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Management Guidelines for Maintenance Services to be Success in to the Industrial

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Abstract

The number of entrepreneurs in the maintenance business continues to increase, and the number of entrepreneurs who lose performance tends to increase steadily every year. The purpose of this research was to study the approaches for successful management of maintenance services in the industrial sector with qualitative research by using in-depth interviews. For quantitative research, a survey was conducted with a questionnaire from business owners or chief executives of the maintenance service business in the industrial sector, which earned profit three years continuously in a total of 500 industries, by using descriptive statistics, reference statistics, and multiple statistics. The results found that guidelines for the successful management of maintenance services in the industrial sector, which are important, can be divided into four components as follows:1) Data Insight aspect, and 2) The aspect of holding the alliance as the center. 3) Innovation and technology and 4) service aspect. It was found that Medium to Small businesses were sized, giving importance to the successful management of maintenance services in the industrial sector. The difference was statistically significant at the level of 0.05. The results of the analysis of the developed structural equation model were found to pass the assessment criteria, which is consistent with the empirical data, with a chi-square probability value of 0.133, a relative chi-square value of 1.065, a consistency index of 0.933, and a root mean square index of the error estimate was 0.011. The study discusses the importance of training and education to ensure the successful implementation of any new technologies or procedures. It also examines the role of communication and collaboration between maintenance teams and other departments in ensuring that everyone is on the same page. The findings of this study can provide valuable insights for industrial

maintenance teams, enabling them to increase their efficiency and reduce costs.

Keywords: Structural Equation Modeling, Business Management Guidelines for Maintenance Contracting Business, Industrial Business.

Introduction

Growth of the economy from the industrial sector, resulting from continuous economic and industrial development plans since the first National Economic and Social Development Plan in B.E. 2504, the Thai economy used to have a high economic growth rate at 7-8% per year, the government began to concentrate on the development of all aspects of industry which are large, medium and small industrial businesses, as a result, there are many different types of industrial factories to produce in a comprehensive form a lot happened then, such as production of parts, forming work, and creating workpieces that can reach consumers completely or in form of supporting industry in production such as produce parts to assemble products, from the accumulated statistics found that, there is an industrial factory that has been licensed to operate in years 2558-2563 B.E. which have a lot of them (Information and Communication Technology Center Department of Industrial Works, B.E. 2564)

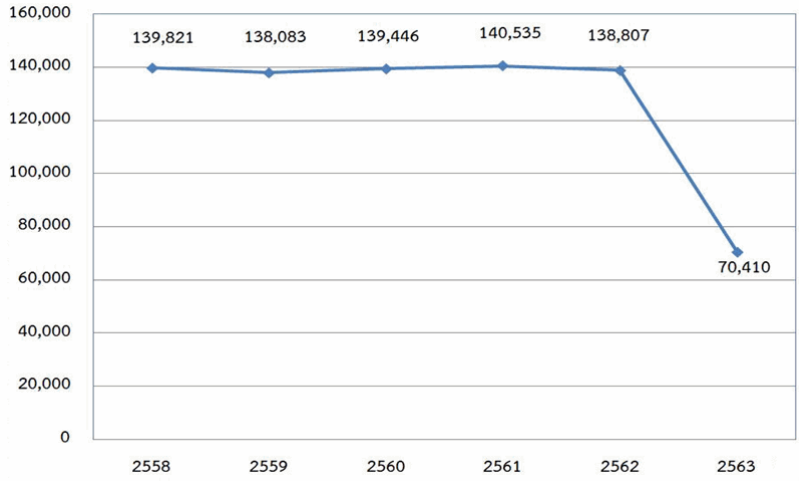

Figure 1 – Illustrates the importance of efficient maintenance management in the modern industrial sector

Number of industrial factories that are allowed to operate between B.E. 2558-2563 (Information and Communication Technology Center Department of Industrial Works, B.E. 2564) have imported a large number of automated machine tools for industrial factories to use in assembly and production. These machines and equipment, when

used are required maintenance and it is a must that the industrial factory should realize its importance and is considered a policy that must be followed, management maintenance, allowing the organization to reduce the cost of producing products. Therefore, if there is a good and efficient maintenance management in the industrial sector and has a good quality it will then can reduce production losses in another hand. Maintenance management in the modern industrial sector, changing the role from being the supervisor and operating by themselves, to being a supervisor, promoting and supporting contractors or maintenance contractors in the industrial sector to work instead, allows the organization to reduce the cost of manufacturing products, reduce investment in the purchase of tools and equipment, reduce operating costs, reduce the size of the organization's structure and manpower (Piyapong, B.E. 2556: 14-19) from the statistics of the number of entrepreneurs who hire maintenance services in all industrial sectors between B.E. 2558-2563 (Department of Business Development, B.E. 2564) the number is increasing every year.

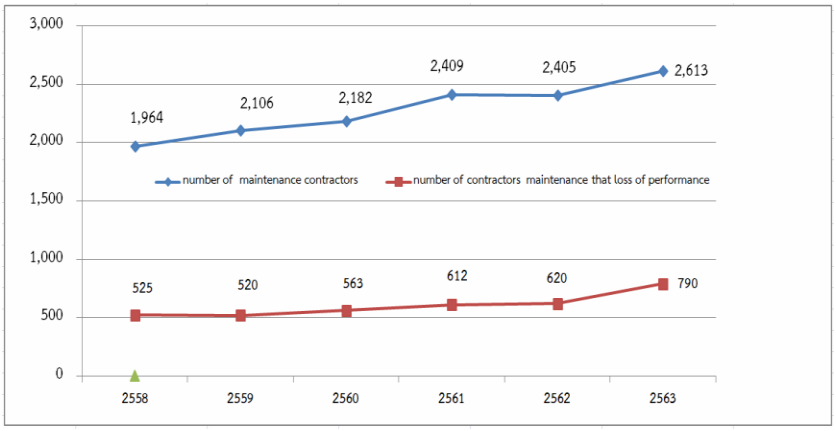

Figure 2 illustrates the trend in maintenance contracting in the industrial sector: increase in adoption and performance loss, and implications for effective management approaches.

The total number of maintenance contractors and the number of contractors maintenance that loss of performance between B.E. 2558-2563 (Department of Business Development, B.E. 2564) from Figure 2 data, number of operators contracting for maintenance in the industrial sector since B.E. 2558-2563 found that, tends to increase continuously every year, with numbers in year 2558 B.E. at 1,964 cases increased to 2,613 in B.E. 2563, and for the number of entrepreneurs whose performance at the end of the year was loss since B.E. 2558-2563 found that the trend which was increased since B.E. 2558 have the numbers of 525 cases and year 2563 B.E. have increased the numbers up to 790 cases from that data found that there will be continuously increasing every year. Therefore, from the

origin and importance of the problem, the researcher is interested in studying the approach to managing a maintenance contracting business in the industrial sector to be successful, as a guideline for entrepreneurs in Thailand to use with potential effectiveness, good for increasing the gross domestic product and resulting in increasing the country's competitiveness in the future.

Research Objectives

1) To study the structure and the nature of operations of the maintenance service business in the industrial sector.

2) To study the components of a successful maintenance management approach in the industrial sector.

3) To develop a structural equation model for successful management of maintenance services in the industrial sector.

Literature Review

The researcher has summarized the management guidelines for maintenance services in the industrial sector to be successful by devided research components into 4 of them which are:

1) Data Insight components aspect, from the studied of Narongrit, B.E. 2557 found that to analyze bid data is really important for entrepreneur because of nowadays the competitive of businesses is pretty high, entrepreneur that could bring the big data to analyzed, inevitably results in that operator having an advantage over competitors in relation to the research of Biazzin and Carvalho, 2019 found that, to analyze a big complex data (Big Data) have high interested because of the possibility to reduce the conflicts and difficulty, helps reduce costs, support accurate decision-making processes.

2) Components of Innovation and Technology aspect, from the studied of Veldman, J., Wortmann, H. and Klingenberg, W., 2011 found that, relevant knowledge for maintenance engineering, it can be explained that an organization in charge of maintenance cannot perform maintenance without sufficient knowledge. To make the organization sustainable, it is necessary to innovate in the organization, innovation in maintenance engineering in the implementation of maintenance projects and joint ventures requires new knowledge and ability to calculate, design, plan and assess situations, maintenance and performance measurement (Straub, A., 2012)

3) Servitization aspect components (Servitization) from the studied of Izogo, 2015 found that, understanding the perception of the customer's needs, is the most important aspect of service quality, reliability and responsiveness to customer satisfaction indicators and influence customer loyalty consistent with the research of Modgil & Sharma, 2016 which found that, service quality and customer satisfaction is a very important concept, to make repeat customers use the service. In organizations, this must be understood in order to operate efficiently and competitively. And,

4) Alliance-centric elements (Alliance Centric) from the studied of Kang, et al., 2014 found that, nowadays businesses can no longer do business alone, because recruiting resources with the above characteristics to increase competitiveness, rely on networks so that businesses can take advantage of the business of other people, be it processes, technologies, products, sales channels, to strengthen the organization by using other people's resources.

Research Methods

This research is an Inductive Research with Mixed-Methodology Research consisting of 3 sections which are Qualitative Research using In-Depth Interview techniques, Quantitative Research with collecting survey data and Qualitative Research with Focus Group discussion techniques to confirm the validity of this research model.

1. Qualitative research using in-depth interview techniques, the population used in this research was 9 experts, using a purposive sampling method (Purposive Sampling) with the qualification criteria of experts (Qualifications of Experts) According to the Doctor of Business Administration Program Department of Industrial Business Administration, Faculty of Business Administration, King Mongkut's University of Technology North Bangkok has defined, consisting of 3 groups of experts which are, a group of entrepreneurs or executives in the maintenance business sector 3 people, a group of government and related organizations 3 people and a group of academics 3 persons.

2. Quantitative Research with Survey Research Techniques, the population used in this research was determined from business entrepreneurs or executives chief of maintenance services in the industrial sector, with continuous earning profits for 3 years in a row, totaling 1,178 establishments. Determining the sample size use the criteria of research on elemental analysis or structural equation modeling that the sample size was set at a highest level of 500 samples (Comrey and Lee, 2013) the stratified random sampling method was used (Cluster Sampling) (Thanin, B.E. 2563) which the business can divided into 2 sizes, both small and medium businesses.

3. Qualitative Research with group discussion techniques (Focus Group Discussion) to certify the model, the population used in this research consisted of 11 qualified persons, using a purposive sampling method (Purposive Sampling)

Results

The guidelines for the successful management of maintenance services in the industrial sector are summarized as follows:1. Level of importance for the successful management of maintenance in the industrial sector. 1. the level of importance for the management of maintenance to be successful in the industrial sector. Overall, it was found to be important at a high level with an average of 4.48. When considering each aspect basis. It was found that Data Insight had an average value of 4.53, an alliance-centric aspect. Alliance Centric have an average value at 4.52. The innovation and technology aspects have an average value of 4.48, and the service aspect has an average value of 4.41. 2. Comparison of the importance of successful maintenance management approaches in the industrial sector, classified by business size by testing. The difference between the means of the population of the two independent groups was determined using a t-test. Overall, when classified by business size, there was a statistically significant difference at the level of 0.05. The results are presented in Table 1.

Table 1. Comparison of the importance of successful maintenance management approaches in the industrial sector.

Elements of a guideline for successful management of a maintenance contractor business in the industrial sector.	Small Size			Medium Size			t-Value	P-Value
	$\bar{X}$	S.D.	Important level	$\bar{X}$	S.D.	Important level		
The importance of the overall element.	4.56	0.31	Highest	4.40	0.31	High	5.67	0.00*
1. Servitization Aspect.	4.52	0.44	Highest	4.30	0.45	High	5.42	0.00*
2. Data Insight Aspect.	4.64	0.34	Highest	4.43	0.35	High	6.76	0.00*
3. Innovation and Technology Aspect.	4.51	0.37	Highest	4.44	0.40	High	2.19	0.03*
4. Alliance Centric Holding Aspect.	4.58	0.31	Highest	4.45	0.33	High	4.16	0.00*

3. A structural equation model is employed for the successful management of maintenance services in the industrial sector. The researcher analyzed and refined the model by considering the values of the Modification Index, as suggested by Arbuckle. Considering the

values of the outputs of the program with theoretical principles and eliminating unsuitable observational variables, the model was reprocessed repeatedly until all four statistical values passed the criteria and were complete. The results were consistent with the empirical data of (Silpcharu, 2020) as in Table 2, shown the statistics before and after model improvement. Figure 4 shows a structural equation model.

Table 2. Statistical value that evaluates the consistency of the structural equation model, comparison before and after model modification.

Statistics	Criteria used to be considered.	Before modification.	After modification.
CMIN–$\rho\rho$ (Chi-square probability level value)	The values was more than 0.05	0.000	0.133
CMIN/DF (Relative chi-square)	The values was less than 2	15.386	1.065
GFI (Conformity Index)	The values was more than 0.90	0.312	0.933
RMSEA (Root mean squared index of the error estimation)	The values was less than 0.08	0.170	0.011

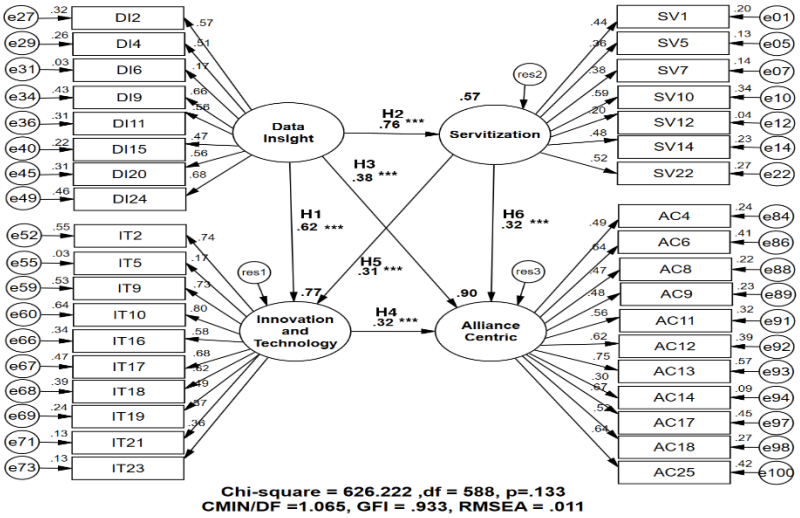

Figure 3. Structural equation modeling, management approach for maintenance services in the business sector industry to succeed with Standardized Estimate mode after modification.

Table 3 Variable definition.

variables	Meaning	variables	Meaning
DI2	Gathering sources of quality raw materials and equipment manufacturers which fast in service.	SV1	Honesty and sincerity in providing services to build credibility and trust for customers.
DI4	Explore customer service behavior data to be used in planning and determining the direction of operations.	SV5	Cultivate the organization's personnel to have a sense of service excellence.
DI6	Have a management system to collect knowledge of maintenance as an electronic database, to be able to perform maintenance efficiently.	SV7	Concentrating on meeting the real needs of customers at the right point.
DI9	Manage a system to listen to the opinions of personnel in order to consider responding to that need.	SV10	Providing a good service standard which is acceptable to customers.
DI11	Survey and collect customer satisfaction information after receiving the service.	SV12	Respect customer confidentiality, forbidden of sharing customer information.
DI15	Providing information about contractors who come to support maintenance work and inspection of equipment to meet various types of engineering standards.	SV14	The price is appreciated for the quality and service provided.
DI20	Keep history data of machinery and equipment by creating reports in order to analyze and find ways to prevent damage in the future.	SV22	Have various tools and equipment used in the service that are modern and highly efficient.
DI24	Analyzed customer service usage data with Data Analytic to help provide more accurate customer service.	AC4	Become a member of the clubs, association of organizations involved in maintenance.
IT2	Bringing innovation and new technology to support maintenance.	AC6	Business operations must be based on equality between the organization and its partners, without maximizing profits.
IT5	Use AI (Artificial Intelligence) to replace working with human labor in the long term.	AC8	Aims to help partners succeed in business operations such as sharing marketing information.
IT9	Remote the machine control with online sy8 (Overwrite) via Mobile Application.	AC9	Organize academic conferences with organizations in the same industry, to create cooperation between organizations.
IT10	Create data display (Dashboard) and intranet, to use information technology systems to work together between the production department, maintenance department and chief executives for quick and accurate coordination.	AC11	Create a development process to educate suppliers such as quality training for suppliers to obtain quality materials and raw materials.
IT16	Use the GPS system to transport goods for convenience, speed, accuracy, and precision.	AC12	Drive operations to achieve goals in the form of partnerships (Partner) and be friendly.
IT17	Have a protection process from attack detection, and recovery of information systems from such attacks.	AC13	Coordinate with the manufacturer of the product to obtain technical information such as the current manual for use.
IT18	Invest and develop the Digital Infrastructure such as Software and Hardware continuously.	AC14	Coordinate and support each other between the organization and competitors, for example, recommending sources to buy equipment for joint repair.
IT19	Changes in the traditional working system to be digitally, such as Smartoffice or use E-Documents (Paperless)	AC17	Pushing the alliance to become a Knowledge Society for stability and sustainability.

IT21	Support corporate financial transactions through digital technology.	AC18	Organize activities to strengthen relationships between partners on a regular basis.
IT23	Bring Social Medias (Social Network) into the organization for a good image of organization continuously.	AC25	Collaborate with competitors in the same industry to prepare a maintenance contract business directory, to disseminate to the industry in general.

4. The results of the hypothesis test for analyzing the causal influence between the latent variables in the structural equation model for successful maintenance management in the industrial sector for the six hypotheses were found. Based on these six hypotheses, we propose the following:

H1: The Data Insight components aspect has a direct influence on Innovation and Technology that is statistically significant at .001. It had a Standardized Regression Weight of 0.62.

H2: The Data Insight components aspect has a direct influence on Servitization, which is statistically significant at .001. It had a Standardized Regression Weight of 0.76.

H3: Data Insight components have a direct influence on alliance centricity, which is significant at the level .001. It had a Standardized Regression Weight of 0.38.

H4: The Innovation and Technology components directly influence the alliance-centric component, which is statistically significant at .001. It had a Standardized Regression Weight of 0.32.

H5: The servitization component has a statistically significant direct influence on the components of Innovation and Technology at the level of .001, with a Standardized Regression Weight of 0.31.

H6: Servitization components have a direct influence on Alliance Centric, which is statistically significant at the level of .001, and has a Standardized Regression Weight of 0.3.

Discussion

The important subject found from the research on how to manage a maintenance contractor business in the industrial sector to be successful is an organizational management approach that concentrates on building competitiveness. Under the environment of nowadays era rapidly changing technology. To achieve long-term success, from the results of this research, the researcher brings relevant research papers to support or contradict 5 items as follows:

• When comparing the components of the maintenance management approach in the industrial sector for overall success, it was found that there was a statistically significant difference at a level of 0.05. Small businesses can penetrate markets in specific

customer segments. They are more flexible, can adapt better than medium-sized businesses, and can survive in times of crisis (Rose 2006). Consistent with Somphoom (2021), smaller businesses could invest less. Easy access to customer groups, low-cost investing, and price assessment can be competitive. Have fewer employees, then the fixed costs are also lower, and they can easily adapt to all plans. Especially in times of crisis, suitable for finding new markets, finding new customer groups, or a quick change in strategy.

• From the results of hypothesis testing, it was found that the Insights Data Components had the highest overall influence on Alliance Centric elements. Empirical data demonstrate that insights are the cornerstones of doing business. The service industry defines business processes that can provide services through information technology systems from all countries. Business processes using outsourced knowledge services are a strategic option for achieving overall efficiency improvements, consisting of making processes either sub- or end-to-end (Maria et al. 2020). Data are large and change rapidly, in line with Godi (2021), who conceptualized the new era of corporate management. It concentrates on connecting business partners to create an effective response to market needs. Customer response efficiency is a supply chain management strategy that concentrates on restructuring business operations to reduce losses from excess inventory and other costs by giving importance to cooperation between partner organizations to create the highest satisfaction for customers.

• Guidelines for successful management of maintenance contracts in the industrial sector in terms of insights data, which is the highest level of importance. This reflects the importance of the information that directly affects the success of business operations, which is consistent with the findings of Pranicevic et al. (2011). Using this information to plan services, marketing, and sales appropriately, as well as in conjunction with marketing strategies and sales, quickly and effectively meets customer needs. It is able to increase and maintain business market share, increase competitive opportunities, and create a good image for the organization. Technology has a positive impact on service industry performance in terms of process quality and customer relations.

• From the results of hypothesis testing, it was found that insights component data most directly influenced the components of servitization. Empirical data demonstrate that insights are the cornerstones of doing business. Because big data consists of both Structured and Unstructured Data, it is growing rapidly and exponentially as it expands continuously. Data must be fast, both in the form of transmission and analysis of the upper transmission mechanism on original Cloud Computing, and issues arise from big

mistakes (Ding et al., 2020). The consistency concept states that information gathered from the sorting of different sources is required, as it affects the processing accuracy. It is a great help for organizations to ensure that their data are ready for the next analysis phase (Fakhitah Ridzuan et al., 2019). Use information to provide services that meet customer needs.

• Guidelines for managing the maintenance business in the industrial sector to be successful show that there is a development process to educate suppliers. It includes quality training for suppliers to obtain available materials and raw materials. Quality was the most important guideline, with an average value of 4.68. These results are consistent with those of Dunn and Young (2004). The authors demonstrate that supplier development affects cost capability, quality, productivity, flexibility, commitment, and inventory. Further, it lowers procurement costs (Modi and Mabert, 2007). The authors state that operational knowledge transfer activities have a positive impact on supplier performance (Arroyo-Lopez et al., 2012).

The roles of technology and digital tools in modern industrial maintenance services are becoming increasingly important. With the increasing complexity of industrial processes and the need for greater efficiency and effectiveness, technology and digital tools can provide ways for industrial maintenance services to keep up. By integrating technology and digital tools into management guidelines, industrial maintenance services can improve the efficiency and effectiveness of maintenance processes. Digital tools, such as computer-aided design (CAD), can help industrial maintenance services generate and store accurate blueprints of facilities. This can reduce the time and effort required to locate and fix faults and improve the accuracy and efficiency of the maintenance process. In addition, digital tools such as predictive maintenance systems can help industrial maintenance services anticipate and prevent potential problems before they arise. This can help reduce downtime, reduce costs, and increase productivity.

Conclusion

Optimizing maintenance services in an industrial setting is challenging. Thus, an efficient and well-structured maintenance system is required to ensure effective outcomes. This study provides a comprehensive guide to help managers design and implement successful maintenance programs. Adopting the right strategies, such as a preventive maintenance system, total productive maintenance, and computerized maintenance management systems, can be a major advantage. Moreover, managers must ensure that maintenance practices are regularly evaluated and updated to keep

up with changing needs. With a proper maintenance system in place, industrial settings will be able to improve their overall efficiency and reduce associated costs.

Recommendations for future research

Recommendations from research on how to manage the maintenance business in the industrial sector have been successful. Thus, the government should promote the creation of a network of maintenance business operators. Promoting a network of connections creates an efficient supply chain between service providers and recipients. The government should restructure trade and import tariffs on machinery and equipment used for maintenance, including credit measures, to support funding sources for entrepreneurs. The government should accelerate the expansion of its scope to cover the development of the national innovation system. Increase the opportunity to thoroughly access innovation and promote knowledge transfer in science and technology. Innovation in the commercial use of the private sector by working with public, private, and university partners. Maintenance businesses should concentrate on management by clearly defining the direction of innovation and technology management, continuously reviewing and planning both short-term and long-term operations in order to be able to meet the organization's goals. The maintenance business should adjust the organization to the current economic environment, society, technology, and competition.

• More research should be conducted on ways to develop human resources in the maintenance business to compete in the digital economy era.

• Focus more on management strategies for equipment rental service maintenance in the industrial sector.

• Focus more on educational strategies to manage maintenance work in the industrial sector to be effective.

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