

The Improvement of Healthcare Management in Thailand via IE Tools: A Survey

Chawis Boonmee

Department of Industrial Engineering,
Chiang Mai University
Chiang Mai, Thailand
golf.chawis@gmail.com

Chompoonoot Kasemset

Department of Industrial Engineering,
Chiang Mai University
Chiang Mai, Thailand
chompoonoot.kasemset@cmu.ac.th

Abstract

Healthcare management is becoming a significant issue in the world scale due to the increasing demand in the healthcare section. Many countries endeavor to improve and develop their healthcare system in order to support those demands. Thailand is a country that also aims to develop the healthcare system to the world class. Many techniques and tools are applied for improving healthcare management in Thailand including IE tools. According to the importance of IE tools associated with healthcare management, this study aims to propose a survey of research work on the improvement of healthcare management in Thailand based on using IE tools. The survey will examine the improvement of healthcare management in Thailand based on IE tool type in the literature review. Moreover, for each research, operational level and system level of the healthcare system will be evaluated and then case studies will then be presented. Finally, research gaps will be identified and be addressed in further research studies to develop more effective healthcare management in Thailand.

Keywords

Healthcare management, Improvement, IE tools, Survey, and Thailand

1. Introduction

Healthcare management or healthcare administration is the management or administration of healthcare systems, public health systems, hospitals, whole hospital networks including other medical facilities. The healthcare management aims to ensure that individual sections run smoothly and efficiently, qualified employees are hired, information is disseminated efficiently throughout the organization or network, specific outcomes are reached, and resources are used efficiently, among many other responsibilities. Recently, the healthcare management has enormous demand since it can assist in managing a hospital and related medical facilities. The scope of healthcare management system is increasing by each day in the world. The solutions of healthcare management are more than one factor that leads to the increasing demand in the healthcare section. The solutions are not only related to management in healthcare system but also related to healthcare services, health policies and enhancement in the demand for world-class healthcare facilities in healthcare management as well. Nowadays, Healthcare management is still undergoing from the inefficient operation. Many hospitals and other medical facilities urgently need to improve their processes and services. However, redesign projects in healthcare management systems have often been unsuccessful.

The healthcare management in Thailand is also suffering from inefficient operation including operational level and system level. Many researchers aim to focus on this point and try to improve and develop the healthcare management system in Thailand. Many tools are proposed to improve several problems in this field such as inventory, material flow, information flow, transportation, service management, etc. Industrial Engineering (IE) tools is a major tool that

can apply to enhance in healthcare management system. Several IE tools have employed in healthcare management such as Lean concept, Plant layout design, Supply chain, simulation, etc. Since IE tools quite influence to the enhancement of healthcare management in several sections of the hospital network and other medical facilities. Moreover, the survey on the improvement of healthcare management in Thailand based on using IE tools is lacking. Therefore, this study aims to propose a survey on the improvement of healthcare management in Thailand via IE tools. This study will be done not only to conduct a survey of existing researches but also present future research possibilities for healthcare management in Thailand via IE tools as well.

The remainder of this study is organized as follows: Section 2 presents the background of healthcare management in Thailand and IE tools. Section 3 presents review of related works. Section 4 presents future research direction. Finally, a conclusion is given in Section 5.

2. Background

2.1 Healthcare management in Thailand

Thailand is one of developing countries that endeavor to develop several sectors including healthcare system. Healthcare system in Thailand is the entrepreneurial market-driven system. It has a pluralistic public/private mix in healthcare providers and financing agencies. Most of the healthcare services are provided by public healthcare providers. The Ministry of Public Health (MoPH) is in charge of public healthcare services, government hospitals, and medical services. The public healthcare facilities are supposed by the government in which mainly budget is obtained from the government. The public healthcare facilities are allowed to keep a revenue from their services for operating business. Currently, more than 900 hospitals belong to the MoPH (CPIRD 2017). The public hospitals cover more than 90% of districts which cover every sub-district, Tambon (Sakunphanit 2015). Public hospitals have a relatively excellent standard of care and the majority of Thai nationals use these facilities. However, lines can be long, equipment is sometimes old and outdated, and the service is quite slow and complicated. For this reason, private healthcare is generally recommended for expats. Private hospitals have increased since economic expansion during 1992-1997. Nowadays, there are more than 300 private hospital and more than 15,000 private clinics in Thailand (NSO 2012). Although the healthcare system in Thailand has a high standard, it still needs to develop and enhance for more efficiency. Several problems were found and some problems have not solved yet. There are various problems such as inefficient pharmacy inventory, complicated information flow, long line service, complicated communication, low technology, complicated operation, inefficiency procurement, etc. Currently, many researchers are enhancing and developing all those points by using many tools and methods.

2.2 IE Tools

Many tools have applied to healthcare management system. IE tools are primarily concerned with the analysis, improvement, design, and control of production, service, and distribution systems. IE tools apply skill and knowledge in mathematical, physical, and social science including the principles and methods of engineering analysis and design, to specify, predict, and evaluate the result to be obtained from such systems. IE tool can be employed in not only manufacturing but also hospitals, retailing, government agencies, research organizations, and consulting firms. IE tool is a tool that can be employed in healthcare management efficiently. Many existing researches have employed IE tools in many sections in the healthcare management system including healthcare provider, medical facilities, hospital, and hospital network. There are many IE tools that can apply in this field for improving and developing healthcare system. In this section, we brief an overview of example IE tools that usually employ in healthcare management. The details of IE tools are presented as follows:

Lean: The system focused on pinpointing the major sources of waste or non-value-added, and then using tools such as JIT, production smoothing, setup reduction, and others to eliminate the waste and non-value-added activity (Abdulmalek et al. 2007).

Value Stream Mapping (VSM): Process of mapping the primary material and information flows in converting raw material to the finished product or creating a service of value that a customer is willing to pay for (Martin 2013).

Integration Definition for Function Modelling (IDFE0): Method designed to model the decisions, actions and activities of an organization or system in which the IDEF0 definition of a function is “a set of activities that takes

certain inputs and, by means of some mechanism, and subject to certain controls, transforms the inputs into outputs” (Kritchanchai and Suwandechochai 2010).

Simulation: The process of creating and analyzing a digital prototype of a physical model to predict its performance in the real world under the different conditions. The tool is used to design new manufacturing systems and to improve the performance of existing ones. This tool can help engineers understand whether, under different conditions (Law 1998).

Plant layout design: A plan of an optimum arrangement of facilities including personnel, operating equipment, storage space, material handling, equipment, and all other supporting services along with the design of the best structure to contain all the facilities. Moreover, it involves proper space allocation, and the arrangement of equipment to ensure that the overall operating costs or times are minimized. (Kumar 2013)

Inventory control model: A set of policies that monitors and controls inventory. It determines the optimum level of inventories that should be kept, manages the frequency of ordering, decides on the quantity of materials to be stored and tracks the flow of supply of materials to customers without any delay in delivery (Laeiddee 2010).

Six Sigma approach: A management approach to enhance the organization’s products, processes, and services in which this approach aims to reduce defects in the system. It is a business strategy that focuses on improving several perspectives such as business systems, productivity, and financial performance. This approach usually integrates with the knowledge of statistics, engineering, and project management (Kwak and Anbari 2006).

Not only the proposed IE tools but also other IE tools can be applied to the improvement of healthcare management. The interested readers are referred to one of the many books on industrial engineering for more details.

3. Review of related works

In this section, the improvement of healthcare management in Thailand via IE tools is examined. To develop the literature database, the healthcare management in Thailand via IE tools were searched for in journals, conference proceedings, and dissertations and then classified according to the application of IE tools as well as operation and system level. Finally, the case study was reviewed. Journal search engines were interrogated using “improvement,” “healthcare,” “management,” “Thailand,” “IE tools,” and “case study” as the key search strings. Further, the references in each paper, including dissertations and conference proceedings, were scrutinized to reveal any additional relevant papers. Most articles identified in the literature search come from a range of journals: International Journal of Healthcare Management, Industrial Engineering & Management System, Thai Association of Radiation System, Operations and Supply Chain Management: An International Journal, International Journal of Supply Chain Management, International Journal of Services, Economics and Management, Supply Chain Management Forum: An International Journal, Therapeutic Innovation & Regulatory Science, Medical Journal of Medical Association of Thailand, Computer & Industrial Engineering, and Journal of Information Science and Technology.

3.1 Application of IE Tools

The application of IE tools for healthcare management is becoming an issue of great interest on a global scale. Many countries have been employed the IE tools in healthcare system such as Lean concept (Rosso and Saurin, 2018), Six Sigma (Venkatadri et al., 2011), Optimization (Zeinali et al., 2015), Simulation (Kovalchuk et al., 2018; Vahdat et al., 2018), Pull system (Tiwari and Sandberg, 2016), layout design (Vahdatzad and Griffin, 2016) etc. For instance, Grida and Zeid (2018) proposed the Theory of Constraints (TOC) and System Dynamic (SD) in order to improve the operational system of a typical medium-sized hospital in Egypt. The results found that a 6% improvement in the system output and 30% decrease in the waiting list can be achieved without any resource elevation. Moreover, Hicks et al. (2015) proposed the application of the Lean 3P (production, preparation, process) participative design method for implementing operation and facilities of a hospital in England. In Thailand, many IE tools have been promoted for improving and developing the healthcare system including public medical facilities and private medical facility. There are many researchers aims to apply IE tools in several segments of hospitals and medical facilities. After we collected the papers, we classified the existing researches based on the IE tool in which it was presented in Figure 1 and Table 1. Among of literature reviews, Lean concept and Simulation technique are majority tools in the healthcare system in Thailand. Khunngio (2012) presented an improvement of the service efficiency by using the Lean concept in order to reduce service time for patients in the emergency care unit. This study could decrease the average service time at 21.29%. Similarly, Wanlopworakit (2012) proposed the effectiveness of applying Lean theory for the out-patient

nursing service system in which the objectives of this study aimed to compare procedures and process time of outpatient nursing services before and after applying Lean theory and to study the satisfaction of patients and nurses on nursing services after applying Lean theory. The results found that this study could reduce process time at 20.78% as well as the patients and nurses ranked the satisfaction at the high levels as well. The lean theory is one technique that can be combined with many tools. Almost studies usually merge lean theory with Six Sigma technique. Wiboonrat (2011) presented the applying Lean Six Sigma for public healthcare services. This research aims to develop service operations improvement in term of speed, accuracy, availability, and quality of electronic medical records (EMR). Likewise, Worawong (2012) studied the manufacturing development process of cytotoxic drug admixtures by using Lean and Six Sigma techniques. After using Lean and Six Sigma techniques, 38.03% of the average time of manufacturing cytotoxic drugs was reduced as well as 70.5% of the number of patients who received the cytotoxic drug admixture was increased. The other major IE tool is a simulation theory. The simulation is employed in many researches in which it will be used to simulate the situation of the process. After Khunngio (2012) improved the service efficiency by using Lean concept, Simulation technique was used to analyze the performance between before and after the improvement. Various published research studies have proposed that Simulation technique is able to be applied to healthcare management in Thailand such as those of Kosayanon et al. (2018), Kritchanchai and Hoer (2017), Khunngio (2012), Chanpuypetch and Kritchan-chai (2017), and Chanpuypetch and Kritchanchai (2018).

To enhance and develop an inventory in the healthcare system, Inventory control model is usually employed in this field. Thongsukdee (2009) proposed inventory control model with the lean concept in order to develop system dynamic modeling for environmental impact assessment based on Green SCOR principle in hospital. The result found that the EF could be reduced by 47%. Not only the inventory control model but also ABC classification and VEN (Vital, Essential, Non-essential) Classification are able to enhance the performance of inventory management in the healthcare system. Kritchanchai and Meesamut (2015) studied inventory management of drug in hospital. The Economic Ordering Quantity (EOQ) was used in this study for calculating the holding cost and the ordering cost. In addition, they also applied ABC and VEN classification in order to propose the new inventory management policy. Owing to their proposed improvement, the number of shortages could be decreased as much as 92.98%, Also, the total inventory cost could be decreased by 14.63%. Laeiddee (2010) presented the improvement of re-order point for drug inventory management. The (s, S) inventory control model was employed in order to find out a suitable re-order point while Activity-Based Costing (ABC) was used to analyze activity and cost of drug purchasing and inventory management. The other related studies for inventory was proposed by Chanchai (2001) and Chungsiwapornpong (2007).

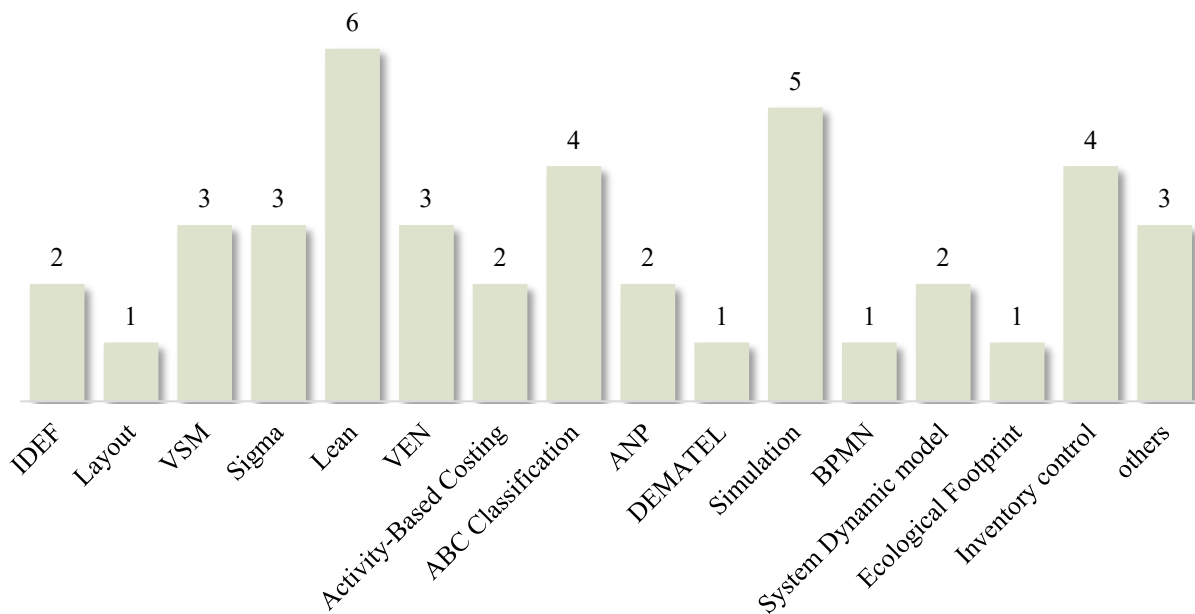


Figure 1. The review of IE tools for improving healthcare management in Thailand

Besides the improvement, an analysis and an evaluation of the operations, processes, and services in the healthcare system are also essential. There are several IE tools can analyze and evaluate the performance of the operating system including processes and services. Wiboonrat (2011) proposed Value Stream Mapping (VSM) to analyze the performance and to identify the waste or non-value-added activity in public healthcare services. Similarly, Worawong (2012) and Khunngio (2012) employed VSM in their researches. For other tools, Meungsu et al. (2012) presented the Integration Definition for Function Modelling (IDFE0) for illustrating the flow of material and information on the medicine supply chain in hospitals. The same research is proposed by Kritchanhai and Suwandechochai (2010). Not only VSM and IDFE0 but also system dynamic model can be applied. Thongsukdee (2009) and Tepjit (2006) applied a system dynamic model for simulating the behaviors of the hospital system that consists of appointment systems, medical units, and outpatient department (OPD). The other research that applied the system dynamic model is Thongsukdee (2009).

Table 1. The classification of existing researches based on IE tool types in healthcare management in Thailand

Studies	IDEF	Layout	VSM	Sigma	Lean	VEN	Activity-Based Costing	ABC Classification	ANP	DEMATEL	Simulation	BPMN	System Dynamic model	Ecological Footprint	Inventory control	others
Chanchai (2007)								*								*
Chanpuypetch and Kritchanhai (2017)											*					
Chanpuypetch and Kritchanhai (2018)											*	*				
Chungsiwapornpong (2007)						*	*									
Khunngio (2012)			*		*			*			*					
Kosayanon et al. (2018)											*					
Kritchanhai (2012)									*							
Kritchanhai (2012)																*
Kritchanhai and Hoeur (2017)		*									*					
Kritchanhai and Meesamut (2015)						*		*							*	
Kritchanhai and Suwandechochai (2010)	*					*		*								
Laciddee (2010)							*								*	
Meungsu et al. (2012)	*															
Muangchoo and Kritchanhai (2015)																*
Sooksriwong and Bussaparock (2009)																*
Supeekit et al. (2016)									*	*						
Tepjit (2006)				*	*								*			
Thongsukdee (2009)					*								*	*	*	
Wanlopworakit (2012)					*											
Wiboonrat (2011)			*	*	*											
Worawong (2012)			*	*	*											

Other IE tools that have applied and succeeded in the improvement of healthcare management in Thailand are Plant Layout (Kritchanchai and Hoeur 2017), Analytic Network Process (ANP) (Kritchanchai et al. 2017), DEMATEL (Supeekit et al. 2016), and BPMN (Chanpuypetch and Kritchanchai 2018).

3.2 Operational level and System Level

The healthcare management system can be separated into two levels; operational level and system level. The operational level is the management of operation sectors in healthcare system including inventory, transportation, queueing and capacity planning. While the system level is the management of information or data in the healthcare system that can be divided into two sections; product data and fragmented system (Kritchanchai and Kritchanchai 2016). According to the existing researches on healthcare management in Thailand, the researchers quite focused on an operational level. Among of literature reviews in operational level, 11 papers aimed to focus on inventory and 10 papers emphasized the capacity planning. While transportation and queueing were done as 6 papers. On the other hand, the study on the system level is less popular than the operational level. Currently, there were few researches in this perspective. The researches of system level aim focus on applying IT technology in order to improve and develop the information network including drug information, patient information, etc. (Kritchanchai and Suwandechochai 2010; Muangchoo and Kritchanchai 2015; Kritchanchai 2012). The classification data of operational level and system level was presented in Figure 2.

A typical healthcare system network or healthcare supply chain is a complex network consisting of many different parties at various stages of the network. According to Rossetti (2008), there are four major types of players in the healthcare network that consists of manufacturers, distributors, healthcare providers, and consumers. In accordance with the existing research, we classified the existing researches into four major types of players that shown in Figure 3. The result found that the healthcare provider is more popular than the other players, while consumer and logistics distributor are the second and the third, respectively. Only manufacturer is a player that no researcher focuses on this stage. Some studies determined many different players simultaneously in which it would be more beneficial (Chanpuypetch and Kritchanchai 2018; Kritchanchai 2012; Muangchoo and Kritchanchai 2015; and Kritchanchai 2012).

From the hospital perspective, the pattern of hospital operation management is able to be classified into three aspects that consist of the structure of nodes and links, information management, and material flow management (Kritchanchai, 2016). According to the categorization of existing researches in Thai hospital operations that shown in Figure 4, we found that most researches emphasized the structure of nodes and links and material flow management. Several IE tools were applied to both aspects for resource management and smooth workflow processes including patients and material (drug, medical supplies, medical supplies, etc.). In information management, 10 papers focused on this aspect in order to improve healthcare service and operations management information in the hospital. The drug information and patient information are the main topics in this perspective (Wanlopworakit 2012, Meungsu et al. 2012, and Chanpuypetch and Kritchanchai 2017).

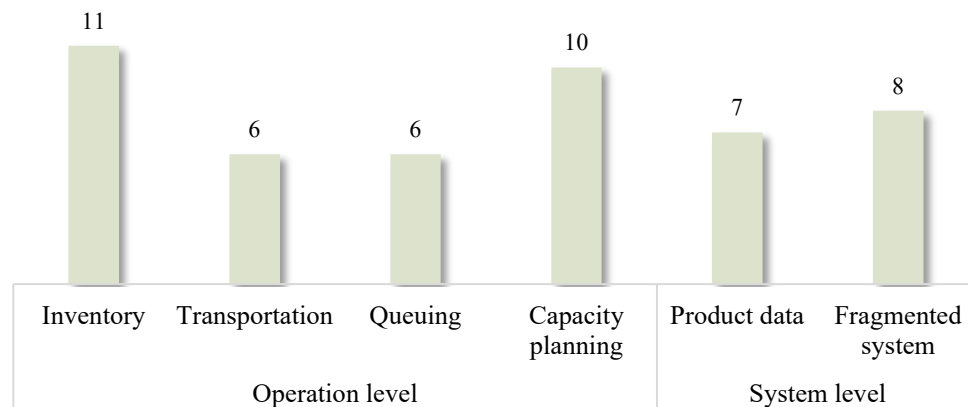


Figure 2. The review of the operational level and system level

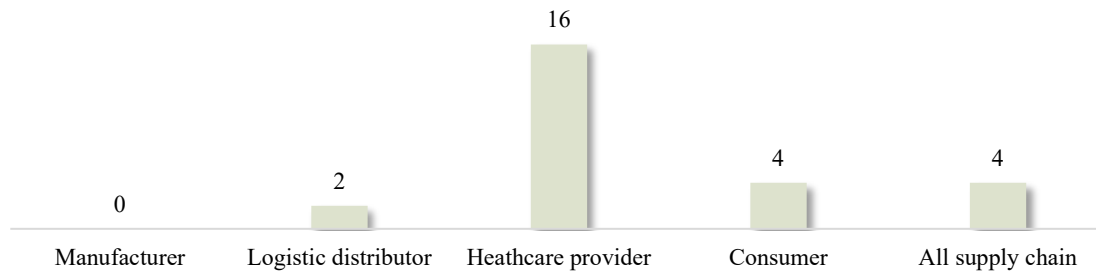


Figure 3. The review of players in the healthcare network

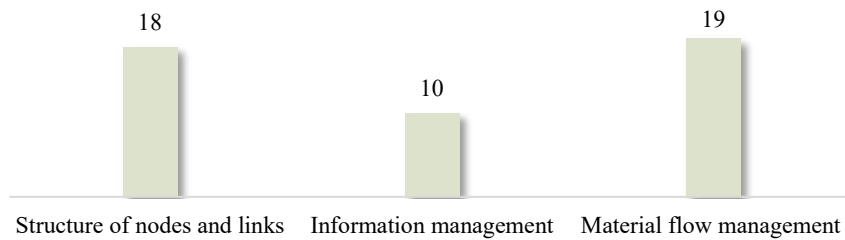


Figure 4. The review of hospital operation management

Table 2. The review of the case study and department type of research in healthcare management in Thailand

Studies	Case study	Department
Chanchai (2007)	Khon kaen hospital	Drug inventory
Chanpuypetch and Kritchanchai (2017)	15 hospitals in Thailand	Drug
Chanpuypetch and Kritchanchai (2018)	4 Thai hospitals	Drug
Chungsiwapornpong (2007)	720 hospitals in Thailand	Drug inventory
Khunngio (2012)	Srinakarin Hospital	Outpatients at the emergency unit
Kosayanon et al. (2018)	Maharaj Nakorn Chiang Mai Hospital	Radiotherapy service
Kritchanchai (2012)	A state-owned hospital	General
Kritchanchai and Hoer (2017)	University Hospital	Outpatient department
Kritchanchai and Meesamut (2015)	Public hospital in Bangkok	Drug inventory
Kritchanchai and Suwandechochai (2010)	N/A	Medicine inventory
Kritchanchai et al. (2017)	5 countries including Thailand	All supply
Laeiddee (2010)	Ramathibodi hospital	Drug inventory
Meungsu et al. (2012)	Ramathibodi, Srinakarin, and Songklanagarind hospital	Drug
Muangchoo and Kritchanchai (2015)	N/A	Drug information
Sooksriwong and Bussaparoek (2009)	720 hospitals in Thailand	Cold storage drugs
Supeekit et al. (2016)	General case	N/A
Tepjit (2006)	Siriraj hospital	Appointment systems, medical units, outpatient department
Thongsukdee (2009)	A private hospital	Drug inventory
Wanlopworakit (2012)	Prachuap Khiri Khan hospital	Outpatient department
Wiboonrat (2011)	6 public hospitals	All process
Worawong (2012)	Queen Sirikit Naval Hospital	The manufacturing development process of cytotoxic drug admixtures

3.3 Case study

Many case studies in Thailand were enhanced and developed. Not only hospitals but also the related medical facilities were researched. Table 2 presented the review of the case study and department type of research in healthcare management in Thailand. According to Table 2, the main case study was hospital since the hospital is the center of the healthcare network. Also, the drug department was the main department of research in Thailand in which those researches aim to focus on the drug flow, drug inventory management, and drug information. Not only the drug department but also the outpatient department, radiotherapy service department, appointment systems department, and medical units have done in the improvement of healthcare management in Thailand as well.

4. Future research direction

In future research, other IE tools could be employed in the improvement of healthcare management in Thailand. Many IE tools are lacking in publications. The framework of future research direction is presented in Figure 5. To analyze and control the problem in the healthcare system, 7 QC tools can be used in order to monitor the overall operation and continuous process improvement in healthcare management. Moreover, Material Flow Cost Accounting (MFCA) could apply to assess the physical material flows in the medical manufacturers. For the improvement of operational level, most existing researches is mainly considering a Lean technique for the improvement. The IE tools such as 5W-H questions, 5S, Kaizen, SWOT, Fuzzy logic, ECRS, motion and time study, flow process chart, swim lane diagram, cross function flowchart, Just In Time (JIT), line balancing technique, supply chain score model, pull and push system, Kanban card and trigger board are also able to apply or integrate to Lean concept. To manage and support the increasing demand, the forecasting technique could be applied for predicting the demand in each day. According to the classification of the operational level, we found that few researchers studied transportation and queueing. To support those problems, traveling salesman problem, vehicle routing problem, scheduling problem and milk run problem based on optimization technique can be applied for improving the transportation as well as queueing theory should be employed for supporting service or patient queue in hospitals. To select the suitable location for a distribution center or warehouse, optimization technique based on facility location problem and allocation problem or multiple criteria decision making (MCDM) can apply to this problem. Besides, an optimization technique is able to apply to the problem of constraints in beds and operating room in the hospital as well. In the system level in healthcare management, the information is quite important. However, few researchers emphasized on the information system. Therefore, the healthcare system in Thailand should more focus on information flow and database management including drug information, equipment information, resources information, producer information, patient information, purchasing information, inventory information.

Among four players of the healthcare network should be determined with respect to material flow and information flow simultaneously. The material flow consists of the drug, medical supply, medical devices, blood, food, money, Staff, and fabrics while information flow consists of drug information, producer information, patient information, purchasing information, inventory information, equipment information, and resources information. According to the literature review, we found that most of the researches in Thailand published their works on the healthcare provider in Thailand, while the work on the consumer and logistic distributor are few researches. Moreover, there is no research considering the medical manufacturer in Thailand. In order to develop the sustainable healthcare management, all healthcare supply chain network or all four players should be simultaneously determined. Presently, the public hospital is a main issue of the research in healthcare management in Thailand. Many researchers aim to focus on the drug department and outpatient department since there are a complicated process and uncertainty condition. Nevertheless, the other departments such as the inpatient service section, medical units, and the general support section should be studied and improved in order to become an efficient hospital.

Not only drug management and service management but also resource management and others material management including waste, medical supplies, medical devices, blood, food, money, Staff, and fabrics should be focused. The big data or machine learning should be applied to IE tool in order to support efficient management in macro scale. Currently, the healthcare management in Thailand is lacking the interconnection in the macro scale, hence the system should be enhanced by using an advanced technology such as QR code, RFID, Barcode, data matrix, etc. Not only IE tools but also other tools should be employed in this field in order to reach the sustainable development in healthcare management of Thailand.

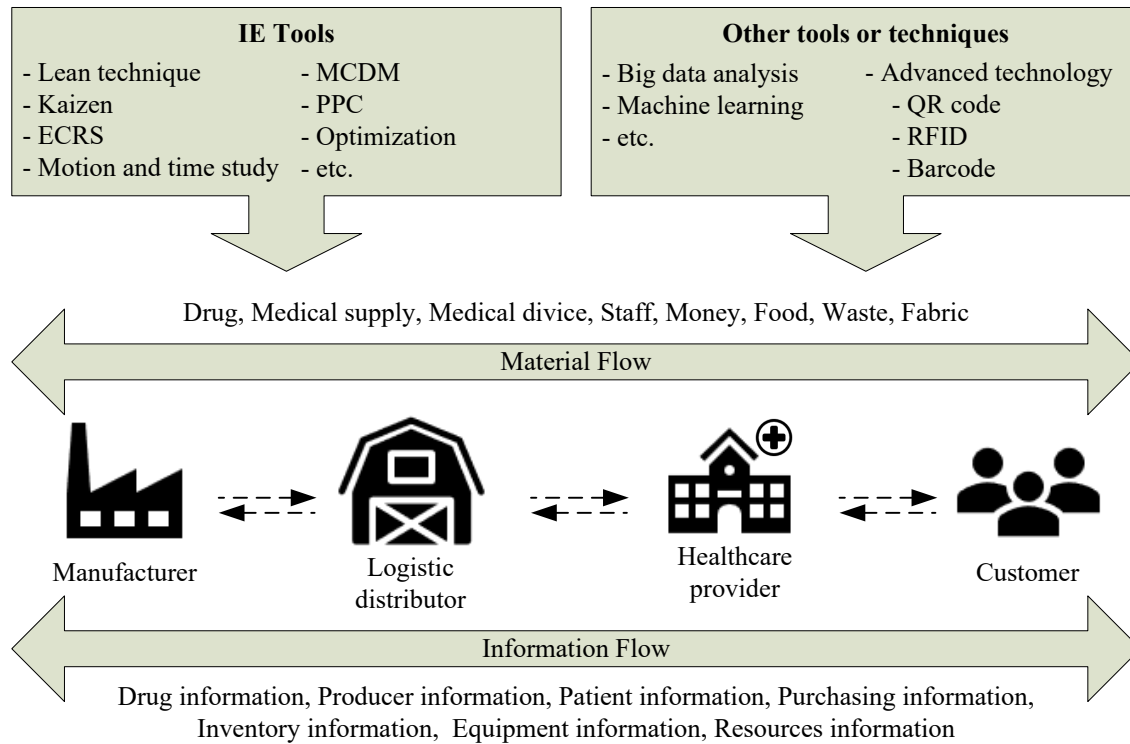


Figure 5. The framework of future research direction

5. Conclusions

This study proposed a survey on the improvement of healthcare management in Thailand based on using IE tools. The existing studies were reviewed and classified based on IE tool type, operational level, and system level, and case study. We found that the main IE tool that the researchers usually employ in the improvement of healthcare management in Thailand is a Lean concept. Not only Lean concept but also simulation, inventory control model, and ABC classification have been applied in this field as well. In operational level and system level, our literature survey found that most researchers published their works on the operation level in Thailand, while the works on the system level are few researches. In accordance with the case study of existing studies, most papers aimed to focus on a hospital in Thailand, especially public hospital. Also, we found that the drug department and outpatient department are the main department of research in Thailand. Finally, research gaps and future research were identified as assisting in developing future healthcare management.

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Biographies

Chawis Boonmee earned B.Eng. degree in Industrial Engineering from Chiang Mai University in 2012, M.Eng. degree in Industrial Engineering from Chiang Mai University in 2015 and D.Eng. in Division of Engineering from Muroran Institute of Technology in 2018. He interested in the field of industrial engineering including optimization, operation & supply chain management, simulation application in production management, decision making, Material Flow Cost Accounting (MFCA), disaster management, humanitarian logistics, and healthcare management. He is a member of Eastern Asia Society for Transportation Studies (EASTS).

Chompoonoot Kasemset is an Associate Professor from the Department of Industrial Engineering, Faculty of Engineering, Chiang Mai University, Thailand. Her research interests are operations management, application of OR in industries, simulation, Material Flow Cost Accounting (MFCA), Theory of Constraints (TOC), and healthcare management.