled to determine the number of products with maximum device is producedin a certain period.

1.2.2. Overview of studies about economic - technical efficiency in Prop equipment using

Author Tran Thanh Hiep, author Truong Duc Du believed that: economic-technical criteria mainly towards: (1) Oven capacity; (2) mining production; (3) length of longwal oven; (4) total investment; (5) equipment performance; (6) ration of average laborate; (7) Technical stability of coal...

Author Tran Xuan Hoa, Tran Van Hiep, Phung Manh Dac and partners shown that modern PE using brought economich - technical efficiency such as increase productivity, reduce product costs, improve working conditions for

workers, improve PE investment efficiency in particular and the equipment inside and outside the mining industry in general.

1.3. Research orientation of the thesis

- Clarifying the concept of economic-technical efficiency of PE using in underground coal mining, which is approached from the perspective of PE using and placed in relation to the PE investment process;
- Identifying criterion evaluation system of economic - technical efficiency of PE using in underground coal mining;
- Identifying and evaluate the factors affecting the economic - technical efficiency using manual PE;
- Recommending the system solutions to improve PE using efficiency to improve economic - technical efficiency of PE using conformity with the conditions of production and business practice.

1.4. Research method of the thesis topic

- Theoretical synthesis method
- Statistical - described method
- Expert method

Summarize chapter 1

Chapter 1 of the thesis has a overview of the studies about economic - technical efficiency of PE using in underground CM and give conclusions that it is necessary to choose a new approach to the notion of economic - technical efficiency of PE using and evaluation foundation of economic - technical efficiency significantly in both theory and practice in order to properly evaluate the results of the economic - technical efficiency of PE using in CM. In addition, it is necessary to determine the system factors affecting economic - technical efficiency of PE using in CM as a basis to analyze the situation and propose solutions to improve economic - technical efficiency of PE using solutions in CM in Quang Ninh area in the future.

CHAPTER 2.
THEORY AND PRACTICES BASIS OF IMPROVE ECONOMIC - TECHNICAL EFFICIENCY OF PROP EQUIPMENT USING IN UNDERGROUND COAL MINING

2.1. Notion of coal mining technology and economic - technical efficiency of PE using in underground coal mining

2.1.1. Notion of technology and equipment in underground coal mining

a. Underground coal mining technology

CM technology is an important notion with Cm enterprises, helping the enterprises organize production, labor, plan and implement business strategies, technology innovation, cost calculation, business results and efficiency. In the process of underground CM, the prevention of longwall oven is an important role to ensure labor productivity, resource recovery and labor safety.

b. Notion of equipment trong prop equipmemnt in underground coal mining

PE *is a system which include a number of section linking together to take the function of propthe ovens to support for cho coal drilling and controling the stone on overburden in the ovens. This system can combine with Combai machines or coal shaper withchain conveyer system to make a mechanized synchronous equipment system orcombining with blasting and drilling technology in a semi-mechanical ovens*. PE play an important role in coal mining in the ovens, is the basis of increasing oven capacity as well as mine capacity, creating conditions for increasing productivity, reducing coal mining cost and raising coal produce and business efficiency.

Feature of PE in underground CM: PE in underground CM is choosed on the basis of evaluating the comparative investment efficiency; plays a decisive role in the effective use of human resources of enterprises; PE using in underground CM efficiency is only dominated by mining and geological conditions of level of organization and using resource.

2.1.2. Notion of economic - technical efficiency of PE using in underground coal mining

Economic - technical of PE using in underground coal mining is understood a category indicating the optimal use of resources related to PE in order to achieve the maximum benefit goal including coal mining output (Technical efficiency) and economic benefits (economic efficiency) with minimal costs.

From the notion of economic - technical efficiency of PE using in underground CM, it is clear that:

- In essence, economic - technical efficiency of PE using signifies a comparative relationship between economic - technical results achieved in the process of PE using with expected economic - technical results. Investors are established when approving and implementing investment projects for PE

In scope, economic - technical efficiency of PE using is allocated in relation with PE choosing and investing actions. The economic - mechanic criteria of PE using in PE designing and choosing is considered the standard for comparison, targeted towards the enterprises as investment and PE using of enterprises..

In content, the economic - technical efficiency of PE using reflect usability optimal resource usage for PE including investment capital and labor resources, at the same time, reflects the ability of achieving investment targets in particular and business goals of enterprises in general.

2.2. Evaluation criterion system of economic - technical efficiency

2.2.1. Evaluation criterion system of economic - technical efficiency viewpoint

Firstly, evaluation criterion system of economic - technical efficiency is determined as criteria of economic efficiency and criteria of mechanic efficiency which reflect the efficiency of PE using in relation with PE investment process.

Secondly, comparative and evaluative basis of economic - technical efficiency of PE using is the level of the criteria of economic - technical of PE được caculated in PE investment plans.

Thirdly, the criteria of criteria system have to ensure the accuracy, timeliness and being integrated with others information to serve enterprise business efficiency evaluation.

Fourthly, economic - technical of PE using has to be caculate particularly for each oven with the PEs having oven capacity and raw coal production và investment funds value…specifically.

2.2.2. Evaluation criterion system of economic - technical efficiency

2.2.2.1. Group of mainly economic - technical criteria in exploitment system (9 criteria)

2.2.2.2. Group of evaluation criteria of investment, innovation and choosing efficiency of PE (9 criteria)

2.2.2.3. Group of economic - technical efficiency of PE applying criteria (5 criteria)

2.3. The factors affecting economic - technical efficiency of PE using

The factor affecting economic - technical efficiency of PE using include objective and subjective factors. Objective factors include: laws, tax policies, mine and geological conditions, technique and technology environment, and market-related factors. In which, the objective factors are those affecting outside the human intervention, therefore, to go into the analysis to find solutions to improve economic-technical efficiency of PE using, the author focuses on studing subjective factors affecting the economic and technical efficiency of PE using.

2.3.1. Quality of exploitment technology design and PE design

The quality of the design of mining technology and PE is expressed through the following aspects: (1) PE's suitability to the mine geological conditions; (2) The suitability of PE with labor capacity; (3) The degree of

conformity of PE with the oven specifications; (4) Relevance of PE to mining technology; (5) The degree of synchronization of PE and other equipment types.

2.3.2. The quality of evaluation economic analysis choosing PE

The quality of evaluation economic analysis options for PE is expressed through the following contents: (1) The process of economic analysis and evaluation of PE selection; (2) The reasonable level of criteria for evaluating economic analysis to choose PE; (3) Capacity of the economic analysis and evaluation team to choose PE; (4) Quality of geological data.

2.3.3. Human resources using PE

Human resource affecting economic - technical efficiency of PE using is shown through the following contents: (1) The capacity of workers; (2) The level of assurance of the number of employees; (3) The level of physical fitness of the employee; (4) Quality of human resource training using PE; (5) Level of remuneration for personnel using PE.

2.3.4. Product organization capacity

Produc organization capacity affecting economic - technical efficiency of PE using is shown through the following contents: (1) The level of rational of work organization; (2) Reasonable level of arrangement of machinery and equipment in the line; (3) The reasonable level of labor arrangement in the line; (4) Production organization encourages creative workers. Organization of production capacity as possible, economic - technical efficiency of advance PE using.

2.4. Experiences about increasing PE using efficiencyin exploitment conditions all over the world

2.4.1. Reality of PE using in coal mining abroad

In conditions of gentle coal-bed exploitation

Many countries have a large numbere of experience do apply the mechanized coal-bed exploitment system can be mentioned as China, Germany, USA, Poland, Ukraine, ...

I*n conditions of sloping coal-bed exploitation*

In many countries on the world such as Russia, China, USA, France, ... there are areas of coal-bed with high slopes accounting for a significant proportion of each country's coal reserves. To exploit the sloping coal-bed, countries have applied many different mining technology systems to ensure labor safety and economic - technical efficiency in the exploitation process.

2.4.2. Lesson forVienam underground coal mining enterprises

It is necessary to learn from the experience of countries in the world in selecting synchronous PEs with CM technology in accordance with mine geological conditions and longwall parameters. Besides, in order to improve the efficiency of mechanization application, in addition to the task of perfecting the technology, it is necessary to organize training and training of

cadres and workers to master the technology, improve the initiative and creativity in production situations.

Summarize of chapter 2

Chapter 2 of the thesis systematize the basis of theory about economic - technical efficiency of PE using in underground CM. On the basis of notion of economic - technical efficiency of PE using, chapter 2 recommend the evaluation criteria of economic - technical efficiency of PE using. The value of the criteriain evaluation criteria system of PE efficiency in the progess of making equipment investment plan is used as evaluation basis for the level of economic - technical efficiency of PE using in underground CM through equipment using process. Morever, Chapter 2 had shownthe factors affecting economic - technical efficiency of PE using to be the base to analyze the facts, recommend solutions which make contribution to increasing economic - technical efficiency of PE using, ensuring feasibility in different coal production and trading conditions.

CHƯƠNG 3.
REALITY OF ECONOMIC - TECHNICAL EFFICIENCY OF PROP EQUIPMENT USING IN UNDERGROUND COAL MINING IN QUANG NINH AREA

3.1. Describe underground coal mininh in Quang Ninh area

Currently, Quang Ninh has 12 underground coal mines, the distribution of reserves in the coal mines is described in Table 3.1.

The Table 3.1 shows that coal reserves are concentrated mainly in some large mines such as Khe Cham (accounting for 23% of total reserves), Mao Khe (accounting for 11% of total reserves), Vang Danh (accounting for 10%). total reserves), Uong Bi (10%), Duong Huy (9% of total reserves), Ha Long (9% of total reserves), Ha Lam (7%). In particular, the reserves are concentrated in areas of medium thick seams (accounting for 43% of the total reserve) and thick seams from 3.5 ÷ 10m (accounting for 50% of the total reserves), these are the thickness areas to be set. secondary research on the applicability of mechanized devices. The reserve of areas of thin seams and seams over 10m thick accounts for a negligible proportion.

Table 3. 1. Summary of reserves by thickness at mines

Measure: million tons

No.	Area	Thickness (m)			
		0,7 ÷ 1,2m	**1,21 ÷ 3,5m**	**> 3,5m**	**Total**
1	Mao Khe	2.738	53.730	18.441	74.909
2	Nam Mau	429	10.192	32.921	43.543
3	Uong Bi	1.772	28.466	8.503	38.741
4	Vang Danh	82	10.475	33.108	43.666
5	Ha Lam	0	1.515	49.458	50.973
6	Nui Beo	0	9.615	54.859	64.474
7	Duong Huy	1.160	43.230	14.686	59.076
8	Quang Hanh	498	19.620	5.040	25.157
9	Thong Nhat	2.146	12.783	22.493	37.422
10	Ha Long	327	23.449	70.890	94.666
11	Khe Cham	1.095	45.631	26.209	72.935
12	Mong Duong	391	13.704	10.987	25.083
Quang Ninh area		**10.638**	**272.411**	**347.596**	**630.644,7**

Source: The Institute of Mining Science

3.2. Analysis of the reality of economic - technical efficiency of prop equipment using in Quang Ninh area

3.2.1. An overview of the use of prop equipment in underground coal mining in Quang Ninh

In the period 2014 ÷ 2018, the types of PE used in the recent period

include: (1) Mobile hydraulic prices; (2) Mobile frame rack; (3) Self-propelled rigs: ultralight rigs, mechanical soft rigs ... The proportion of coal exploited using PE tends to increase significantly in the period 2014 ÷ 2018. In 2014, the market share of PE using PE accounted for 54.1%, in 2018 this proportion increased to 73.8%. The growth rate of PE production in mining increased from 10.56 million tons (2014) to 16.76 million tons (2018) with an average growth of 10% / year, in which, the highest growth rate was achieved. is 2016, an increase of 16% over the previous year. The main anti-equipment in CM in Quang Ninh is the frame price, chain and mobile hydraulic price XDY with the annual output increasing gradually in the period of 2014 ÷ 2018, in 2014, the output was approximately 10 million tons, accounting for 10 million tons. 51% of the total output of longwall mining coal and by 2018, the output reached 12.9 million tons, this proportion increased to 57% of the total output of longwall mining. The types of anti-self-propelled rigs with synchronous CGH technology also tend to be applied in enterprises with an investment of hundreds of billion VND are also showing superiority and CM efficiency.

3.2.2. Some results obtained from the use of prop equipment in underground coal mining in Quang Ninh

In the period of 2014 - 2018, along with the trend of increasing the use of PE and technological innovation in CM, the ability to recover resources of the CM enterprises in Quang Ninh has also increased. For the whole Group, in 2014 the proportion of pit coal loss was 24.13%, in 2018 this rate decreased to 21.66%. The coal recovery ratio of the Group in 2014 was 75.87.97%, in 2018 this rate was 86.19%. This result has significantly improved economic-technical efficiency in using the assets in the CM of the Group in general and of the enterprises of Quang Ninh in particular. The most significant improvement in coal loss rate is Thong Nhat Coal Company, Duong Huy Coal Company, Ha Long Coal Company, Mao Khe Coal Company and Uong Bi Coal Company .... with the loss rate decreased from 22 - 23% to 18 - 19%. Coal recovery rate also improved significantly in Quang Hanh Coal Company, increasing from 76.28% to 80.84%, the coal recovery rate of Ha Long Coal Company increased from 77.09% in year. 2014 amounted to 81.38% in 2018.

3.2.3. Economic - technical efficiency of prop equipment using in underground coal mining in Quang Ninh

In general, the use of PE has low economic-technical efficiency, specifically as following: Equipment usage efficiency is still low in comparison with the design capacity. At companies, the efficiency of using PE is only 66% to 70% of the design. The reason is that the mining planning and the auxiliary technical stages are not synchronized to meet the appropriate conditions for the CGH oven. This lead to the uniformity of mining equipment in the whole production line capacity of PE. In the recent time, at Quang Hanh Coal

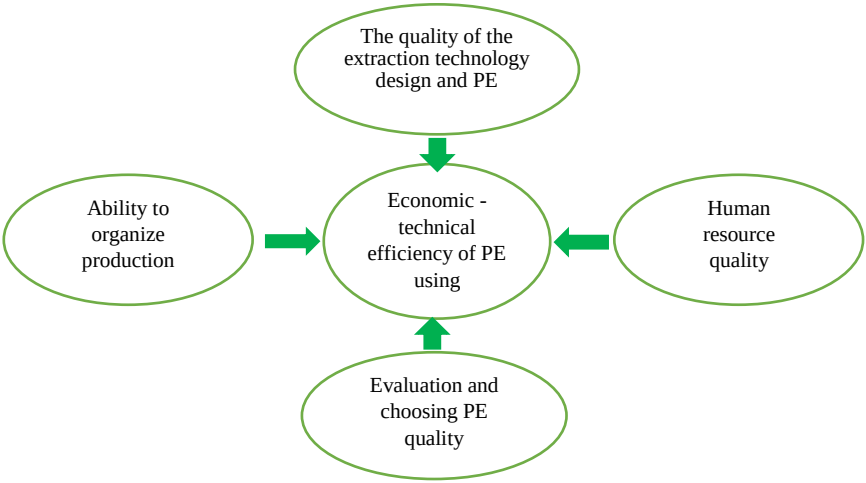
Company, Vang Danh Coal Joint Stock Company due to the asynchronous transport system, limited passage capacity should affect the operation of equipment in the process of using equipment, problems which are not immediately solved had occured and interrupted production. On the other hand, due to the actual geological conditions during the construction of the project, there are many fluctuations, resulting in: (i) the capacity and investment level are not up to the design; (ii) failing to achieve the designed output due to stone cutting, which has to be changed many times to produce to solve the problem of the coal-bed burning itself that lead to dealing with the unstable coal mirror situation frequently.

3.3. Analysis the factor affecting economic - technical efficiency of prop equipment

3.3.1. Model of assessing the impact of factors on economic - technical efficiency of prop equipment using in underground coal mining

The model to evaluate the impact of factors affecting economic - technical efficiency of PE using in Quang Ninh's CM was built on the basis of the analysis results of theoretical and practical studies on economic - technical efficiency of PE using, building a system of exploitation, evaluation and selection of PE, using PE ...

Independent variables in the model are determined from the perspective of the author Tran Xuan Hoa; Nguyen Anh Tuan and Tran Tuan Ngan, including: (1) LC - Quality of design of mining technology and PE; (2) DG - quality of evaluation of PE investment projects; (3) NL - Quality of human resources; (4) TC - Possibility to organize production at the longwall.



Picture 3. 1. Model of researching factors affecting economic and technical efficiency using PE

The hypotheses of the model include:

LC - The quality of the exploitation technology design and PE have a positive relationship with the economic - technical efficiency of PE using.

DG - the quality of the evaluation of economic analysis choosing PE has a positive relationship with the economic - technical efficiency of PE using.

NL - The quality of human resources has a positive relationship with economic - technical efficiency of PE using.

TC - The ability to organize production in longwall oven has a positive relationship with economic - technical efficiency of PE using.

The relationship between variables can be described through linear regression model as follows:

$$\mathbf{HQ = \beta_0 + \beta_1.LC + \beta_2.ĐG + \beta_3.NL + \beta_4.TC} \qquad \mathbf{(3.1)}$$

From the survey data, using SPSS 20.0 software, the calculation results are presented in Table 3.9.

Table 3.9. Analysis results of survey data on SPSS software

Anova[a] & Coefficients[a]

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	23,589	4	5,897	96,009	,000[b]
Residual	6,743	110	,061		
Total	30,332	114			
Model	Unstandardize Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-1,461	,305		-4,792	,000
LC	,390	,063	,367	6,172	,000
DG	,169	,070	,135	2,419	,017
NL	,323	,066	,256	4,906	,000
TC	,503	,053	,461	9,480	,000

a. Dependent Variable: HQ

b. Predictors: (Constant), TC, NL, DG, LC

Data analysis results on SPSS 20.0 software

From the data in Table 3.9, the sample regression function has the form:

$$\mathbf{HQ = 0,367.LC + 0,135.DG + 0,256.NL + 0,461.TC} \qquad \mathbf{(3.2)}$$

The sample regression function R2 = 0.778 shows that 77.8% of the variation of economic-technical HQ variables using PE is caused by variables in the model, the sample regression function has a corresponding level. relatively high. The value of F = 96,209 for the whole range, the regression function is also suitable.

Sig value. corresponding to the independent variables are smaller than 0.05, it shows that the independent variables in the model have significant explanations for the HQ variable.

From the sample regression function:

- With $\beta 1 + \beta 2 = 0,367 + 0,135 = 0,503$ shows 2 variables including: the quality variable of the design of exploitation technology and PE (LC) and the quality variable of the economic analysis evaluation for PE selection. (DG) of the same process of design and selection of PE is the most influential to economic and technical customs using PE in CM region;

- With $\beta 4 = 0.461$ shows that the ability to organize production (TC) has the second largest influence on economic-technical efficiency using PE in CM in Quang Ninh region;

- With $\beta 3 = 0,256$ shows that the quality of human resources (NL) has the third largest influence on economic - technical efficiency using assets in Quang Ninh region;

Thus, the system of solutions to improve the quality of the longwall technical design using PE requires the design of PE to be synchronous, consistent with coal mining technology and conditions, and the quality of business analysis and evaluation. PE and selection; strengthening production organization capacity, improving the quality of human resources are all capable of improving economic-technical efficiency using PE in CM region. However, the design of solutions should be based on: (1) the importance of independent variables: the solutions should focus on improving the production organization capacity and effectiveness of the PE selection process, ensure consistent with the geological conditions of mines, ensure the uniformity of equipment in the line in terms of technology level, type and technical conditions. After being approved, the technological plan must be strictly observed during use in order to bring high HQ; (2) The results of the assessment of the current status of the factors affecting the components as a basis for designing the specific impact directions of the solutions.

3.3.2. The results assess the status of the level of the influencing factors

a. The quality of the extraction technology design and PE

The degree of synchronization of PE with the types of equipment in the extraction line and the suitability of PE with the geological condition is relatively low, reaching 3.74 ÷ 3.87 points. The suitability of the device with geological conditions is low and it is the basic factor to reduce economic - technical efficiency of PE using. However, the changing geological condition is an objective factor, despite the application of high-tech exploration equipment, the exploration documents cannot control all the changes of the geological conditions.

b. The evaluation of economic analysis and selection of PE

According the survey results, the opinions highly appreciate the science of PE assessment and selection process, the capacity of the PE assessment and

selection team with an average evaluation score of 4.15 ÷ 4. , 23 on a 5-level Likert scale. When preparing a technology renovation project in general and PE in particular, only the evaluation and comparison of some economic and technical indicators are expected to be obtained from the investment in equipment renovation without economic – technical efficiency evaluation of investment activities for PE in relation to the amount of capital invested in PE.

c. The quality of human resources using PE

The degree of the level of guarantee of the number of employees; the quality of human resource training using PE; remuneration for personnel using PE is relatively high with an average score of 4.12 to 4.31 points on a 5-level Likert scale. In the opinion of experts, in recent years, CM enterprises in particular and TKV in general have identified one of the top strategic tasks to train high-quality human resources to apply advanced technology. advance serving coal production.

d. Production organization capacity

In practice, the consulting units that formulate PE investment projects have a chart of estimated cycles based on experience and form but do not calculate specifically according to norms and labor science organizations and almost have Differences from the design.

In the marketplaces using advanced PE, after a new time of operation, the output has not been achieved as the design and plan of the enterprise, the number of employees is arranged in accordance with the jobs in the mining cycle. all exceeded the level calculated by the model of the construction company; The main reason is that workers do not have experience in operating advanced equipment.

3.4. Overall assessment of economic and technical efficiency using PE

3.4.1. These achievements

In the period of 2014 ÷ 2018, the output exploited in the synchronous CGH furnace in Quang Ninh area is tending to increase gradually due to HQ due to the mechanization implementation. The average output of longwall coal using PE during the period was 21.69 million tons / year, accounting for 55.43% of the entire coal mining industry, the average increase was 3.84% / year.

Vietnam National Coal and Mineral Industry Group and Northeastern Corporation in the period 2014 ÷ 2018 have focused on mechanization and use of more advanced underground mining facilities with the goal of economic, technical and safety efficiency. Increasing labor productivity as well as minimize the probability of unsafe risks in production. In the same condition, in mechanized longwall furnace mechanized the average number of employees 95 people / workshop, output reached 230 ÷ 400 thousand tons / year, compared with blast furnace blast furnace 120 ÷ 160 people / workshop and production. the amount of 120 ÷ 180 thousand tons / year; The labor productivity increases 1.5 ÷ 2.5 times, reaching 8.2 ÷ 15 tons / work.

3.4.2. Limitations and causes of limitations

Firstly, production organization capacity has not met the requirements of technological change and PE, especially the level of compliance with technological processes according to the design and production organization capacity to encourage workers. creativity in the mining process in general and in CM at the longwall in particular.

Secondly, restrictions on the suitability of PE to geological conditions, the degree of synchronization of PE with other types of equipment, especially transport equipment, makes the capacity of restriction through should be affected. to device performance.

Thirdly, limitations on the quality of human resources using PE as the capacity of employees and the level of physical security of workers.

Fourthly, limitations in the evaluation of PE investment project, especially the reasonable level of criteria for selecting PE; When applying advanced PE in Vietnam, there is no method of assessing economic - technical efficiency using PE in relation to the investment level for PE to identify the HQ of investment activities for PE and search for solutions to improve HQ to invest and use PE

Fifthly, the evaluation of the efficiency of using PE has not been conducted periodically and is relatively independent of other mining equipment, causing the lack of timely information for investing in technological innovation.

Summarize of chapter 3

In recent years, the output of underground coal mining in Quang Ninh has a high growth rate, the coefficient of coal loss has decreased and the coefficient of clean coal recovery has increased. The strong growth in output is the result of the step of gradually renewing mining technology towards mechanization of production technology, meeting the basic criteria of modern mines such as mining capacity. high waterfall, safety, advanced technology and equipment, reducing manual labor. However, if considering economic - technical efficiency based on design criteria, in general, the enterprises in Quang Ninh region have not yet achieved the design efficiency in terms of mining output, labor productivity and capacity. longwall ... Therefore, to improve economic - technical efficiency using PE, it is necessary to ensure that the selection of PE in synchronization with the CM technology in the longwall oven must be suitable with geological mine conditions and specifications. of longwall and must have economic efficiency and must select and evaluate the economic efficiency of investment, PE innovation according to a reasonable process. At the same time, the production organization, labor organization and procurement, installation and maintenance processes need solutions to overcome the problems that occurred in PE ovens.

CHAPTER 4
ENHANCING THE ECONOMIC – TECHNICAL EFFICIENCY OF PROP EQUIPMENT USING IN UNDERGROUND COAL MINING IN QUANG NINH AREA

4.1. Orientation to improve economic - technical efficiency of prop euipment using in underground coal mining in Quang Ninh area

4.1.1. Development orientation of coal mining activities in Quang Ninh

Investing in renovation and expansion to raise capacity; Investment in maintaining the capacity of built mine projects.

- Striving to 2023, the coal output exploited by CGH (synchronous CGH, light CGH and other types of CGH) will reach 20 ÷ 25% of the total output of pit coal.

Study to invest in additional longwall ovens using soft rigs in units with average seam thickness of up to 4.5m, slopes above 45o such as Vang Danh Coal Joint Stock Company, Quang Hanh Coal Company, Uong Bi Coal Company, Ha Long Coal Company, Hon Gai Coal Company...

Continue to promote the application of synchronous mining technology, research and application of light duty rig, combined with frame and chain rack, to completely replace single wooden and hydraulic poles to improve labor productivity and level safety.

4.1.2. Requirements for improving economic - technical efficiency of prop euipment using in underground coal mining in Quang Ninh

It is necessary to carefully study geological documents as a basis for identifying appropriate technologies and PE;

Proposing to develop solutions to select specifications of each PE suitable to the conditions of each longwall, to build and rationally organize technical processes corresponding to each type of PE;

Completing the system of economic-technical efficiency evaluation criteria to use PE in CM as a scientific basis for selecting PE and creating practical basis for the assessment of using PE efficiency and proposing solutions to improve economic - technical efficiency of PE using;

Solutions to improve economic - technical efficiency of PE using should be developed synchronously, ensuring high compliance according to technical designs and creating conditions to improve the quality of human resources.

4.2. Solutions to improve efficiency to improve economic - technical efficiency of prop euipment using in underground coal mining in Quang Ninh area

4.2.1. Improve the quality of mining system design and complete the PE selection process

4.2.2.1. Basis for implementing the solution

From the results of the analysis of the ability to synchronize using PE in combination with stage and roadheaders at Khe Cham coal companies, Duong Huy coal companies, Vang Danh coal companies, Nam Mau coal companies, ... with investments of tens of billions to more than hundred billion dong but the actual coal production produced from the investment of advanced technologies are still mainly on the testing side but not yet widely applied.

4.2.2.2. Content of the solution

* Establishing the bases for calculating and selecting PE appropriate
* Improving the quality of geological and exploration documents
* Improve the quality of exploitation technology selection
* Complete the evaluation process of economic analysis to select PE

4.2.2. Improve the organization of production in the longwall

4.2.2.1. Basis for implementing the solution

The results of the analysis of the status of CM production organization of the coal mining enterprises in Quang Ninh show that: most of the CM enterprises in Quang Ninh have not done well according to the periodic operation and maintenance process for PE in particular and machinery in general, leading to unsafety in the labor process, machinery and equipment encounter difficulties that are difficult to overcome causing loss of time and interruption of production.

4.2.2.2. Content of the solution

* Organizing scientific labor in the longwall PE using
* Strictly comply with the approved production organization plan

4.2.2.3. The expected effect of the solution

+ Increase the rate of actual capacity compared to the design due to good implementation of design specifications.

+ Contribute to reduce production costs and reduce the level of the actual cost ratio ratio compared to the design

+ Make the most of the oven oven capacity due to reduced working hours / day due to lack of spare parts and accessories.

4.2.3. Improve the quality of human resources

4.2.3.1. Basis for implementing the solution

The results of the quality analysis of human resources show that the CM workers in the longwall at pit enterprises have not been highly appreciated in terms of both professional and physical qualifications. The fact that workers in long-term ovens have low qualification and physical ability, often fluctuate in number will

affect the ability to adapt to the job, the ability to be creative at work, the ability to achieve work productivity and labor productivity according to design.

4.2.3.2. Content of the solution

** Improving the quality of the management staff*

+ Constantly improving the professional management level for the management team, creating conditions for developing leadership ability

+ Building specific training programs such as advanced training, retraining, supplementary training, specialized training for technical staff on anti-pit mines so that they can promptly stabilize the increasing technological line. advanced and modern.

** Improve the quality of workers directly engaged in production*

+ Opening training and fostering courses for workers to help them perfect their skills in using new machines and equipment, ensuring maximum efficiency.

+ Arranging, arranging workers with different skills in a scientific way;

+ Improve the quality of training at enterprises;

+ Improve the health care regime for employees.

4.2.3.3. The expected effect of the solution

- Enhancing the capacity of human resources, meeting the work requirements and increasing labor productivity and efficiency of using assets;

- Increasing the stability of the number of employees, thereby reducing recruitment and training costs, contributing to reducing product costs;

- Creating favorable conditions for technological innovation, implementing business strategic goals of businesses and TKV Group.

4.2.4. Other solutions group

** Standardize processes of procurement, installation and operation of PE*

** Good management of PE repair and maintenance activities*

** Strengthen the cost management of marketplace CM*

Summary of chapter 4

The solution of selecting PE according to the objective of improving economic-technical efficiency, the author has proposed steps to select PE to synchronize the technology of longwall mining ovens in accordance with the geological geological conditions and the specifications of the longwall furnace. thereby achieving the goal of improving economic and technical efficiency.

With the concept to achieve economic - technical efficiency of PE using, people play a significant role. Therefore, the solution of improving production organization and labor organization in the longwall in order to improve economic - technical efficiency of PE using has given basic steps to build a production arrangement chart. longwall and oven production chart. In addition,

the author also proposes solutions to standardize the procurement, installation, operation and repair of PE; solutions to improve human resources and cost management solutions.

Improving economic - technical efficiency of PE using in underground coal mining in Quang Ninh is a complex issue, requiring a combination of many factors, solutions that may still exist certain limitations. However, the basic solutions given in chapter 4 of the thesis have been calculated and argued quite specifically, the author of the thesis has certain hope about the feasibility of these solutions for the improvement objective of economic - technical efficiency of PE using in underground coal mining.

GENERAL CONCLUSIONS AND PETITION

A. GENERAL CONCLUSION

Through the study of theoretical and practical overview of economic - technical efficiency of PE using in underground CM, the thesis has determined the research orientation, especially built concepts and indicators system. assess the economic - technical efficiency of PE using with an effective approach to PE using in relation to the economic - technical efficiency indicators identified in the design of the mining system and PE selection. On the basis of theoretical analysis, current situation and factors affecting the author of the thesis, propose solutions to economic and technical efficiency using appropriate and feasible PE in practice and giving main conclusion:

(1) Prop oven is an important role in underground coal mining.

(2) Prop equipment (PE) is a hydraulic system consisting of many separate parts linked together to perform anti-furnace function in service of coal and rock wall in the longwall.

(3) economic - technical efficiency of PE using can be understood as a category indicating the optimal utilization of resources related to the use of PE to achieve the PE investment objectives of coal mining enterprises. .

(4) To ensure the use of PE to be economically and technically effective, firstly, the assessment method and selection process of PE must first be completed.

(5) In order to improve the economic-technical efficiency of using PE in underground coal mining, it is necessary to apply solutions to streamline production organization and enhance the quality of labor force; Comply with operating procedures for using, maintaining and repairing PE in time to ensure the longevity of PE.etc.

Although the solutions are proposed on the basis of scientific and practical basis, ensuring the feasibility, the system with expected results. However, due to the limited time and resources, these solutions have not been implemented and applied in reality of production activities of the coal mining enterprises with specific production conditions from which to base the assessment. Real price compared to the solutions provided. This limitation of the thesis and the concepts and system of criteria for evaluating economic efficiency - techniques of using PE in underground CM has been developed also opens up the next research direction, including: (1) Complete the method of economic - technical efficiency evaluation using assets in CM in Quang Ninh area; (2) Solutions to improve economic-technical efficiency using CM equipment in Quang Ninh; (3) Assess the practical applicability and efficiency of solutions to improve economic-technical efficiency in using PE in underground CM in Quang Ninh; (4) Research conditions to apply economic - technical efficiency solutions to use assets in Quang Ninh area's CM.

B. PETITION

To develop the coal industry in general and underground coal mining in Quang Ninh in particular on the basis of improving economic-technical efficiency of PE using, the author propose government and CM enterprises to settle the following contents:

1. Petition to Government

- Elaborating and promulgating standards, technical regulations, technical regulations, economic-technical norms in service of geological survey, mineral exploration, exploitation and processing activities.

- Promulgating preferential regimes and policies to attract laborers to work in coal mines, especially laborers working in underground coal mines.

- Strengthening cooperation and links between enterprises inside and outside the industry, international cooperation in research, application of science and technology, transfer and reception of advanced technologies in manufacturing and effective use of mine equipment, especially PE.

- Promulgating mechanisms and policies to diversify capital mobilization in various forms: financial leasing, contracting, bidding for a number of mining activities, issuing bonds, stocks, commercial loans...therefore, CM enterprises can have enough financial resources to invest effectively.

2. Petition to coal mining enterprises

- Promoting basic investigation activities, exploration and assessment of coal resources and reserves, mine geological conditions capable of applying mechanization to prepare reliable resource bases for sustainable development solid coal industry.

- Collaborating with CM enterprises, domestic and foreign consultancy units and organizations to research and apply mechanized mining technology solutions to gradually modernize mines and improve production capacity.

- Establishing appropriate mining technology diagram at the same time studying, evaluating, selecting and deciding reasonable parameters applicable to different mining geological conditions and mine areas.

- Actively and flexibly encourage the mobilization of social investment capital for mechanized exploitation and equipment investment projects.

- Building a center for maintenance and maintenance of equipment, improving the quality of organization and management of maintenance activities, and at the same time enhancing the application of advanced and modern inspection and testing techniques.

- There should be a policy to support resources for the research and development of new technologies.

- Be proactive in health care for workers and train high-quality human resources to meet the needs of raising the level of mechanization and improving modern machinery and equipment.

LIST OF RESEARCHES
OF THE AUTHOR RELATED TO THE THESIS TOPIC

1. Nguyen Hong Thai (2008), "Application of anti-segregation price combination for slope seams 45^0, *Vietnam Coal and Mineral Magazine*, (4), pp 34-35.
2. Hong Thai (2008), "Analyzing the effect of applying ZH mobile brackets in market ovens", *Vietnam Journal of Coal and Minerals*, (14), pages 23-24.
3. Nguyen Hong Thai (2009), "A number of technical solutions to improve the investment efficiency when applying ZH holistic mobile bracket", *Journal of Mining Industry*, (6), pages 13 and 26- 27.
4. Hong Thai (2009), "Differential hydraulic prices for sloping market furnaces", *Vietnam Journal of Coal and Minerals*, (15), pages 35-36.
5. Nguyen Hong Thai (2014), "Solutions to improve the efficiency of mechanization of pit coal mining", *Vietnam Coal and Mineral Magazine*, (9 + 10), pages 46, 47.
6. Hong Thai (2014), "Some issues when manipulating Mobile hydraulic frame prices", *Vietnam Coal and Mineral Magazine*, (13 + 14), page 55.