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RESEARCH ARTICLE

Guidelines for Effective Management of Production Costs in the Rubber Wood Processing Industry

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ABSTRACT

The rubber wood processing industry is another industry with high business competition due to the changing direction of government policy, the economy, and industry. This research aimed to study the structure and characteristics of operations in the rubberwood processing industry and the components of the approach to managing production costs in the rubberwood processing industry, including developing a structural equation model for the approach to managing production costs in the rubberwood processing industry effectively. This research used both qualitative and quantitative approaches. The qualitative study was conducted through an in-depth interview with nine experts and group discussions with 11 qualified experts. For the quantitative section, a survey of 500 industrial business executives was conducted using questionnaires analyzed by descriptive and inferential statistics, including multivariate statistics. The results showed that guidelines for effective management of production costs in the rubber wood processing industry with the highest averages ranked by the importance in four components were as follows: 1) Creative Innovation ($\bar{X}$= 4.21), the most important items are setting the direction of organizational development toward becoming an innovative organization and disseminating it to personnel thoroughly. 2) Direct Labor Management ($\bar{X}$= 4.15), the most important item is follow-up on personnel training to ensure that it meets the training criteria. 3) Production Overhead Management ($\bar{X}$= 4.13), the most important items are Making a comparison (Benchmarking) of the organization's production expenses with competitors regularly to improve and develop them, and 4) Direct Material Management ($\bar{X}$= 4.13), the most important items are building good and strong relationships with key raw material suppliers, it was found that the two business groups were not different overall, and it was statistically significant at the level of 0.05. For the results of hypotheses testing, overall, none of the difference was found in the two business groups at a statistical significance level of 0.05. The analysis results of the developed structure equation model passed the evaluation criteria with conformity to the empirical data. The chi-squared probability value was equal to 0.089 and the relative chi-squared value was 1.123. The concordance index was 0.956 and the root mean squared value of the error estimate was equal to 0.016.

INTRODUCTION

According to the European Union timber trade control measure through Supply Side Management that prohibits the import and distribution of products produced from illegal wood, the wooden furniture manufacturers in China and Asia then need to use legal rubber wood from Thailand for their furniture production and to preserve more markets in EU (Spear et al., 2021). Thailand has had a significantly decreasing number of rubber tree planting areas from 2017 onward (Alongkorn, 2022). Approximates, this has resulted from the government policy to rush in cutting the old rubber trees to reduce the areas for rubber tree planting targeted at 16,000 hectares per year. It requires reducing the rubber tree planting areas to approximately 2,944,000 hectares within 2036 to form stability for rubber prices. This would cause insufficient rubber trees to serve the demands of the expanding

market. In addition, it would increase the rubber tree export values from seven billion US Dollars to twenty billion US Dollars according to a 20-year rubber strategic plan (Association of Natural Rubber Producing Countries, 2024). According to such a situation, the industries in Thailand that use rubber wood will be affected in the future by the higher cost of raw materials. Entrepreneurs in the rubber wood processing industry need to adjust their structure and internal organization operation manner to reduce production costs for efficiency and competitive advantages since arranging for a good operation system would reduce production costs (Krunsri, 2024). These show that the fundamental reason for higher costs results from insufficient production management, as well as the control over raw materials and operational costs. Moreover, the skillful labor, knowledge, or activities that do not add value are also insufficient. However, good production cost management would create competitive advantages for the entrepreneurs.

Objectives

1. To study the structure and characteristics of operations in the rubberwood processing industry effectively.
2. To study the components of the approach to managing production costs in the rubberwood processing industry effectively.
3. To develop a structural equation model for the approach to managing production costs in the rubberwood processing industry effectively.

LITERATURE REVIEW

1. Cost management: It is the strategic management of any operations based on the organization's mission through the worthiest use of resources, factors, and manpower with the least loss and the operation characteristics that lead toward objective-based results while saving time, resources, and cost as targeted)Adam et al., 2022). Efficiency in the production process is an allocation of resources for minimal loss by being able to achieve the goal through the lowest use of resources. The usage is based on goals, to achieve the highest goal, or that the organization can produce the highest output)Profit) while employing the least input)Cost( )Certo, 2000).

2. Balanced scorecard (BSC): Bringing a balanced scorecard to increase operation efficiency requires focusing on the balance of the index on four aspects: Financial Perspective, Customer Perspective, Internal Process Perspective; and, Learning and Growth Perspective)Tawse et al., 2023). Each aspect of an index would affect the other aspects in connected as a system, thus the organization shall set a clear mission and analyze the four aspects of the index in conformity with such organization's key mission)Kumar et al., 2022). Besides, bringing the principle of a balanced scorecard to improve operational efficiency requires all operators from every department to work based on a planned strategy. There is the work performance indicator called Key Performance Indicators (KPI) for the organization to achieve its objectives and remain in conformance with the organization's missions.

3. Creative innovation: The rubber wood processing industry operation should focus on product innovation since the current competition is mainly driven by technology. Technology influences the creative innovation of new products and services in the market (Jusni et al., 2023). As a result, products can be rapidly imitated, which narrows the gap to obtain the cost advantages with a narrowing area of differences. (Wattanakomol et al., 2023) Therefore, the strategies that have been applied to compete and gain competitive advantages over the rivals may not remain effective, and the organization may be unable to keep on with the past success to form present and future anymore. The innovative strategy will be another choice of competitive strategy that could lead to a new form of competitive advantage (Rahmana et al., 2021).

4. Logistics management: The original concept of logistics was the process of obtaining such products in the warehouse and distribution to bring the right products to the consumers at the right time at the right place under the condition of accurate amount and cost (Christopher, 2023). The modern concept of logistics emphasizes the process of product movement in three ways: product procurement and delivery, information exchange, and transfer and payment. (Wattanakomol et al., 2022) Business processing via logistics business management consisted of six outcomes: 1) Speed of delivery, 2) Product flow, 3) News and information flow, 4) Value-added, 5) Cost reduction on the part

of processing related to products and delivery supervision; and 6) Increasing potential and competitive efficiency (Richey et al., 2021).

5. Labor management: Labor is considered another type of cost with a major role in the production process since labor can be developed and enhanced toward higher knowledge, skills, and abilities which results in higher production efficiency (Tate et al., 2024). Labor also has direct results on national development; therefore, it is even vital for production and national development. However, though labor has a relationship with production and national development in all ages, labor from the past period is still facing ongoing problems (Benmelech et al., 2021).

6. Cost analysis: It is an evaluation of strengths and weaknesses for the best choice, or the options that the selector would obtain the utmost benefits. Cost analysis is then a comparison between causes that arise in the project and with impact on the project cost (Wieruszewski et al., 2023). Therefore, project entrepreneurs will analyze any information with impacts on the costs and decide to select the activities to run the business at the lowest cost. The key principle for cost analysis is to calculate or compare the cost of investment or "cost" that was spent and the amount of benefits received in return. Besides, cost analysis is also related to cost efficiency analysis, where it will mostly relate to money values compared to the passing time (Bortoluz et al., 2020).

Research Hypotheses

Hypotheses for the research on the guidelines for effective management of production costs in the rubber wood processing industry are as follows:

H1: Creative Innovation has a direct influence on Direct Material management.

Organizational support and organizational operation support will promote the bond among the personnel that makes them want to forever stay with the organization. This then leads to self-development to become equal or to respond to the organization with potential in terms of skills and knowledge, ideas, and skillful experiences and to keep specializing on the job, plus to connect things with creative innovation output to solve the problems or add more potential for the better operation)Pavlenchyk et al., 2023).

H2: Creative Innovation has a direct influence on Direct Labor Management.

To set a clear organizational vision to promote innovation in knowledge management toward defining knowledge and to select knowledge and experiences from the top personnel in the operation of the organization specialists to store as the explicit knowledge in which necessity for creative innovation, diverse backgrounds, and different perspectives that would lead to new ideas toward innovation development for the innovative and creative organization)Rasool et al., 2023).

H3: Creative Innovation has a direct influence on Production Overhead Management.

Internal organization factors are such as production, financial, procurement, innovation, labor, information systems, data management, and human resources. Bringing them to analyze the organization's requirements on various dimensions to be the guidelines for the development of problem solutions and operational process improvement at the lower operational cost via controlling the non-revenue operating expenses)Elghaish et al., 2021).

H4: Direct Labor Management has a direct influence on Direct Material management.

Supplier performance is the factor influencing the potential of raw materials supplier performance. In the employment contract with an external organization, trust from purchasers and raw material suppliers is a key indicator of the supplier performance. The factor influencing the potential of supplier performance can add more value to the industry by focusing on support provided in every step from the beginning until the final process. The competitive ability depends on supplier performance related to price, quality, and punctual delivery, though the new product development is crucial for the ability of raw materials suppliers)Brewer et al., 2022(

H5: Direct Labor Management has a direct influence on Production Overhead Management.

Planning on labor employment is the process that contains steps related to labor operation in the organization. An active operation to obtain the top and potential labor for the organization to have

personnel who are suited for the functions. This should be an ongoing or dynamic work analysis, planning on manpower, recruitment, selection, hiring, training, retention, compensation, welfare, organization membership termination, and retirement. These are the keys for organization labor management to enhance the happiness of labor work in the organization as well as the quality of life)Argilés et al., 2022).

H6: When separating the guidelines for effective management of production costs in the rubber wood processing industry based on business sizes, there will be no difference.

Both SME and large rubber wood processing businesses focus on their business survival. They need to form competitive advantages among the existing rivals where they have to compete with negotiation power from the raw materials providers, purchasers, threats from new rivals, as well as threats from substitute products (Memari et al., 2022).

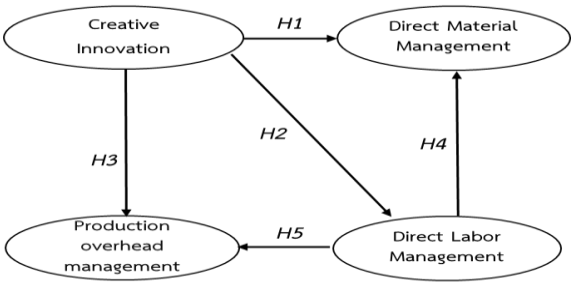

Figure 1: Research framework

RESEARCH METHODOLOGY

This study was an Inductive Research that employed Mixed-Methodology Research.

1. Qualitative research was conducted via an in-depth interview with nine specialists consisting of three groups of specialists for instance, the group of three entrepreneurs or management from business organizations, the group of three participants from government sector and relevant units, and the group of three academics.

The researcher set the interview guideline with four components: 1) Creative Innovation, 2) Direct Labor Management, 3) Production Overhead Management; and, 4) Direct Material Management.2. Quantitative research, the population used in this research was determined from executives of rubberwood processing industry businesses that were registered with the International Plant Protection Convention (IPPC) and were still operating, totaling 725. The sample size was determined using the criteria of research in the form of factor analysis or structural equation modeling, which determined the sample size to be very good at 500 samples (Silpcharu, 2024). A multi-stage sampling method (Silpcharu, 2024), was used, consisting of:

1. Cluster sampling procedure, dividing the types of rubberwood processing businesses by the size of the business into two groups which are: 1) Large-sized rubberwood processing businesses, and 2) Medium and Small-sized rubberwood processing businesses.

2. Probability random sampling using the Lottery Method (Silpcharu, 2024), was used and data was collected from samples in each industry size calculated in proportion to the number of operators.

Application for quantitative research used a draft of a questionnaire created together with an evaluation form where five specialists were asked to find out the tool quality through Index of item objective congruence (IOC) testing. The value obtained was between 0.60-1.00 (> 0.50(. After that, the questionnaires were brought to Try-Out, and the results of analysis on power values classified into each item were between 0.38-1.53)> 0.30(. Cronbach's Alpha Coefficient value was at 0.99 (> 0.80(. The research contained 500 populations, obtained by random Lottery Method, and collected data from 250 participants from each group. General data analysis either on descriptive statistics or reference statistics was done by the SPSS program. The structural equation model was analyzed by multiple linear regression using the advanced statistical data analysis program AMOS. (Silpcharu,

2024) Evaluation criteria on the consistency of the structural equation model consisted of four values as follows: 1) Chi-square probability level value)CMIN–p) > 0.05. 2) Relative chi-square value)CMIN/DF(> 2. 3) Compliance level index)GFI) > 0.90, and 4) Root Mean Squared Error of Approximation)RMSEA) < 0.08 (Arbuckle, 2016)

3. Qualitative research was conducted via group discussion to support the model. Populations in this research consisted of eleven experts. The purposive sampling method was used with the qualifications of experts as specified in the Doctor of Business Administration Program in Industrial Business Administration, Faculty of Business Administration, King Mongkut's University of Technology North Bangkok.

RESULTS

Table 1: The important levels of the guidelines for effective management of production costs in the rubber wood processing industry are classified by the business sizes

Guidelines for effective management of production costs in the rubber wood processing industry	SME Business			Large Business		
	$\bar{X}$	SD.	Level of importance	$\bar{X}$	SD.	Level of importance
Overall	4.13	0.38	important	4.18	0.40	important
1. Creative Innovation	4.18	0.46	important	4.23	0.39	important
2. Direct Labor Management	4.13	0.37	important	4.17	0.35	important
3. Production Overhead Management	4.12	0.39	important	4.13	0.40	important
4. Direct Material Management	4.09	0.47	important	4.17	0.42	important

Overall, results from Table 1 showed that large businesses focused more on the guidelines for effective management of production costs in the rubber wood processing industry than SME businesses and rated it at a very important level at an average of 4.20.

Results from each aspect showed that the greatest focus of management either from SME businesses or large businesses was on the Creative Innovation aspect.

Results from statistical values used in the comparison between differences in the levels of importance overall as classified by business size found no statistical significance difference at the level of .05.

Statistical values used to assess the consistency of the structural equation model after improved found with the value of Chi-Square Probability Level at 0.000, CMIN/DF value at 2.210, GFI value at 0.718, and RMSEA value at 0.045. All four statistics passed the criteria of evaluation on the consistency of the structural equation model and the empirical data as can be seen in Figure 2.

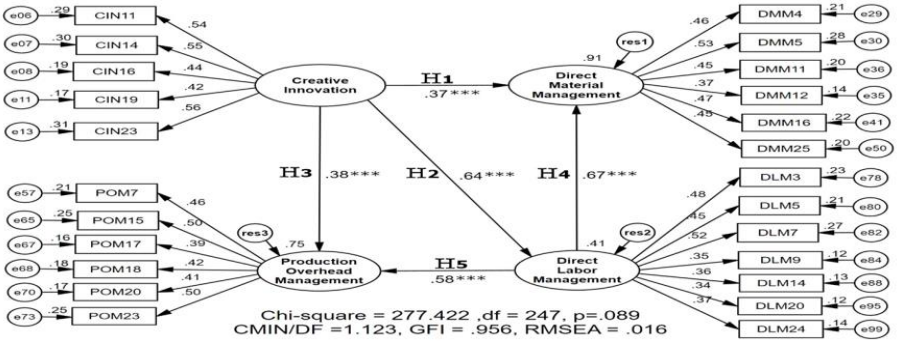

Figure 2: Structural equation model after model improved

From Figure 2, the results of five hypotheses testing for the analysis of the causal influences between latent variables in the structural equation model of the guidelines for effective management of production costs in the rubber wood processing industry are as follows:

1. H1: Creative Innovation had a direct influence on Direct Material Management with statistical significance at the level of 0.001 and the value of Standardized Regression Weight was 0.37; this result was in line with the proposed hypothesis.

2. H2: Creative Innovation had a direct influence on Direct Labor Management with statistical significance at the level of 0.001 and the value of Standardized Regression Weight was 0.64; this result was in line with the proposed hypothesis.

3. H3: Creative Innovation had a direct influence on Production Overhead with statistical significance at the level of 0.001 and the value of Standardized Regression Weight was 0.38; this result was in line with the proposed hypothesis.

4. H4: Direct Labor Management had a direct influence on Direct Material Management with statistical significance at the level of 0.001 and the value of Standardized Regression Weight was 0.67; this result was in line with the proposed hypothesis.

5. H5: Direct Labor Management had a direct influence on Production Overhead Management with statistical significance at the level of 0.01 and the value of Standardized Regression Weight was 0.58; this result was in line with the proposed hypothesis as can be seen from Table 2.

Table 2: Statistical values from the analysis of the Structure Equation Model after the model improved

Variables	**Estimate**		R^2	**Variance**	**C.R.**	**P**
	Standard	Unstandard				
Creative Innovation				0.17		
Direct Material Management	0.37	0.30	0.91	0.01	3.50	***
Direct Labor Management	0.64	0.54	0.41	0.07	6.21	***
Production Overhead Management	0.38	0.30	0.75	0.03	3.44	***
Direct Labor Management				0.07		
Direct Material Management	0.67	0.65	0.91	0.01	5.17	***
Production Overhead Management	0.58	0.54	0.75	0.03	4.63	***
Creative Innovation						
CIN11	0.54	1.00	0.29	0.42		
CIN14	0.55	1.02	0.30	0.41	8.29	***
CIN16	0.44	0.93	0.19	0.62	7.16	***
CIN19	0.42	0.82	0.17	0.56	6.86	***
CIN23	0.56	0.97	0.31	0.36	8.36	***
Direct Material Management						
DMM4	0.46	1.00	0.21	0.44		
DMM5	0.53	1.17	0.28	0.41	7.73	***

DMM11	0.45	1.01	0.20	0.48	7.03	***
DMM12	0.37	0.93	0.14	0.64	6.18	***
DMM16	0.47	1.13	0.22	0.52	7.25	***
DMM25	0.45	0.99	0.20	0.45	7.05	***
Direct Labor Management						
DLM3	0.48	1.00	0.23	0.42		
DLM5	0.45	0.97	0.21	0.45	7.04	***
DLM7	0.52	1.06	0.27	0.38	7.63	***

Table 2)cont.(

Variables	Estimate		R^2	Variance	C.R.	P
	Standard	Unstandard				
Direct Labor Management (cont.(						
DLM9	0.35	0.70	0.12	0.44	5.90	***
DLM14	0.36	0.73	0.13	0.46	5.98	***
DLM20	0.34	0.66	0.12	0.42	5.75	***
DLM24	0.37	0.81	0.14	0.50	6.16	***
Production Overhead Management						
POM7	0.46	1.00	0.21	0.41		
POM15	0.50	1.17	0.25	0.45	7.22	***
POM17	0.39	0.82	0.16	0.40	6.26	***
POM18	0.42	0.91	0.18	0.42	6.53	***
POM20	0.41	0.88	0.17	0.41	6.42	***
POM23	0.50	1.12	0.25	0.42	7.19	***

***** Statistical significance level of 0.001**

According to Table 2, it was found that the structure equation model of the guidelines for effective management of production costs in the rubber wood processing industry after the model improved consisted of the following latent variables:

1. One Exogenous latent variable was the Creative Innovation component.
2. Three Endogenous latent variables were Direct Material Management, Direct Labor Management, and Production Overhead Management.

Creative Innovation consists of five observed variables ranked by the Standardized Regression Weight from high to low as follows:

1. Applying Artificial Intelligence (AI) technology to increase the operation efficiency and cost saving)CIN23), the Standardized Regression Weight is 0.56.
2. Bringing the technological system to use in real-time monitoring of the raw materials allocation to prevent loss)CIN14), the Standardized Regression Weight is 0.55.
3. Bringing Big Data system to use systematically to reduce cost)CIN11), the Standardized Regression Weight is 0.54.
4. Awarding to motivate personnel who can create innovation to save the production costs for the organization)CIN16), the Standardized Regression Weight is 0.44, and

5. Bringing the IOT technology system to connect with the machine to develop toward Smart Machine (CIN19), the Standardized Regression Weight is 0.42.

The aspect of Direct Material Management consists of six observed variables ranked by the values of Standardized Regression Weight from high to low as follows:

1. Products costs comparison to obtain the raw materials with quality, good price, and best purchasing condition in regular)DMM5), the Standardized Regression Weight is 0.53.
2. Bringing the Kanban system to use in raw materials inventory management to reduce the amount of raw materials in the production process)DMM16), the Standardized Regression Weight is 0.47.
3. Forming healthy and firm relationships with the key raw materials distributors)DMM4), the Standardized Regression Weight is 0.46.
4. Applying technology or software in purchasing, inventory monitoring, and supplier management)DMM25), the Standardized Regression Weight is 0.45 (C.R. = 7.05).
5. Creating a Supplier Complain System (DMM11), the Standardized Regression Weight is 0.45 (C.R. = 7.03), and
6. Improving the purchasing system, cutting off unnecessary processes, and issuing the electronic purchasing order for purchasing approval)DMM12), the Standardized Regression Weight is 0.37.

Direct Labor Management consists of seven observed variables ranked by the values of Standardized Regression Weight from high to low as follows:

1. Arranging for the regular personnel performance evaluation on their knowledge and skills)DLM7), the Standardized Regression Weight is 0.52.
2. Creating a recruitment system that would allow the organization to obtain the labor with specialized skills, knowledge, and ability as needed)DLM3), the value of Standardized Regression Weight is 0.48.
3. Monitoring the results of personnel training to be by training criteria)DLM5), the value of Standardized Regression Weight is 0.45.
4. Supporting for teamwork system rather than focusing on individuals)DLM24), the value of Standardized Regression Weight is 0.37.
5. Setting proper compensation for knowledge, ability, expertise, and experiences)DLM14), the value of Standardized Regression Weight is 0.36.
6. Arranging for the comfortable in proper operation)DLM9), the value of Standardized Regression Weight is 0.35, and
7. Forming organization culture for the personnel to stay together in the organization)DLM20), the value of Standardized Regression Weight is 0.34.

The aspect of Production Overhead Management consists of six observed variables ranked by the values of Standardized Regression Weight from high to low as follows:

1. Adjusting toward electronic operation to save cost such as reducing paper used by electronic file system instead)POM15), the value of Standardized Regression Weight is 0.50)C.R.= 7.22(.
2. Planning and controlling the waste and unnecessary costs)POM23), the value of Standardized Regression Weight is 0.50)C.R. = 7.19(.
3. Setting for the equipment and machine maintenance schedule for the worth operation of the machine)POM7), the value of Standardized Regression Weight is 0.46.
4. Controlling non-value generating tasks such as no job, machine maintenance, raw materials with low yield, and waste from the processes)POM18), the value of Standardized Regression Weight is 0.42.

5. Always benchmarking the production overhead between the organization and rivals for better improvement and development)POM20), the value of Standardized Regression Weight is 0.41, and
6. Analyzing the Bottleneck activities in the production process for further improvement)POM17), the value of Standardized Regression Weight is 0.39.

DISCUSSION

The level of importance for the components in the guidelines for effective management of production costs in the rubber wood processing industry overall as classified by business size showed no difference with the statistical significance level of 0.05. Both SMEs and large businesses supported the invention and creation works, as well as research and development by allowing the personnel to learn and collect their experiences. To proceed with the research and development that lead toward new technologies and innovations either on the organization or personal level, for them to become the innovation and intellectual property and to increase the economic value above the contests)Hurmekoski et al, 2021). The most important aspect of this study was Creative Innovation. It was the most crucial for the effective management of production costs in the rubber wood processing industry (Borowski, 2021). Moreover, production technology investment, planning for operational process improvement, and labor skills development to increase innovation concepts are used in process improvement for better operation efficiency (Guenther et al., 2021(. The organization focused on the development of innovative organizations and thoroughly communicated with personnel to acknowledge each highest priority item (Kraus, 2021). The organization shall begin with the establishment of objectives and vision with the need to achieve them via digital change, it is a self-adaption from technological disruption problem via Digital Transformation)Nadkarni et al., 2021(. Direct Labor Management had a direct influence on Direct Material Management. It is shown from the empirical data that to achieve sustainable success, the organization should focus on effective personnel skills development, inventory control on the proper amount, and control on expense accuracy (Sai et al., 2018). The personnel in charge of inventory are in the group of the key persons to control raw materials payment for the organization, an insufficient of responsibility and work skill would lead to unnecessary costs for the organization on storing and more raw materials purchasing (Anantadjaya et al., 2021).

CONCLUSION

There are four important variables for the effective management of production costs in the rubber wood processing industry details are as follows:

1. Creative Innovation: Support from the organization management on innovation development with proper technology selection to ease production cost and operation cost reduction.
2. Direct Material Management: Selecting raw materials suppliers from various sources to mitigate risk from dependence on a single supplier.
3. Direct Labor Management: Supporting for teamwork system rather than focusing on individuals and providing appropriate compensation to the personnel with knowledge, ability, and experience.
4. Production Overhead Management: Always assessing the production overhead of the organization with confronts to improve for better development.

Overall, the level of importance from the results of this study as classified by business size showed no difference with the statistical significance level of 0.05. Both SMEs and large businesses supported the invention and creation works. The most important aspect of this study was Creative Innovation. It was the most crucial for the effective management of production costs in the rubber-wood processing industry.

SUGGESTIONS

1. Investigate the impact of creative innovation and digital transformation on operational efficiency and cost reduction in the rubber wood processing industry.
2. Explore for insight into the effects of supply chain variation and labor skills development on risk management and labor efficiency.

3. Study the role of assessing intellectual property in encouraging competitive advantage, and reducing production elevated costs.

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