Study of the Need for Automation System Integrators from the Perspective of Industrial Business Sector in Digital Era

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The objective of this research is to Study of the Need for Automation System Integrators from the Perspective of Industrial Business Sector in Digital Era. The research is structured into a comprehensive model encompassing both qualitative and quantitative research methods. Qualitative research involved in-depth interviews with 9 experts and group discussions with 11 experts. For quantitative research, a survey was conducted among industrial business executives or individuals responsible for automation, with an effective questionnaire distributed to 500 respondents. The survey utilized descriptive statistics, reference statistics, and multiple statistics. The research findings indicate that the guidelines for developing automation system integrators to meet industry sector requirements consist of four essential elements, prioritized in the following order of importance: 1) Quality Management ($\bar{X}$ = 4.50), 2) Financial Performance ($\bar{X}$ = 4.45), 3) Human Capital ($\bar{X}$ = 4.42), and 4) Technological Innovation ($\bar{X}$ = 4.36). The results of hypothesis testing revealed that industrial businesses located within industrial estates and outside the industrial estate do not significantly differ in their emphasis on the study of the need for automation system integrators from the perspective of industrial business sector in digital era at the 0.05 level. The analysis of the developed structural equation model met the evaluation criteria, showing consistency with empirical data. The chi-square probability level value was 0.057, the relative chi-square value was 1.179, the consistency index value was 0.961, and the root mean square index value of the estimated error was 0.019.

Keywords: Automation System Integrator, Quality Management, Financial

Performance, Industrial Business Sector.

1. Introduction

The automation industry in Thailand has been growing steadily over the years, with the country being ranked 12th in the world in installing industrial robots in 2021 (International Federation of Robotics: IFR, 2022). However, there are still challenges faced by automation system integrators in meeting industry sector requirements. The government's promotion policy that gives importance to industrial development with automated production systems demands quantity and poses problems in the readiness of automation integrators. The need for automation technology and industrial robots has led to a continuous increase in imports, with a consistent trade deficit in this industry as reported by the Thai-German Institute in 2022. The report on the number of industrial robot installations in Thailand has shown a decline from 2011 to 2021. However, a continuous increasing trend is anticipated due to various factors. It is predicted that the utilization rate of industrial robots in Thailand will grow by an average of 5% to 10% annually during 2023 to 2024 (Thai-German Institute, 2022). As a hub for assembling and exporting automobiles, electrical appliances, and electronic components, Thailand serves as a production base for world-class companies. With the government's policy plans to drive the country's industrial progress by utilizing production technology with automation, it is crucial to develop automation system integrators that can meet industry sector requirements.

From the policy of driving the country with innovation towards the 20-year Thai Industrial Development Strategy 4.0 (2017-2036) of the Office of Industrial Economics, Ministry of Industry designated the robot and automation industry as one of the modern industries (New S-Curve). The goal is to transform the production process by incorporating robots and automation to support existing industries (First S-Curve) and enhance product quality through advanced technology to transition into the modern industry (Ministry of Industry, 2016). According to the World Robotics Report 2022 by the International Federation of Robotics (IFR), the global use of robots in the industrial sector has been on the rise. Thailand was ranked 12th in the world for installing industrial robots in 2021 (IFR, 2022), and the trend of industrial robot installations worldwide is expected to continue increasing rapidly (International Federation of Robotics: IFR, 2023).

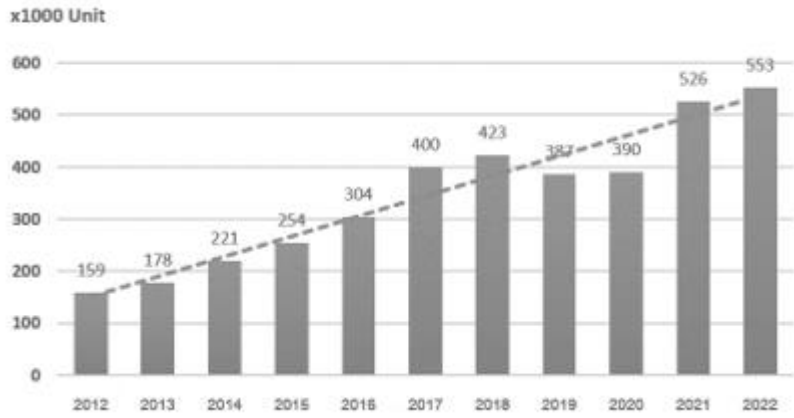

Figure 1. World Robotics Report 2022 (International Federation of Robotics: IFR, 2022).

The report on the number of industrial robot installations in Thailand has shown a decline from 2011 to 2021. However, a continuous increasing trend is anticipated due to various factors. It is predicted that the utilization rate of industrial robots in Thailand will grow by an average of 5% to 10% annually during 2023 to 2024 (Thai-German Institute, 2022). Thailand serves as a production base for world-class companies in assembling and exporting automobiles, electrical appliances, and electronic components. With the increasing need for automation technology and industrial robots, there is a continuous rise in imports. An analysis of the value of industrial robot imports and exports in Thailand reveals a consistent trade deficit in this industry, as reported by the Thai-German Institute in 2022.

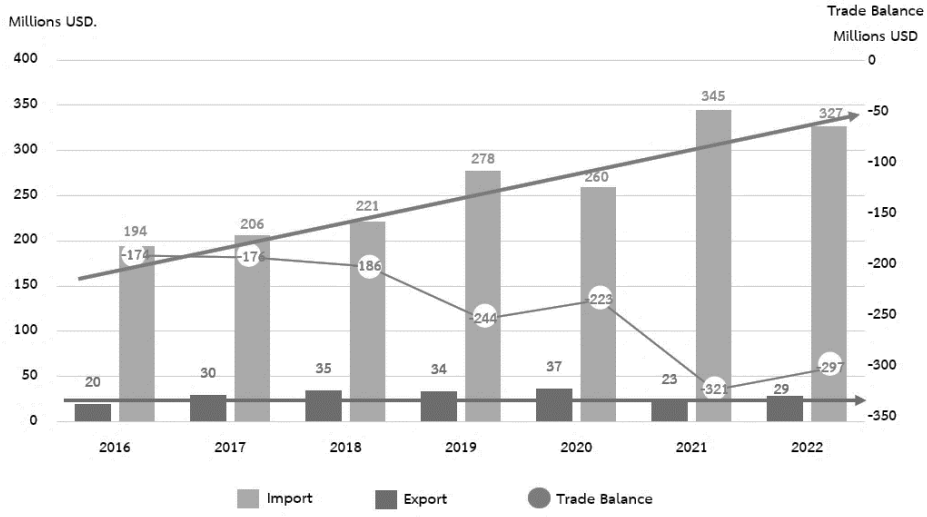

Figure 2. Imports and exports and trade balance in the industrial robot industry group (Thai-German Institute, 2022).

The government's promotion policy that gives importance to industrial development with automated production systems demands quantity and problems in the readiness of automation integrators. It is the source of research on "Study of the Need for Automation System Integrators from the Perspective of Industrial Business Sector in Digital Era" The researcher expects that this research will help guide the development of automation systems integrators, prepare to respond to the government's policy plans to create the country's industrial progress by using production technology with automation, increase industrial competitiveness on the world stage escape from the middle-income country trap, and stepping into economic and social development according to the national development plan for stability, prosperity, and sustainability.

The objective of this research is to study of the need for automation system integrators from the perspective of industrial business sector in digital era. These guidelines aim to help guide the development of automation systems integrators, prepare them to respond to the government's policy plans, increase industrial competitiveness on the world stage, and escape from the middle-income country trap. The research is structured into a comprehensive model, including both qualitative and quantitative research, to gain an in-depth understanding of the challenges faced by automation system integrators and the key factors that are important for their development.

2. Literature Review

From previous concepts and theories on the study of the need for automation system integrators from the perspective of industrial business sector in digital era, this researcher can summarize into four components as follows:

1. Quality Management refers to activities and continuous processes that emphasize and enhance the quality of work at every stage of an operation. It is a comprehensive management system dedicated to ensuring quality in all aspects, aiming to produce products or services that meet customer needs. Concentrating on customer satisfaction is crucial. According to a study by Wai Ting Eric Ngai (2019), advancements in quality positively impact performance, with a business model incorporating components such as policy planning and environmental quality management, the development of service quality models, and the integration of quality. This is consistent with Nopporn (2021), Stating that supply chain management strategies in the industrial sector play a crucial role in determining strategies for managing new industries. The focus is on enhancing operational processes across the supply chain and supporting the coordination among various departments in the organization. The results, including shared information resources analyzed in the process, lead to the conclusion that an effective business strategy is achieved.

2. Financial Performance refers to the ability to manage finances, including the status, operating results, liquidity, and readiness of the organization's asset management to effectively respond to business activities. According to a study by Didin Fatihudin (2022), financial performance represents the overall success of an organization's operations, measured by factors such as capital adequacy, liquidity, and the ability to achieve financial performance and profitability. This is consistent with Golmohammadi et al. (2018), which

suggest that development strategies for sellers may include: 1) price adjustment, 2) dividends, and 3) investment control. The optimal decision among these strategies leads to an increase in profit margins.

3. Human Capital refers to the capital of human resources, which consists of accumulated skills, knowledge, expertise, experience, creativity, as well as personality and other intangible personal property, such as personal relationships in society. Recognition in the organization will allow that person to create value for themselves, the organization, and society. Wardlaw (2019) found that strategies that improve practices to increase efficiency, compliance with performance measurement requirements, and appropriate evaluation of personnel knowledge lead to increased productivity and a competitive advantage for the business. This is consistent with Sunee and Thanin (2023), who discovered that the business environment has undergone significant changes. Intensified competition has stimulated business organizations to apply flexible human resources management, transitioning from control to trust. This encourages attitudes that match personnel skills, leading to the sustainable success of the organization.

4. Technology Innovation refers to new ideas or inventions that expand and apply what is already there to be more modern by relying on advances in science used to create products and new services to solve problems and respond to customer needs. From a study by Ode, E., & Ayavoo, R. (2020), it is stated that knowledge storage and the application of knowledge have a significant and positive effect on organizational innovation. Moreover, knowledge management practices contribute to innovation. This is in line with Julian M. Müller (2020), as absorbing change and the ability to leverage knowledge allows organizations to innovate effectively at all sizes of business.

Research Objectives

The research aims to study of the need for automation system integrators from the perspective of industrial business sector in digital era. The objectives include:

1. To study the structure and operating characteristics of industrial businesses that use automation in the production process.

2. To study the elements of the study of the need for automation system integrators from the perspective of industrial business sector in digital era.

3. To develop a structural equation model outlining the study of the need for automation system integrators from the perspective of industrial business sector in digital era.

Research Hypothesis

This research aims to study the organizational model that integrates automation systems to meet the needs of the industrial sector has the following hypotheses:

H1: Quality Management have a direct influence on Human Capital. Pankaj Kumar (2017), Quality management has a direct and positive impact on overall organizational operations such as efficiency, finance, and human resources of the organization in marketing, and operational aspects, consistent with YuanMa (2020), management based on the principles of quality management influences labour efficiency in all lines of influence.

H2: Quality Management have a direct influence on Technology Innovation. Ana B. Escrig-Tena. et al. (2018), Quality management influences both directly and indirectly on innovation efficiency, and consistent with Mauro Sciarelli (2020), quality management directly influences management innovation and technical innovation and affects the operating results of the organization to have more flexibility in operations.

H3: Quality Management have a direct influence on Financial Performance. Jawad Abbas (2021), Quality management directly influence the overall picture of the organization, this includes the financial performance of the organization as well, consistent with Pankaj Kumar (2017), Quality management has a direct and positive impact on overall organizational operations such as efficiency, finance, human resources, marketing, and operations.

H4: Technology Innovation have a direct influence on Financial Performance. Shashi (2019), Innovative products directly influence financial efficiency and influences indirectly through environmental performance, this is consistent with R.P. Jayani Rajapathirana (2017), that innovation performance indirectly influences financial efficiency through marketing performance.

H5: Technology Innovation have a direct influence on Human Capital. Forouzan (2021), Knowledge management has elements of structure, strategy, technology, culture, leadership, and trust that directly influence the human capital component, and organizational efficiency consistent with Iwan's (2020) research, information technology has a direct impact on an organization's human capital. It also has an indirect influence through leadership on the human capital of the organization. In the same year, Iwan (2020) found that, this information technology indirectly influences the effectiveness of human capital.

H6: The Importance level of the Study of the need for automation system integrators from the perspective of industrial business sector in digital era when classified according to the location of the industrial business, there is no difference. Sri Sarjana (2020), regional and sustainable development depends on strengthening various business units within industrial areas. Modern supply chain management has the potential to significantly improve people's quality of life, as highlighted by Radhya (2020) in their new paradigm of digital control and automation for manufacturing systems. This approach ensures maximum uptime across the production chain, leading to increased productivity and reduced costs in sectors such as rail transportation and wind energy, consistent with Sunee's (2022) perspective, relevant agencies must earnestly support the automotive parts manufacturing industry to meet global buyer demands. Operators in this industry require investments in automation, modern information systems, and innovation to consistently deliver high-quality products.

3. Research Methodology

The research methodology used to gather and analyze data for this study is structured into a comprehensive model, including both qualitative and quantitative research methods. The qualitative research method used in-depth interviews with 9 experts and group discussions with 11 experts. For the quantitative research method, a survey was administered to industrial business executives or individuals responsible for automation, using an effective questionnaire distributed to 500 respondents (Comrey and Lee, 1992 cited in Thanin, 2024).

The survey questionnaire comprised three sections. Section one collects information about the general status of industrial businesses. Section two collects information about the operating characteristics of industrial businesses. Section three included questions related to the four essential elements of the study of the need for automation system integrators from the perspective of industrial business sector in digital era, namely quality management, financial performance, human capital, and technology innovative. Respondents were asked to rate the importance of each element in developing automation system integrator on a 5-point Likert scale. Section four included open-ended questions that allowed respondents to provide additional comments and suggestions on the topic. The criteria used for selecting the experts for the qualitative research method were based on their experience and expertise in the field of automation system integration. The experts were selected based on their knowledge in the areas of quality management, financial performance, human capital, and technology innovation. The experts were identified through a review of relevant literature and recommendations from industry professionals. The data collected through the surveys and qualitative research methods were analyzed using descriptive statistics, reference statistics, and multiple statistics. The results were analyzed to determine the study of the need for automation system integrators from the perspective of industrial business sector in digital era.

1. The research employed qualitative research methods, specifically in-depth interviews, to gather data from a population of 9 experts who were selected through purposive sampling with qualification criteria for experts according to the Executive Committee of the Doctor of Industrial Business Administration Program, Faculty of Business Administration, King Mongkut's University of Technology North Bangkok. The experts were divided into three groups: three business executives, three government agency representatives, and three education experts.

2. For the quantitative research, the population consisted of executives or individuals responsible for the automation of industrial businesses. The sample size was determined to be 500, which was considered very good, using the criteria of factor analysis or structural equation models. A multi-stage sampling method was used, including a cluster sampling procedure that divided the factories according to their location in industrial estates or outside and randomly selected 500 factories for data collection. The data was collected from the sample group based on the accumulated statistical data on the number of factories permitted to operate according to the Factory Act B.E. 2535 and the Factory Act (No. 2) B.E. 2562, classified by province, category at the end of B.E. 2565, which showed a total of 73,232 industrial factories (Department of Industrial Works, B.E. 2566).

4. Results

Table 1. Importance level of the Study of the need for automation system integrators from the perspective of industrial business sector in digital era, classified according to industrial business location.

Study of the Need for Automation System Integrators from the Perspective of Industrial Business Sector in Digital Era.	Inside the Industrial estate			Outside the Industrial estate		
	$\bar{X}$	SD.	Importance Level	$\bar{X}$	SD.	Importance Level
Overall importance level	4.43	0.29	High	4.43	0.31	High
1. Quality Management	4.49	0.28	High	4.51	0.26	Highest

2.	Financial Performance	4.45	0.30	High	4.45	0.31	High
3.	Human Capital	4.42	0.36	High	4.42	0.37	High
4.	Technology Innovation	4.37	0.39	High	4.35	0.45	High

The study assessed the importance of the need for automation system integrators from the perspective of industrial business sector in digital era based on the location of industrial businesses.

1. Industrial businesses within industrial estates rated the guideline highly, with an average score of 4.43. Quality Management was the most important aspect (4.49), followed by Financial Performance (4.45), Human Capital (4.42), and Technology Innovation (4.37).

2. Industrial businesses outside industrial estates also rated the guideline highly, with an average score of 4.43. Quality Management was the most important aspect (4.51), followed by Financial Performance (4.45), Human Capital (4.42), and Technology Innovation (4.35).

3. Statistical analysis found no significant difference in the importance of the guideline based on the location of industrial businesses.

4. The structural equation model for the guideline was found to be consistent after adjustment, meeting all evaluation criteria. The chi-square probability value (CMIN-ρ) was 0.057, chi-square correlation value (CMIN/DF) was 1.179, consistency level index (GFI) was 0.961, and root mean square error approximation index (RMSEA) was 0.019, indicating a good fit with the data.

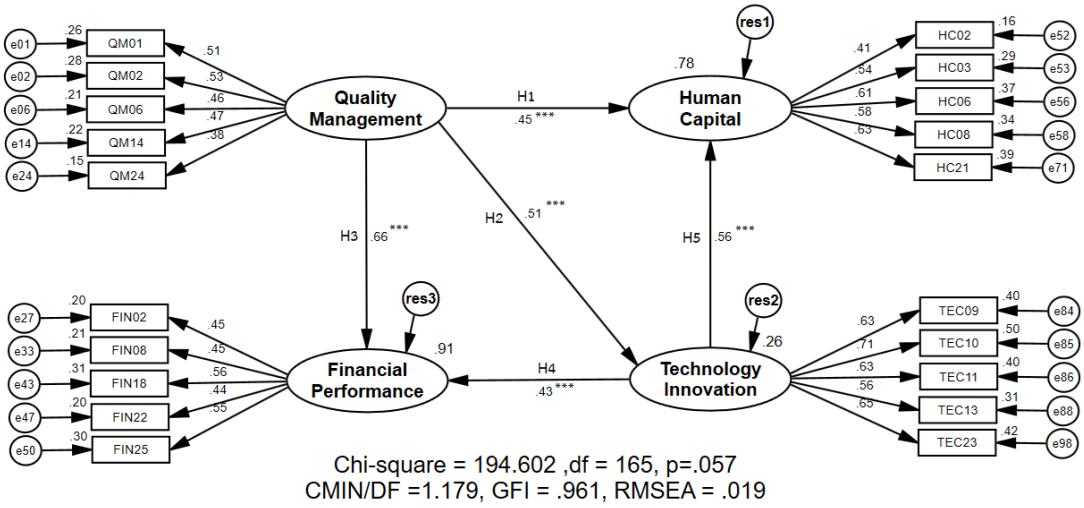

Figure 3. Structural equation modeling of the Study of the Need for Automation System Integrators from the Perspective of Industrial Business Sector in Digital Era, Standardized Estimate mode after model improvement.

The hypothesis testing examined the relationship between latent variables in a structural equation model for developing an Automation System Integrator Guideline to meet industry requirements. Five hypotheses were tested:

1. H1: Quality Management significantly influences Human Capital (Standardized Regression Weight = 0.45, $p < 0.001$).

2. H2: Quality Management significantly influences Technology Innovation (Standardized Regression Weight = 0.51, $p < 0.001$).

3. H3: Quality Management significantly influences Financial Performance (Standardized Regression Weight = 0.66, $p < 0.001$).

4. H4: Technology Innovation significantly influences Financial Performance (Standardized Regression Weight = 0.43, $p < 0.001$).

5. H5: Technology Innovation significantly influences Human Capital (Standardized Regression Weight = 0.56, $p < 0.001$).

5. Discussion

Study of the Need for Automation System Integrators from the Perspective of Industrial Business Sector in Digital Era overall are important at a high level. Quality management is at the highest level of importance. As for Financial Performance, Human Capital, and Technological Innovation, they are important at a high level.

1. Study of the need for automation system integrators from the perspective of industrial business sector in digital era in terms of Quality Management are of the highest level of importance. It has an average of 4.50, which is the highest average. Wai Ting Eric Ngai (2019), advances in quality will have a positive impact on the bottom line. This is consistent with Nopporn (2021) saying that, the important goal in determining the strategy of new industry management is to focus on developing operational processes, the result is an effective business strategy.

2. Quality Management has the greatest overall influence on the Financial Performance with a weight of 0.88. Jawad Abbas (2021), Quality management directly influences the overall of the organization. This includes the financial performance of the organization as well. This is consistent with Pankaj Kumar (2017), Quality Management has a direct and positive impact on overall Organizational Operations such as Efficiency, Finance, Human Resources, Marketing, and Operations.

3. From the results of the research, when comparing the Study of the need for automation system integrators from the perspective of industrial business sector in digital era, classified according to the location of establishments located in industrial estates, and outside the industrial estate. Overall, it was found that there was no statistically significant difference at the 0.05 level. Sri Sarjana (2020) that strengthening the business unit in industrial areas and modern supply chain management will truly help change people's quality of life, while Sunee (2022) relevant agencies should seriously support the automotive parts manufacturing industry. It requires investment in automation, modern information, and innovation to produce quality products.

4. Policy and standards for Non-Disclosure Agreement: NDA has a mean value of 4.56 (SD = 0.528) with the highest importance. Tarun (2020) said that, the concept of a Non-

Disclosure Agreement is protection, disputes that will arise from business collaboration violating the agreement hurt the collaboration. Consistent with Ziana's (2024) Non-Disclosure Agreements. It is a form of protecting a company's trade secrets. The contracting party must protect trade secret information.

5. Relationship between variables, “Technology and innovation are transferred to customers regularly” (TEC09) , with the variable “Creating a society of learning about technology, innovation, and application both inside and outside the organization” (TEC10), with a value of 0.468, indicating the highest relationship. Forouzan (2021) noted the positive effect of the variables on structure, culture, and leader innovative technology. Knowledge management also influences organizational performance both directly and indirectly, and through the variable of human capital, consistent with Ndingi Junior Itoe Mote and Georgiana Karadas (2022). Personnel with knowledge in automation work has a strong influence on knowledge transfer. Knowledge transfer has a strong influence on employee creativity and innovation efficiency.

Based on the research findings, it is evident that the development of automation system integrators is crucial for enhancing product quality and propelling the industrial sector into the modern era. The four key elements emphasized in the study, Quality Management, Financial Performance, Human Capital, and Technology Innovation, underscore the areas that demand the most attention for the successful advancement of automation system integrators. However, it is important to acknowledge that the study did not address the challenges that could potentially arise in the development of automation system integrators. For example, sourcing skilled human capital capable of handling advanced production technology may pose a significant obstacle. Additionally, the study did not delve into the financial implications associated with developing automation system integrators, such as the costs of acquiring advanced production technology and training personnel to operate it.

Moreover, the research findings underscore the importance for industrial businesses to prioritize the guidelines for developing automation system integrators. Nonetheless, the study did not explore the reasons why some industrial businesses may not give these guidelines the necessary attention. Future research could investigate the challenges that industrial businesses encounter in implementing these guidelines and the obstacles hindering the adoption of automation technology. Further research is warranted to delve into the challenges that may arise in implementing these guidelines and to understand why some industrial businesses may not prioritize them.

6. Suggestions

Research on “Study of the Need for Automation System Integrators from the Perspective of Industrial Business Sector in Digital Era” This issue focuses on finding the right combination of approaches for developing automation system integrator to meet industry sector requirement, leading to the integration and cooperation in developing the production system of Thai industry at the international level. This helps increase the competitiveness of Thai products in the world market. The researcher would like to suggest Study of the Need for Automation System Integrators from the Perspective of Industrial Business Sector in Digital

Era. The details are as follows:

Policy Suggestions:

1. Ministry of Industry:

- Implement policies to enhance industrial production processes through automation and digitalization to boost demand for automation integration businesses.

- Provide tax exemptions for income from automation operations in the industrial sector and promote competency development in automation work.

2. Ministry of Higher Education, Science, Research, and Innovation:

- Focus on creating skilled personnel in technology and innovation for industry and commerce.

- Encourage research on production technology to meet international standards and drive economic growth.

3. Ministry of Labor:

- Improve labor quality in automation system integration work through skill development and data sharing between government and private sectors.

- Support entrepreneurs in integrating automation systems for sustainable economic growth and decent work opportunities.

4. Thailand Board of Investment (BOI):

- Offer tax incentives for operators integrating automation systems in industrial businesses.

- Provide funding and support for automation system integration businesses to promote entrepreneurship.

Operational Research Suggestions:

1. Quality Management:

- Maintain trade secrets and adhere to quality control standards for materials and accessories.

- Provide after-sales services and guarantees to ensure system usability.

2. Financial Performance:

- Manage business partnerships with honesty and transparency.

- Establish cooperation networks and build trust with financial institutions.

3. Human Capital:

- Implement effective human resource management and development strategies.

- Motivate personnel with rewards and create opportunities for skill development.

4. Technology Innovation:

- Select technology suitable for industrial needs and focus on research and innovation.

- Support research and development to enhance product efficiency and industrial development.

Suggestions for Further Research:

1. Study guidelines for upgrading production processes with automation technology to enhance competitiveness in the industrial sector.

2. Research market development opportunities for the automation industry to support new and existing entrepreneurs.

3. Investigate business management strategies for integrating automation during crises like economic downturns or supply chain disruptions.

7. Conclusion

The research findings underscore the significance of cultivating automation system integrators to enhance product quality, propel the industrial sector into the modern era, and foster technological advancement. The four key elements that demand the most attention for the successful development of automation system integrators are Quality Management, Financial Performance, Human Capital, and Technology Innovation. The practical implications of this research suggest that industrial enterprises must prioritize these guidelines to stay competitive in the global market. The study emphasizes the importance of investing in advanced production technology and skilled human capital to achieve financial performance and enhance product quality. The establishment of automation system integrators is vital for the effective implementation of automation technology and the progression of the industrial sector in Thailand. The research findings offer valuable insights into the essential elements necessary for the successful development of automation system integrators. Industrial businesses can utilize these guidelines to cultivate their automation system integrators and maintain competitiveness in the global market.

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