



Evaluation of information system efficiency for the maintenance of the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway

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Abstract

The study on the evaluation of information system efficiency for the maintenance of the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway aimed to study 1) characteristics of basic personal, economic, and social data; 2) management performance of the Chalerm Mahanakorn Expressway; 3) Factors affecting the efficiency of the information system on the maintenance management of the Chalerm Mahanakorn Expressway, and 4) problems, obstacles, and suggestions concerning the maintenance of the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway. The sample group used in the study was the 23 staff who used the information system for the maintenance of the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway completed the SAP training course and currently still use geographic information system (GIS) for the maintenance. Data were collected by interviews and data were analyzed by using descriptive statistics to find the percentage, mean, and standard deviation. The results of the study showed that most of the respondents were male (87%), aged between 25-40 years old (78.3%). Most of them received a Bachelor's degree (73.9%), positions responsible for maintenance officers of the Chalerm Mahanakorn Expressway (56.5%), and positions responsible for maintenance officers of the Chalong Rat Expressway (30.4%). The average working period was 5-10 years (56.6%) with an average income of 25,001 - 35,000 baht (39.1%). The frequency of using information systems in work is used every day (87%) because it is convenient, fast, and efficient (60.9%). In terms of opinion level on the current management of the Highway Maintenance Division of Chalerm Mahanakorn Expressway and the Chalong Rat Expressway, the results of the study showed that the sum of all aspects was at the highest level with a total mean of 4.49 (S.D. = 0.591). When considering each aspect, it revealed that the respondents had the most average opinion in terms of traffic guidance signs with an average of 4.55, followed by maintenance and the cost of traffic surfaces with an average of 4.50, and

sound barriers with an average of 4.43. In terms of the level of opinions on factors affecting the efficiency of information systems on the maintenance management of the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway, the study revealed that the sum of all aspects was at the highest level with a total mean of 4.56 (S.D. = 0.520). When considering each aspect, it revealed that the mean opinions with the most opinions were in the planning aspect and personnel management in operation with an average of 4.61, followed by reporting with an average of 4.58, coordination with an average of 4.56, budget with an average of 4.56, organization management with an average of 4.53, and administration with an average of 4.50. In terms of problems and suggestions on the information system efficiency for maintenance of the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway, it revealed that most of them had main problems in terms of maintenance and cost of traffic surfaces because there is the unclear set of repair cycles and it was checked when deterioration occurs; therefore, it causes serious problems such as road accidents. Suggestions to solve the problem should develop an efficient information system in which the information system is considered a storage process, collecting available information into the form of the most useful news by people and information technology in the process to be a conclusion used to support make a person's decision to be suitable for work or activities. It also includes the maintenance of the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway, which will be able to assess and predict the age of traffic routes before serious problems arise including increasing the frequency of maintenance and improvement of the Chalerm Maha Nakhon Expressway and Chalong Rat Expressway to be a tool for quality work.

Keywords: Information system, maintenance, administrative management, Chalerm Mahanakorn Expressway, Chalong Rat Expressway

Introduction

From the vision of the Expressway Authority of Thailand (EXAT), it is an agency that focuses on expressway development to serve the people who use the expressway with good and cost-effective, convenient, fast, safe, and sustainable services by striving to solve traffic problems in Bangkok and its vicinity according to their roles and responsibilities assigned under the policies of the government and the Ministry of Transport (Expressway Authority of Thailand, 2022). System development of information technology and application infrastructure within the organization is very important to the strength and stability of the work system in the organization. It can be compared to a change in the organization's system. Such changes must be done on a directional and continuous process of system development both in terms of developing

work systems in accordance with technology and the use of technology to develop the work systems (Sanan, 2010). The utilization of the information system can be considered one way that can be utilized to manage data in modern times. In addition, traffic problems in Bangkok are regarded as a big problem due to poor management of urban planning. The increase in population and employment has led to more travel. The addition of roads cannot keep up with the demand for roads, resulting in continual traffic jams. Caused by investment in increasing road potential is not suitable and makes the road network to be inefficient (Ekasit, 2010). In addition, there is a lack of promotion and development of public bus service efficiency and a lack of demand control in using the car on the road including the lack of effective control of land use and development.

The Chalerm Mahanakorn Expressway or the First Stage Expressway System is the first expressway in Thailand constructed and opened for service on October 29, 1981, by the Expressway Authority of Thailand. It is an expressway that connects transportation between different parts of the country without having to travel through heavy traffic in the heart of Bangkok. It helps to reduce the amount of traffic congested on the road at ground level including helping to transport goods between Klong Toey Port and other regions to be convenient and fast with a total distance of 27.1 kilometers (Expressway Authority of Thailand, 2022).

The Chalong Rat Expressway opened for service on October 6, 1996, with the objective of a construction project to solve travel problems and lighten the traffic on Raminthra Road and the downtown area without going through the roads with traffic jams, namely Ladprao Road, Rama 9 Road, Phetchaburi Road, and helping to relieve traffic on the Chalerm Mahanakorn Expressway for those who are traveling in or out of the city. It also expands the scope of the expressway to facilitate and speed up traffic more efficiently. The route starts from Ram Inthra - At Narong Road, with a distance of 18.7 kilometers (Expressway Authority of Thailand, 2022).

The Highway Maintenance Division of the Expressway Authority of Thailand has its main duty to maintain the pavement and various equipment on the expressways, setting a budget to prepare an appropriate expressway maintenance plan. It includes developing a database system to be used for management, supervision, maintenance, and analysis to consider making road maintenance plans to be effective. Therefore, the researcher is interested in studying the evaluation of information system efficiency for the maintenance of the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway. The objectives were to study 1) characteristics of basic personal, economic, and social data; 2) management performance of the Chalerm Mahanakorn Expressway; 3) Factors affecting the efficiency of the information system on the maintenance management of the Chalerm Mahanakorn Expressway, and 4) problems, obstacles,

and suggestions concerning the maintenance of the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway to use the results from this study as a guideline for system development and to improve the operational efficiency of the Highway Maintenance Division of the Expressway Authority of Thailand in the future.

Equipment and Methods/ Research Methods

It is mixed methods research (quantitative and qualitative) to study the evaluation of information system efficiency for the maintenance of the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway. The sample group used in the study was the 23 staff who used the information system for the maintenance of the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway completed the SAP training course and currently still use geographic information system (GIS) for the maintenance. This research was conducted from February 2012 to February 2023.

Data Collection

Data sources collected for use in research can be divided into two types: 1) Secondary data which is a compilation of information from documents, research reports, the study of concepts, theories, and related research; and 2) primary data by using semi-structured interviews as tools for collecting research data which the researcher formulated by researching from textbooks, books, and related research along with seeking advice from Principal Advisor, Co-advisor, and research experts consisted of four parts: Part 1: Basic personal, economic and social status of the respondents using closed-ended questions and open-ended questions; Part 2: Current management of Highway Maintenance Division of the Chalerm Mahanakorn Expressway Maintenance Work and the Chalong Rat Expressway by using Gulick & Urwick's modern organizational and management theoretical framework to study opinions and analyze the management of the Highway Maintenance Division of the Expressway Authority of Thailand Thailand today; Part 3: Factors Affecting the Efficiency of Information Systems on the Management of Maintenance Work of the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway based on the concept of organizational management of McKinsey's 7s Framework to study the opinions and determine management development guidelines; and Part 4: information about problems, obstacles and suggestions of respondents about Maintenance work of the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway with the open-ended questions.

Data Analysis

This research used a ready-made statistical program for the analysis of social science research. The analysis of statistical data was divided as follows: 1) basic personal status

economic and social of respondents by using descriptive statistics: Percentage, Mean, and Standard Deviation. 2) Analysis of current management data of the Highway Maintenance Division of the Chalerm Mahanakorn Expressway and the Chalongrat Expressway consists of three aspects: maintenance and cost of traffic surface, sound barrier work, and traffic guidance signs, a total of 21 items, and 3) data analysis on the efficiency of the information system on the management of the expressway maintenance work of the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway consist of seven aspects, namely planning, organization, personnel management, administration, coordination, reporting and budgeting which is divided into three different aspects, namely maintenance and the cost of the traffic surface, sound barrier work and traffic guidance signs, a total of 105 items. They were used to assess the level of data analysis in terms of management and efficiency of information systems for the management of the maintenance of the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway applied from Likert's scale by setting the scores as follows: Level 5: the mean of 4.21 - 5.00 means the highest opinion level. Level 4: the mean of 3.41 - 4.20. means a high opinion level. Level 3: the mean of 2.61 - 3.40 means a moderate opinion level. Level 2: the mean of 1.81 - 2.60. means low opinion level. Level 1: the mean of 1.00 – 1.80 means the lowest opinion level.

Research Results and Discussions

Basic personal, economic, and social status of the respondents

The results of the study showed that most of the respondents were male (87%), aged between 25-40 years old (78.3%). Most of them received a Bachelor's degree (73.9%), positions responsible for maintenance officers of the Chalerm Mahanakorn Expressway (56.5%), and positions responsible for maintenance officers of the Chalong Rat Expressway (30.4%). The average working period was 5-10 years (56.6%) with an average income of 25,001 - 35,000 baht (39.1%). The frequency of using information systems in work is used every day (87%) because it is convenient, fast, and efficient (60.9%).

Current management of the Highway Maintenance Division of the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway Maintenance

The results of the study showed that the sum of all aspects was at the highest level with a total mean of 4.49 (S.D. = 0.591). When considering each aspect, it revealed that the respondents had the most average opinion in terms of traffic guidance signs with an average of 4.55 (S.D.=0.596), followed by maintenance and the cost of traffic surfaces with an average of 4.50 (S.D.=0.583), and sound barriers with an average of 4.43 (S.D.=0.593), respectively, which was the highest level of agreement in all aspects (as shown in Table 1). The study showed that the

respondents agreed with the management issues of the Highway Maintenance Division of the Chalerm Mahanakorn Expressway Maintenance Work and the Chalong Rat Expressway in every aspect equally, which had three issues: the work of traffic guidance signs, maintenance and cost of traffic surfaces, and sound barrier work. Geographic Information Systems (GIS) are used in operations that can be used for planning, surveying, and solving problems quickly and easily. In addition, the information system has been applied to the current management of the Highway Maintenance Division of the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway maintenance works, such as establishing an organizational structure, Personnel allocation control, and orders of the executives. This makes the operation of the Highway Maintenance Division of the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway maintenance works continue with convenience, speed, and being able to solve problems on the spot and on time. In addition, using information systems in management keeps executives and personnel informed of the results of various job movement reports thoroughly. This is consistent with the study of Rewadee Makhunthod (2009) found that the development of the system provides personnel information that covers all five frameworks to meet the needs of users. Completely correct processing is fast and up-to-date, but still face problems in terms of implementing the system for maintenance and inspecting the system. In the second cycle, the development strategies namely supervision, monitoring, and follow-up to assist, recommend, add, correct, and improve the use of the program revealed that the participants have the knowledge and understanding of skills, techniques, and methods in computer use and the use of personnel information system programs which be able to process required information accurately and suitable for needs. This is also consistent with the study of Suchada Kiranan (1998), who revealed that currently, the relationship between the organization and the information system and information technology is more clearly seen because the management in the organization has many levels. The activities of different types of organizations may be different, so the information systems of different organizations may be categorized differently. This research also supports the study of Songsiri Tohlieng (2017), who found that the engineering team responsible for bringing the geographic information system to manage and analyze the data so that information is effective both in the storage and deployment aspects that can be prioritized to resolve problems. The researcher started the process by defining the problem and studying basic information by asking operators about the steps in the work and various problems encountered, then collecting data to be analyzed and writing a workflow to know the elements and steps in the work to analyze the root cause of the problem.

Table 1 Mean, Standard Deviation, and the opinion level of the respondents towards the Current management of the Highway Maintenance Division of the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway Maintenance

Management Issues of the Highway Maintenance Division of the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway Maintenance			
	\bar{X}	S.D.	Opinion Level
1. Maintenance and the cost of traffic surfaces	4.50	0.583	Highest level
2. Sound barriers	4.43	0.593	Highest level
3. Traffic guidance signs	4.55	0.596	Highest level
Total	4.49	0.591	Highest level

Factors Affecting Efficiency of Information System in the Management of Maintenance Works for the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway Maintenance

The study found that most of the respondents had opinions on factors affecting the efficiency of information systems in the management of maintenance works for the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway in all aspects at the highest agree level with a total mean of 4.56 (S.D. – 0.520). When considering each aspect, it revealed that the respondents had the most average opinions in the planning with an average of 4.61 (S.D.=0.611), the personnel management with an average of 4.61 (S.D.=0.485), the reporting with an average of 4.58 (S.D.=0.502), coordination with an average of 4.56 (S.D.=0.525), budget with an average of 4.56 (S.D.=0.505), organization management with an average of 4.53 (S.D.=0.502), and administration with an average of 4.50 (S.D. = 0.509), respectively (as shown in Table 2).

The results of the study showed that respondents gave their opinions on the factors affecting the efficiency of information systems in the management of maintenance works for the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway in all aspects equally. The factors affecting the management consisted of seven aspects, namely planning, organization management, personnel management, administration, coordination, reporting, and budget. Respondents commented on factors affecting management efficiency that various tasks are planned in a sequence of steps, such as setting guidelines before every operation before operation. There is a joint operation plan between executives and personnel. Moreover, there is a clear physical direction or objectives of the operation to ensure continuity of work including reducing redundant work and preventing future impacts. When the work is completed, there is an evaluation to analyze the management. The respondents suggested that the organization should divide the work according to expertise. Knowledge of personnel is developed regularly. There is a good working atmosphere, including the application of information systems in various fields.

All resulted in management being more efficient. In terms of directing, respondents suggested communication systems and network building are organized using various aspects of information. There is coordination between executives and personnel resulting in good human relations. This is important for the management of expressway maintenance works. In the coordination of various tasks, it is important in driving operations including solving problems quickly. The respondents believed that it was a duty that everyone had to jointly perform to achieve efficient operations. In addition, the use of information joined with coordination will create an understanding of various tasks easily, making it possible to know the progress of work. But respondents disagree with coordination by communicating with only individual executives. There should be coordination with all relevant sectors to make management efficient. In terms of reporting, the respondents viewed that they should report the progress of their work regularly to apply the performance to the management of expressway maintenance work by using the information for reporting, which is the most convenient, fast, and realization by providing accurate information and timely information, it will lead to effective management. On the last aspect about the budget, the respondents commented that the use of information in various fields is a budget saving in the organization which is important in the management including budgeting planning. This allows the executives to make clear operational decisions and can control the budget to avoid surplus and use resources to operate according to the specified policy. This is consistent with the study of Ekamon Iamsri (2011), which revealed that the organization of seven educational guidelines for internal audit requires proximity (no gaps between departmental corners or groups that are far apart) within the organization to be successful. The 7s McKinsey concept can be applied within the organization in a variety of situations, such as improving the performance of the company, examining factors of trends that may change the company in the future, organizing the necessary departments and processes to be merged or dissolved, and determining how best to implement the presentation strategy. The 7s McKinsey concept deals with the seven factors of interdependence. They are divided into both “hard and heavy” and “humble” within an organization. “hard and heavy” elements consist of strategy, structure, and system. “Hard and heavy” elements are easier to define or identify how to manage them directly and influence them, and these strategies require organizational charts and a formal chain of command and processes and information systems to support them. The “Humble” element includes shared values, skills/ experience, style, and employees. The “Humble” element is difficult to describe and has little identity influencing the overall organizational culture in which the “Humble” element is very important to any organization that wants to be successful. It is also consistent with the study of Kannika Sittichai and Santidhorn Pooripakdee (2018), who found that private companies have their management and operation including various activities that

contribute to innovation organization in all factors both in Hard S's (compares to hardware) and Soft S's (compares to software). Hard S's is the company structure which is plane. It causes high flexibility for working, emphasizes expressing opinions, and enables direct approval rapidly. Soft S's chief executive style, uses a participative management model to establish sustainable organization by emphasizing team building and giving priority to innovation creation. In addition, it is always a role model for employees.

Table 2 Mean and Standard Deviation and the opinion level of the respondents about factors affecting the efficiency of the information system on the management of maintenance works for the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway

Factors affecting the efficiency of the information system on the management of maintenance works for the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway	\bar{X}	S.D.	Opinion level
1. Planning	4.61	0.611	Highest level
2. Organization management	4.53	0.502	Highest level
3. Personnel management	4.61	0.485	Highest level
4. Administration	4.50	0.509	Highest level
5. Coordination	4.56	0.525	Highest level
6. Reporting	4.58	0.502	Highest level
7. Budget	4.56	0.505	Highest level
Total	4.56	0.520	Highest level

Problems, obstacles, and suggestions of the respondents about the maintenance works of the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway

The study results of problems, obstacles, and suggestions about the effectiveness of information systems on the management of maintenance works of the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway found that the respondents faced the main problems related to maintenance and cost of traffic surfaces due to unclear repair cycles and will check when deterioration occurs. As a result, there are serious problems such as road accidents. For Geographic Information Systems (GIS), it revealed that the map displayed in the system is unclear and difficult to use. Therefore, the problem could not be solved quickly. In terms of obstacles to the maintenance system of the Chalerm Mahanakorn Expressway and the Chalongrat Expressway, most of them are related to the use of the budget, which causes waste of the budget for repairs in various fields including wasting human resources with redundant operations. Several respondents gave suggestions on the development of information systems for maintenance work systems of the Chalerm Mahanakorn Expressway and the Chalong Rat

Expressway that information systems should be developed to be more efficient which will be able to assess and predict the age of traffic routes, both Chalerm Maha Nakhon Expressway and Chalong Rat Expressway before serious problems can occur including the frequency of maintenance and improvement of the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway should be increased.

This includes the development of the sustainability of the information system about the maintenance of the expressway in three aspects: 1) Knowledge and understanding of system users by organizing training for employees who are responsible for and are the main functions of the information system. The EXAT has developed a policy and plan to become a learning organization to promote Knowledge Management by transferring tacit knowledge in the form of information of explicit knowledge that can enter and apply knowledge to lead to innovation and develop knowledge and abilities in information and communication technology to comply with the policy of the government in the Thailand 4.0 era by improving the administration system and government services to be modern by using computer and communication technology (Expressway Authority of Thailand, 2019). This is consistent with Phat (2018) who stated that human resource development through innovation is the result of linking human resources, financial capital, and infrastructure including research and development to create an innovation ecosystem on technology-based projects. It is a guideline to lead the country out of the middle-income country trap. 2) The form of the packaged program of the geographic information system must be able to show the damage to data storage, and image processing, and be able to propose a database of maintenance plans of the traffic surface in the form of geographic information (GIS) (Uruya, 2019). They must also be able to disseminate information to responsible officers to find solutions accordingly. 3) Hardware or computer: purchasing computer materials that are regarded as the main work equipment capable of collecting data, analyzing, and processing data, must consider the efficiency that is suitable for the information system work to be a tool for quality work.

Conclusion

The study on the evaluation of information system efficiency for the maintenance of the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway found that the respondents expressed their opinion towards the current management of the Highway Maintenance Division of the Maintenance works for the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway overall was at the highest level with a total mean of 4.49. When considering each aspect, it revealed that the respondents had the most average opinion in terms of traffic guidance signs with an average of 4.55, followed by maintenance and the cost of traffic surfaces with an

average of 4.50, and sound barriers with an average of 4.43, respectively. The efficiency of information systems in the maintenance works management for the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway in all aspects are at the highest agree level with a total mean of 4.56. When considering each aspect, it revealed that the respondents had the most average opinions in planning with an average of 4.61, personnel management with an average of 4.61, reporting with an average of 4.58, coordination with an average of 4.56, budget with an average of 4.56, organization management with an average of 4.53, and administration with an average of 4.50, respectively. The problems, obstacles, and suggestions about the effectiveness of information systems on the management of maintenance works of the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway found that the respondents faced the main problems related to maintenance and cost of traffic surfaces due to unclear repair cycles and will check when deterioration occurs. As a result, there are serious problems such as road accidents. Suggestions to solve the problem should develop an efficient information system that can assess and predict the age of traffic routes before serious problems and increase the frequency of maintenance and improvement of the Chalerm Mahanakorn Expressway and the Chalong Rat Expressway.

Recommendations

The results of the study indicated that to increase the efficiency of the use of information systems for the management of the highway maintenance division of expressway maintenance work, promotion officers, or relevant agencies should pay attention to the following issues:

1. Knowledge promotion for executives/ officers about the use of information systems to control the maintenance work and the cost of the traffic surface, the sound barrier, and the work of traffic guidance signs continually, for example, geographic information system (GIS) training, so that personnel in each position have more knowledge. If when experiencing a shortage of personnel to solve that problem, personnel in other positions will be able to help solve immediate problems and can also resolve the situation to prevent it from becoming more violent as well as promoting awareness or encourage personnel to love and be proud of their profession for the organization to operate efficiently.

2. Promoting coordination through information systems creates awareness of problems, and obstacles, including suggestions for assistance when there are special problems by reporting the movement of operations or reporting when the situation has been resolved to the commander. The coordination through the information system will reduce redundancy including reducing operational costs in various aspects.

3. Support and direct operations in various areas such as building good human relations between the organization and personnel, or executives with organizations with joint activities such as planning operations, troubleshooting, and decision-making authority are assigned to personnel responsible for the job for personnel feeling of pride in one's position and duties.

Acknowledgment

The researcher would like to thank the staff who use information systems for the maintenance works of Chalerm Mahanakorn Expressway and Chalong Rat Expressway, including teachers and personnel of Resources Management and Development, Faculty of Agricultural Production, Maejo University, for information, advice, and support in this research.

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