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Guidelines for Cost Reduction in the Electrical and Electronics Industry

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Abstract

The electrical and electronics industry has been a major industry of Thai economy for decades. However, the number of Thai entrepreneurs at losses remains higher each year. Therefore, improvements to reduce costs for the electrical and electronics industry are very important to create business competitiveness and sustainability. The purpose of this research was to study cost reduction guidelines in electrical and electronics industry then developed into a structural equation model for both qualitative and quantitative research. Quantitative data surveyed 500 executives of companies with profits for 3 consecutive years, using descriptive statistics, reference statistics, and multiple statistics.

The results showed that the guidelines for cost reduction in the electrical and electronic industry is composed of 4 aspects. The most important factors of each aspect are as following: 1) Labor Management aspect ($\bar{X}$ = 4.04, S.D. = 0.36) which its most important factor is encouraging workers to be aware of self-improvement 2) Material Management aspect ($\bar{X}$ = 4.04, S.D. = 0.38), which its most important factor is specific characteristics of raw materials are clearly defined. 3) Process Management aspect ($\bar{X}$ = 3.96) which its most important factor is manage production with the PDCA system continuously and 4) Overhead Management aspect ($\bar{X}$ = 3.93) which its most important factor is preventive maintenance of machinery. For the hypothesis test showed that the difference in manufacturing enterprise sizes revealed overall aspects that were significantly different at the level of 0.05.

The analysis of the developed structural equation model showed that it was in accordance and harmony with the empirical data and passed the evaluation criteria.

Its Chi-square probability level, relative Chi-square, the goodness of fit index, and root mean square error of approximation were 0.069, 1.107, 0.944, and 0.015, respectively. The statistical significance of this study was set at 0.05.

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Keywords: Structural Equation Modeling, Cost Reduction Guidelines, Electrical and Electronic industry.

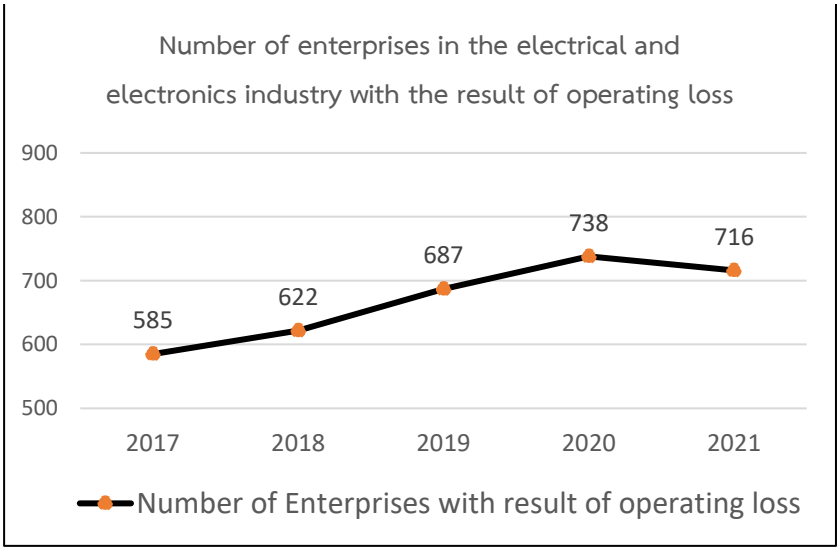
Introduction

The electrical and electronics industry is one of the industries that play an essential role in today's Thai economy. In 2021, exports of electrical and electronic products amounted to USD 63.8 billion or about 2.2 trillion baht, employing more than 700,000 people or 14% of total employment, and Thailand has approximately 3,223 factories in the electrical and electronics industry (Electrical and Electronics Institute, 2022).

The main strength of Thailand's electrical and electronics industry today is that it is a vital export production base for the United States of America and Singapore, especially Japan, which has invested heavily in Thailand in recent years. In addition, Thailand has begun to develop the capabilities of electrical and electronic product testing centers to meet international standards. As a result, Thailand's electronics industry has begun to be recognized for its potential and has gained trust in manufacturing from foreign agencies and companies. The apparent weaknesses of the Thai electrical and electronics industry are related to the low ability to design and develop products independently and the need for local entrepreneurs' marketing expertise. Most companies that can compete in the global market are joint ventures with foreign investors or those that invest in Thailand. Thus, products in this industry are a relatively rapid technology change. Therefore, most Thai businesses are in the assembly and testing of products. As a result, Thai workers need more opportunities to develop their skills to a level related to high technology. As a result, raw materials or parts must be imported from overseas, which results in higher costs for the production in Thailand.

According to the Department of Business Development (2022), the total number of electrical and electronics industry manufacturers with losses reached 585 in 2017, and the trend continues to increase to 622, 687, 738, and 716 from 2018 to 2021, respectively, as shown in Figure 1

Figure 1 Report on the number of enterprises in the electrical and electronics industry with operating losses from 2017-2021.



Research Objectives

1. To study the components of the guidelines for cost reduction in the electrical and electronics industry.

2. To develop a structural equation model for the guidelines for cost reduction in the electrical and electronics industry.

Literature Review

Based on a literature review, concepts, and theories on the electrical and electronics industry cost reduction, the guidelines of cost reduction present a framework for managing costs in the industry more efficiently. In today's era, both small and large organizations are committed to developing the organization to reduce costs, which will help the organization maintain competitiveness. Cost reduction is essential to solve the problem of costs caused by internal forces, such as the decline in employee efficiency, delayed workflow, unclear standard of work, higher cost of production, high energy costs, and external forces such as raw materials increase in price, increased customer demand, global trade, and free markets, both of which have resulted in higher corporate costs, declining profits, uneven quality, as well as problems with untimely delivery, etc.

The researcher has applied the main theory that is used to formulate a research conceptual framework; the guidelines for cost reduction in the Electrical and Electronics Industry, to develop guidelines to drive cost reduction for the electrical and electronics industry which the cost elements consist of direct material, direct labor and manufacturing

overhead along with process management which is the key driver for manufacturing production, efficiency and improvement.

1. Materials Management

Regarding material management (Kanchanasunthorn, 2008), it relates to the procurement, storage, use for production, and distribution of raw materials or materials in the system, considering human resources and schedule or plan for the use of raw materials or materials in order to shorten the time and reduce costs in the system. An analysis of Malaysia's electrical and electronic industry and its implications to practitioners by Fu Haw Ho, et al. (2021) found that customer requirements are the main factors related to the efficiency of raw material utilization in production. Products requiring less energy, smaller size, and eco-friendly product design, and to reduce production costs, companies must design processes to be more efficient. Shorten a step or process Smaller-sized product development Use of nanotechnology, use of fewer components The study, A Business Model of Small and Medium-Sized Enterprises: A Case Study of the Textile and Clothing Industry in Thailand (Sawatenarakul & Roopsing, 2021), found that the Collaboration Network variable causes resource sharing in Thailand's textile and garment industry sector. Network members also share knowledge, skills, and new techniques to improve product standards and quality. The research titled Guidelines for creating transparency in the procurement process of the industrial business sectors (Prateep Na Thalang, Silpcharu, and Wattanakomol, 2023) found that the internal control component is the most important for developing transparency in purchasing processes.

2. Labor Management

It involves labor planning management, starting from analyzing data to know the amount of workforce demand of the organization in terms of quantity, quality, and budget, as well as labor planning such as recruitment, recruitment, interviews, etc. Appointment, training, and skill development to be ready for work. Khanthanapa (2010: 183 - 192) outlined the process of human and labor resource planning. Ovidijus (2022) summarizes the management strategy concept with the theory of McKinsey 7S Framework from the research titled Value Chain Cost Accounting Potential and Performance: Empirical Research on Electronics and Electrical Equipment Business in Thailand by Suphatranon, S. et al. (2018) that found that promoting the development of knowledge and ability to reduce production costs in order to create opportunities for competitive advantage and effective performance in the future, and Dhammasaccakarn, W., et al. (2019) that examined entrepreneurs' perspectives on the shortage of qualified workers and skills in line with employment. The study found that the problem of qualifications and skills of workers is caused by the

workers are unable to adapt to the advancement of new product technologies. Lack of management skills and knowledge in human resource management and lack of language skills, especially for foreign customers. The research titled Guidelines of Industrial Business Development by Good Governance Principles for Sustainable Growth (Suriyo, Sawatenarakul and Worawattanaparinya, 2021) found that team management variable is of utmost importance to the development of industrial business organizations in accordance with good governance principles for sustainable growth. Efficient and effective business operations depend on developing the talents of multicultural team members. According to the research titled Factors Enhancing Employee Loyalty towards Organization (Sawatenarakul, Nanthasudsawaeng, 2022), it was found that the most significant leadership factor is that executives prepare work manuals explaining work structures.

3. Overhead Management

Related to management, expenses from producing goods and services are hidden costs. Entrepreneurs have to reduce overhead costs to reduce business risks and other burden costs. The overhead cost has 3 categories (Apisithpinyo, 2015), indirect materials, indirect labor, and other production costs. Prasertsak (2011) has suggested several strategies to reduce costs: logistics and cost reduction by learning best practices from other business units or benchmarking, reducing costs by creating bargaining power, and reducing costs using outsourcing methods. (Outsourcing) Plungpongpan (2020) found that the cost of production at the beginning of new products will be higher than when already produced because production costs are affected by new product prototyping activities and production preparation activities. Therefore, an efficient new product cost analysis can be applied to reduce the initial cost of the product, and Nasomboon (2020) found that Japanese Manufacturing Management consisting the total productive maintenance where everyone is involved has a statistically significant cost reduction effect at the 0.05 level due to the total productive maintenance that everyone contributed allows employees to inspect and maintain the machine by themselves, resulting in reduced machine waste and the cost of repairing the machine when broken (Breakdown maintenance), which is often high-value and reduces waste caused by setting up non-standard machines as well.

4. Process Management

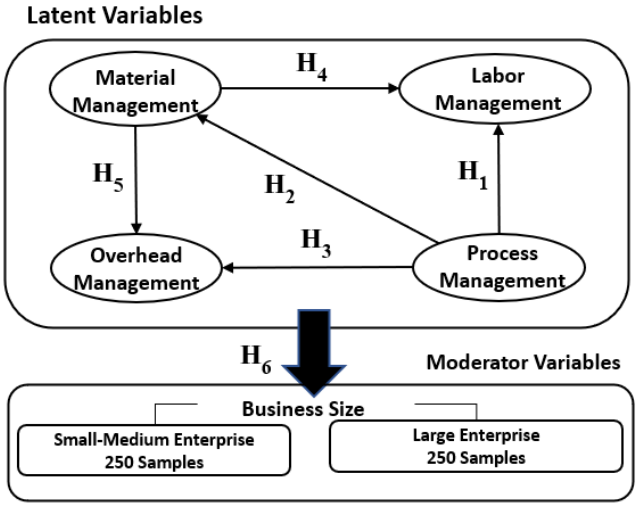
Involves a focus on agility, cost reduction, and time-cycle reduction, which requires process management to be able to adapt or respond quickly, flexibly, and efficiently to changing needs, as well as having an advantage-building strategy by Lean Management, reducing the seven losses (7 Wastes) (Buakaew, 2009: 30-31), including overproduction,

inventory storage, transportation, motion, Processing, Delay, and Defect production, Akaraprathompong (2009) has cited ECRS as a cost-reducing and optimizing tool of the process, including eliminate, combine, rearrange, and simplify, which Kanoksirirujisaya, N., et al. (2022) found to reduce losses in hard disk drive parts production line (HDD) by applying ECRs techniques to reduce the waste in the manufacturing process, the head handle arm reads the hard disk drive to reduce unnecessary workflow from the process of combining similar tasks together and rearranging to balance the production line by reducing the waste caused by overworking people and reducing non-value added tasks. B.Venkat Jayath, et al. (2020) conducted a research study on the Implementation of lean manufacturing in the electronics industry, finding that the electronics industry is one of the fastest growing industries, and there are many increases in investment to increase quality and capacity, but increasing challenges. The electronics industry, which implements lean, can increase productivity by reducing errors and improving quality, adjusting correctly parameters for the production line. One of the electronics suppliers has considered implementing lean in engineering and management functions, and after implementing lean to production, it found that 23 percent improvement in yield and quality. From the study of What key Drivers are Needed to Implement Material Efficiency Strategies? An Analysis of the Electrical and Electronic Industry in Malaysia and Its Implications to Practitioners by Fu Haw Ho, et al. (2021) to reduce production costs, the company needs to design more efficient processes, shorten the process or process, to develop smaller product sizes, to use nanotechnology, to use fewer components, to use new, less expensive materials. this will result in the company reducing the cost of production from the process, and the raw materials. Pietro and Alfio (2020) studied business management research on Process innovation throughout the industry. 4.0 technologies, lean practices, and green supply chains. The results found that the process innovation used by Lean will improve the efficiency of the process, which will result in better economic outcomes.

According to the literature review above, that can formulated the conceptual framework for the guidelines for cost reduction in the electrical and electronics industry is defined by

4 elements: Labor Management, Material Management, Process Management and Overhead Management, as shown in Figure 2.

Figure 2: Conceptual framework for the guidelines for cost reduction in the electrical and electronics industry



Hypothesis

In accordance with the objectives and related literature, the researcher determined six hypotheses based on the related theories as follows.

H1: Process management elements directly influence labor management elements

According to a study on The Mediating Effect of Kaizen Event between Production Management in Japanese Style and Cost Reduction in Lat Krabang Industrial Estate, Nasomboon (2020) found that production management in Japanese style (PMJS) directly influenced KAIZEN and production management in Japanese style (PMJS) significantly influenced cost deduction (COSDE) and the research on Understanding the needs and criteria of employees in the electronics industry for English e-learning website programmes by Paul & Ming-Hung (2017) found that employees of the electronics industry in southern Taiwan in higher-educated groups will pay attention to technical knowledge.

H2: Process Management elements directly influence material Management elements

Pradabwong J. et al. (2017) conducted a study on Business process management and supply chain collaboration: effects on performance and competitiveness, found that the organization has a working structure that collaborates between business process management and supply chain management results to have a competitive advantage, and process management also directly affects raw materials and supply chain management and Odkhishig (2019) has

concluded that the organizations that have internal process management with data integration between departments for material requirements planning results in a better handling of the material level and has a positive influence on all operational performance indicators.

H3: Process Management elements directly influence overhead management elements

From the research Effect of lean manufacturing tools on sustainability: the case of Mexican maquiladoras (Jorge et al., 2022) found that continuous process improvement, good machine maintenance system, implementation of machine performance, and promotion tools to support good production directly affect machinery and equipment in reducing waste reduce errors in work, reduce tuning time, and also reduces production cycle time. B.Venkat Jayath & P.Prathap (2020) found that adopting a lean management system or lean management to electronic part manufacturers can increase productivity by reducing errors and improving quality by optimizing parameters for the production line and analyzing the specifics of manufacturing electronics

H4: Material management elements directly influence labor management elements.

Khai Loon Lee (2022) summarized the relationship between efficient raw material management and its correlation with the organization's efficiency in the provision of labor for operations. Strategic planning was found to significantly correlated with process success by having a positive influence on many industries, such as banking, and tourism, Zairra (2020) researched The Structural of Effective Materials Management Factors Model: A PLS-SEM Approach and concluded that proper material management has an impact positively influence project and operational efficiency, and proper material handling also positively influences the efficiency of labor management as in the reduce labor losses in redundant material handling, proper storage location increases work productivity, proper material planning improves employee productivity, availability of materials increases work productivity, and adequate supplies and equipment can increase worker productivity.

H5: Material management elements directly influence overhead management elements.

According to the research entitled The impact of inventory management practice on firms' competitiveness and organizational performance: Empirical evidence from micro and small enterprises in Ethiopia by Daniel Atnafu and Assefa Balda (2018), which was conducted and found that raw material management, for example, the use of ABC Analysis, EOQ, Demand Forecasting, JIT, as well as the use of IT computer systems directly affects the cost efficiency of the

company and Rahmat & Jaka (2018) concluded that training has a significant influence on employee work to help improve and maintain a person's performance.

H6: Importance levels of guidelines for cost reduction in the electrical and electronics industry, classified by business sizes were different

Rahul C., et al. (2017) conducted a study titled Supply Network Structure and Firm Performance: Evidence From the Electronics Industry found that reputation and the number of networks will have a positive influence. The efficiency of a company is influenced by resource efficiency, cost reduction, and process efficiency. According to research on the impact of business size on its relationship with strategic planning Sven-Vegard, et al. (2021) have researched that a larger company or manufacturer can implement cost reduction by adopting lean production methods faster and easier than smaller manufacturers. Adopting lean Manufacturing will also affect process efficiency. Guilherme, et al. (2017) concluded that in adopting Lean to reduce costs in the supply chain, large companies could have significantly more influence over their suppliers than smaller ones.

Research Methodology

This research aims to create new knowledge (inductive research) by using mixed-methodology research consisting of 3 parts: qualitative research with in-depth interview techniques, quantitative research using survey techniques, and qualitative research using focus group discussion techniques to confirm the validity of this research model.

1. Qualitative Research with In–Depth Interview techniques, The population used in this research was 9 experts, selecting a purposive sample group with the qualification of experts criteria which is appropriate according to the Doctor of Business Administration Program Executive Committee Industrial Business Administration Faculty of Business Administration King Mongkut's

University of Technology North Bangkok, the research on “Guidelines for Cost Reduction in the Electrical and Electronics Industry” consists of experts in 3 groups which are a group of electrical and electronic industry executives 3 people, a group of experts from government organizations 3 people, and a group of experts from educational institutions 3 people.

2. Quantitative Research, The population used in this study were executives of electrical and electronics industry, totaling 3,223 cases. The researcher determined the group's size that was at a very good level for 500 samples (Silpcharu, 2020), and a multi-stage sampling method was used consisting of executives from medium and small electrical and electronics companies, totaling 250 samples and 250

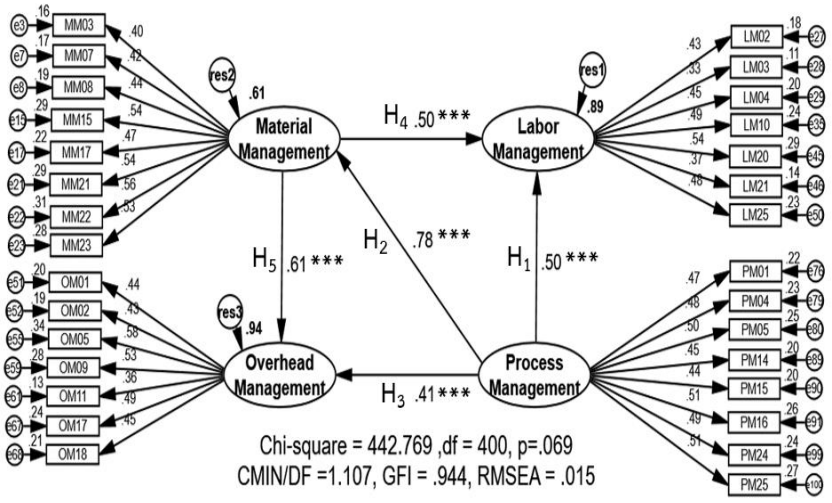
samples of large executives from medium and small electrical and electronics companies, which also uses probability random sampling lottery method.

3. Qualitative Research Focus Group Discussion techniques, to certify the structural equation model by 11 qualified persons, using a Purposive random Sampling method.

Results

1. The results of the analysis of the Guidelines for Cost Reduction in the Electrical and Electronics Industry can be classified into 4 elements which are Material Management, Labor Management, Overhead Management) and Process Management. It shows that the empirical data is consistent with the values as: p-value = 0.069, CMIN/DF=1.107, GFI = 0.944, and RMSEA = 0.015 statistically significantly at 0.001 which is consistent with literature and empirical data and passed the consideration criteria of Arbuckle (2016) by showing the structural equation model Guidelines for Cost Reduction in the Electrical and Electronics Industry after model improvement as in Figure 3.

Figure 3 Structural equation model Guidelines for Cost Reduction in the Electrical and Electronics Industry



2. From Figure 3, the results of hypothesis testing to analyze the causal influence between latent variables in the model structural equations for the Guidelines for Cost Reduction in the Electrical and Electronics Industry 5 hypotheses found that, consistent with the hypothesis that was set 5 of them, namely:

1) H1: Process Management elements directly influence the Labor Management elements statistically significantly at level 0.001 have the value of Standardized Regression Weight at 0.50

2) H2: Process Management elements directly influence the Material Management elements statistically significantly at level 0.001 have the value of Standardized Regression Weight at 0.78

3) H3: Process Management elements directly influence the Overhead Management elements statistically significantly at level 0.001 have the value of Standardized Regression Weight at 0.41

4) H4: Material Management elements directly influence the Labor Management elements statistically significantly at level 0.001 have the value of Standardized Regression Weight at 0.50 and

5) H5: Material Management elements directly influence the Overhead Management elements statistically significantly at level 0.001 have the value of Standardized Regression Weight at 0.61

3. The level of importance to the Guidelines for Cost Reduction in the Electrical and Electronics Industry found that, overall, the importance is at the highest level with an average score of 3.99, as for the results of consideration each aspect was at the high level of 4 elements, in descending order of importance as follows:

1) Labor Management elements have an average score at 4.04 (S.D. = 0.36)

2) Material Management elements have an average score at 4.04 (S.D. = 0.38)

3) Process Management elements have an average score at 3.96 and

4) Overhead Management elements have an average score at 3.93 respectively

4. Comparison of importance level from the Guidelines for Cost Reduction in the Electrical and Electronics Industry classified by business size and testing the difference between 2 independent population means by t–test found that, overall when categorizing by business size, there are difference, with large business size companies which is concentrating on the Guidelines for Cost Reduction in the Electrical and Electronics Industry more than small-medium business size companies statistically significantly at level 0.05 by showing the comparison of the importance of the Guidelines for Cost Reduction in the Electrical and Electronics Industry as in Table 1.

Table 1 Comparison level of the importance for Guidelines for Cost Reduction in the Electrical and Electronics Industry

Component Guidelines for Cost Reduction in the Electrical and Electronics Industry	Small-Medium			Large			t–Value	P–Value
	$\overline{X}$	S.D.	Importance level	$\overline{X}$	S.D.	Importance level		
Overall	3.81	0.27	High	4.17	0.31	High	–13.74	0.00*
1. Material Management	3.88	0.33	High	4.20	0.36	High	–10.35	0.00*
2. Labor Management	3.93	0.32	High	4.15	0.36	High	–7.23	0.00*
3. Overhead Management	3.75	0.30	High	4.11	0.35	High	–12.38	0.00*
4. Process Management	3.70	0.36	High	4.22	0.34	High	–16.67	0.00*

Discussion and Conclusion

1. The overall results of comparing the levels of importance to Guidelines for Cost Reduction in the Electrical and Electronics Industry classified by size of the industrial business was a statistically significant difference at the 0.05 level, which was consistent the results of the Meza–Ruiz et al. (2017) said that large-scale industrial enterprises with good management characteristics are constantly managing quality improvement strategies, learning, systematic revision, can constantly create the best Practice in the enterprise for sustainability, in contrast to small and medium-sized enterprises with gradual quality management characteristics in the enterprise.

2. The results of the analysis of the highest overall influence were at the process management elements had an overall influence on the labor management element with a standardized regression weight of 0.889, demonstrated empirical data that organizations with a clear cost-reduction structure, corporate leaders and senior executives focus on process management, vision, mission, and strategies that support Labor Management in order to improve their skills, knowledge, ability to perform tasks, as well as focus on maintaining employees to work with the organization in the long-term, consistent with lung & Tanpao (2019) ' s research that says organizational knowledge management to support production and human resource

management strategies must be constant development and improvement by modern manufacturing industry changes that are surrounded by information and technologies that are constantly evolving.

3. According to the hypothesis test results, process management influences material management which is the highest direct influence, with a Standardized Regression Weight of 0.78. which is consistent with the research of Romain Miclo et al. (2018) that using MRP to plan products, which supports the lean principle that prioritizes losses and reduces fluctuations in production lines with the Six Sigma principle, makes inventory management and strategic deployment of inventory more efficient that will result in reducing cost of material over stock, holding of inventory and waste from material expiration as well as material quality degradation.

4. It was found that, in each element, the labor management element was the most important component with an average of 4.04, S.D. of 0.36, which top 3 important factors are encouraging workers to always realize their self-development with an average of 4.21, followed by provide training on labor management for supervisors for control and effective cost reduction for related parties the average was 4.21 and there was a working standard and standard time of each job with an average of 4.21, respectively, which in line with Buaphan (202)'s research, improving the production process and timetable, the number of employees used in each of the appropriate production lines results in increased productivity and a focus on reducing losses and waste from employee error or mistake, these activities will result in a decrease in the cost of labor in the production process as well as waste from employee error.

5. It was found that the item that was most important to the Guidelines for Cost Reduction in the Electrical and Electronics Industry was clearly defined material specifications with an average of 4.38. This is consistent with the research of Keawkasetkon & Jarujittipant (2020), which said that the system reducing waste from materials, and equipment is a way to increase the productivity of production with the development of the quality of production factors.

Suggestions

From the research on Guidelines for Cost Reduction in the Electrical and Electronics Industry as guidelines for the public and private sectors in conjunction with educational institutions to improve the structure and operational characteristics to achieve the achievement of reducing production costs, sustainability, and ability to compete with business changes. The researcher has proposed Guidelines for Cost

Reduction in the Electrical and Electronics Industry in 2 issues as follows.

1. Policy Level Recommendations

1) Government sector related to the Guidelines for Cost Reduction in the Electrical and Electronics Industry, including the Ministry of Industry, Office of Small and Medium Enterprises Promotion, the Federation of Thai Industries should promote networking of entrepreneurs in a cluster to connect manufacturers as buyer and seller organizations into a network of alliances. Promote the construction of a network to connect the supply chain between the electrical and electronic industry sectors and related trades together will help strengthen the supply chain, foster economic dynamics, and elevate the competitive potential, including the Revenue Department and the Customs Department should review trade tariff policies and import tariffs to support international trade competition and help reduce the tax cost of importing materials and exporting products.

2) National Science and Technology Development Agency (NSTDA), Thailand Development Research Institute (TDRI), Electronics and Computer Employers Association (EICC), and Electrical and Electronics Institute of Thailand. There should be a support unit in research studies to reduce costs. Aims to provide research funding with high growth potential and high returns. Promote knowledge transfer in science, technology, and innovation to commercial use in the private sector and increase workforce skills in research and development, including promoting the exchange of knowledge between the network of electrical and electronics industry operators in the country and abroad regularly to exchange knowledge, share information, strategies, or best practices to reduce costs and increasing productivity.

2. Operational Recommendations at the operational level of Electrical and Electronic industry, that should pay attention to cost reduction by defining the direction of the management of cost reduction, the establishment of a cost reduction department, and indicators to drive the organization in the field of cost reduction. Management should focus and support cost reduction activity by supporting budgets, training, and providing leadership in changes of cost reduction continuously to create a sustainable advantage and maintain a good performance. Organizations should focus on building partnerships by looking for new opportunities from small and medium enterprises within the country as a source of support for cost reduction, such as increasing the proportion of domestic raw materials, selecting machinery, or co-developing machinery, as well as sharing knowledge or tools that can be shared, which will result in co-development, production opportunities or service with reduced costs, and help to drive sustainable domestic development, as well as the development

of personnel in the field of cost reduction with internal training, create exchange knowledge opportunities, learn from successful organizations. There should be an innovative incubation process in product development under its brand, including production techniques that encourage cost reduction or resource-saving both raw materials, labor, energy, and waste reduction. This scope could be expanded to include in investing in energy-efficient technologies such as variable power consumption equipment, low energy consumption LED, Co-generator System, heat exchanger and etc. which will help to reduce cost of energy consumption and exploring alternative sourcing options can also help to reduce cost of materials in terms of increasing negotiation powers over suppliers, identify opportunity of selecting lower cost supply sources from difference technology and technics of suppliers' production, and saving on logistic cost from shorter distance and transportation mode opportunities.

Recommendation

As a result of research, large-scale electronics and electronics business organizations have clear cost reduction guidelines, focusing on cost reduction policies, practices, teams, and management support, while medium-and small-scale enterprises still need clear guidelines. The next study should study the cost-reduction guidelines of business organizations in the electronics and electronics industries medium-and small-scale enterprises are comparable to large-scale enterprises in area of material management, labor management, manufacturing overhead management and process management competencies, including electronics, and electronics industry executives should pay attention to improvements that can bring modern technology replacing or blending existing technologies to reduce costs and maximize investment efficiency. Therefore, it is essential to study the guidelines to incorporate modern technologies into existing technologies to reduce machinery investment costs and operating costs. Moreover, the industrial sector should focus on supporting planning in uncertain circumstances, such as during the recent covid-19 pandemic, which significantly impacted businesses and activities. Thus, the business organization should prepare and adapt to change to work and manage production online. The following research should be further studied in managing and controlling operations online in the electrical and electronics sectors.

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