

**THE ACCEPTANCE AND POTENTIAL OF ROBOTIC SURGERY
IN THAILAND**



**A THEMATIC PAPER SUBMITTED IN PARTIAL
FULFILLMENT OF THE REQUIREMENTS FOR
THE DEGREE OF MASTER OF MANAGEMENT
COLLEGE OF MANAGEMENT
MAHIDOL UNIVERSITY
2021**

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Thematic paper
entitled
**THE ACCEPTANCE AND POTENTIAL OF ROBOTIC SURGERY
IN THAILAND**

was submitted to the College of Management, Mahidol University
for the degree of Master of Management
on
September 12, 2021



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ACKNOWLEDGEMENTS

This study would not be complete without the assistance of many key stakeholders who always encourage and motivate me. First and foremost, I would like to thank Assoc. Prof. Nathasit Gerdri, Ph.D., who is a kind advisor that offers suggestions for improvement in my research as well as time to consult on topics that I don't understand in order to clarify my direction. Furthermore, he teaches a technique and skill that I can apply in my professional life to improve my thought process.

Second, I would like to thank all of my respondents who are medical school professors for sparing their time to support me in this research; without them, this study would be incomplete. Furthermore, I am extremely thankful to my bosses and colleagues for their assistance in recommending a surgeon who uses robotic surgery in relation to the study and connecting me to an interview with the surgeons.

Finally, this chapter of my life would not be possible without the support of my family, who constantly inspire and give opportunity for me. The experience I gained at Mahidol University's College of Management was valuable in terms of academics, as it reshaped my perspectives and improved my ability to adapt with my work life. Furthermore, I made many good friends who always support and exchange experiences with me, making me very happy during my studies at CMMU.

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THE ACCEPTANCE AND POTENTIAL OF ROBOTIC SURGERY IN THAILAND

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ABSTRACT

With the advancement of surgical treatment around the world, a new technology known as robotic surgery was developed to overcome the limitations of surgery with a minimally invasive approach in order to deliver a better outcome for the patient and increase surgeon efficiency. This procedure is frequently used as a standard surgical protocol and is widely accepted by many surgeons across the world. However, robotic surgery is still growing slowly in our country due to various factors that perform as a barrier to this approach. The purpose of this study is to determine the elements that influence the acceptance and potential of robotic surgery in Thailand, in collaboration with a surgeon who has experience with the technique and patients who have had robotic surgery services. The study used an in-depth interview method to collect data and analyze it to identify the factors influencing the implementation of robotic surgery, which can be used to develop the country's structure to improve technology's accessibility for surgeons and patients with the goal of improving their quality of life and upgrading our healthcare organization to meet international standards.

KEY WORDS: Robotic surgery/ Medical device/ Minimal invasive surgery/ Customer acceptance

68 pages

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CHAPTER I

INTRODUCTION

1.1 Background

When patients have diseases, they usually take some medicine on their own as primary care, although this does not always cure the specific or acute diseases. The hospital has become a major component in improving humanity's quality of life. Infectious disease, genetic and non-genetic disease, deficiency disease and physiological disease are the four primary categories of diseases that can be classified. As a result, the writer will concentrate on non-infectious diseases such as cancer and tumors in this study. Cancer is defined as a malfunctioning cell that grows uncontrollably in the body. Furthermore, it can arise when a normal physiological mechanism fails, and it can grow into a mass of tissue known as a tumor. This disease is particularly serious since the cancer can spread to any organ in the patient's body and cause it to stop working. Finally, the patient will die as the organs fail to function.

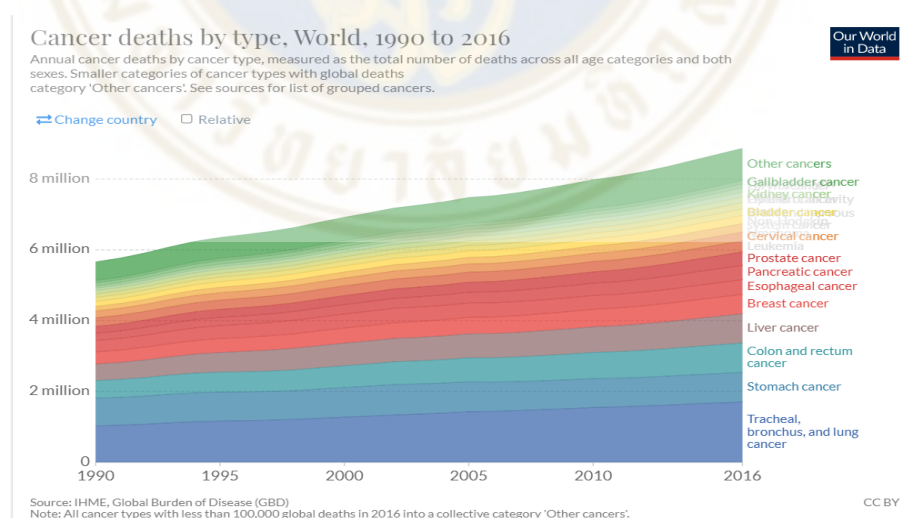


Figure 1.1 The number of cancer deaths is increasing as the world population is growing and aging

Every year, the number of cancer mortality rises in every type of cancer. Therefore, demanding the development of high-tech devices or medicines by the healthcare industry to increase patient survival rates are increasing. Chemotherapy, targeted therapy and surgery together known as "multi-modality treatment," are all options for treating cancer diseases, depending on the patient's complication and the doctor's investigations. The writer of this thematic paper concentrates on the surgical section, which can treat cancer by removing tumors of cancer cells in specific organs such as the colon, gastric, liver etc. In terms of medical treatment through surgery, it includes a variety of procedures that are constantly updated and tailored to each process in order to provide the most effective solution for patients. The first procedure is open surgery, in which the surgeon operates on the abdominal cavity by cutting the skin and tissue. The surgeon will get a complete view of the structure or organs using this technique. The benefit of open surgery is that the surgeon can operate with clear vision and feel the texture of the tissue with their hand. The disadvantage is that the procedure may result in a higher infection rate than other techniques, as well as a longer hospital stay. The surgical wound is quite large, and it will take a long time to heal. All surgeons strive for open surgery as a tradition and objective. From the discomfort of open surgery, which can lead to the many post-operative issues. The surgery's innovation was created by utilizing technology to aid with vision and accessibility. Laparoscopic surgery is a technique that utilizes by use of a "lens and monitor" to provide visual assistance during surgery while leaving a small incision on the skin. Minimal invasive surgery, or MIS, is the term given to this technique. In many countries, MIS is quite popular for removing tumors with a minimal incision and allowing patients to recuperate quickly. The advantage of MIS is a shorter hospital stay and a quick recovery with a small surgical wound. The disadvantage of MIS is its high cost, and the surgeon must improve their MIS skills. "Robotic surgery" is a revolutionary approach that has just been implemented in the surgical profession. This method will employ a robot that will be controlled by the surgeon to do an operation. The robot has four arms that can also be used like human hands, and each hand can change instruments. The surgeon actually sits at a console and controls the robot it like it was a game. Robotic surgery, according to this technology, is more precise than MIS and open surgery, and it can operate in the deep field very effectively. Human stability differs from that of robotics because when

a human's hand becomes fatigued, it will shake or drop its capacity to accomplish an operation. Robotic surgery has grown in popularity as a result of this factor in several nations, including Taiwan and the United States. Many surgeons have developed the technique to use robotics in a variety of procedures in order to improve the patient's and hospital's performance. Precision and steadiness in surgery are two advantages of robotic surgery. Furthermore, it can provide a 3D monitor that allows a surgeon to feel as though they are standing inside the abdominal cavity. The source of the discomfort is a high cost and a tactile sensation. Tactile sensibility refers to the surgeon's sense of touch while he or she operates and feels for tumors or organs to locate and optimize force in the surgery.

Robotic surgery is an advancement that uses a robot to do surgery instead of a human, although it is still controlled by a surgeon who has completed robotic surgery training. The advantage of robotic surgery is that it can provide patients with safer and more effective outcomes. With fewer complications following the surgery, the hospital can save money while also improving clinical outcomes and increasing the patient's survival rate. The type of robotic surgery is determined by the procedure performed using robots. For example, if surgeons use robotics to transect the colon and remove a tumor in the lower GI, the process is known as robotic colorectal surgery. Furthermore, the robotic arm can change a variety of instruments that are required during the surgery, such as vessel sealing, staples, and hand instruments. Additionally, a 3D monitor will be installed at the controller station to improve the surgeon's surgical efficiency. When a hospital installs a robotic system, it must create a special team for robotic surgery because this technology is unique and necessitates specialist staff to set up or be on call at all times. Another advantage for the user is that the surgeon will be less tired from the surgery in many operation cases when compared to Laparoscopic surgery or traditional surgery. And the operation will be more exact, resulting in less blood loss and infection.

1.2 Problem Statement

Robotic surgery is becoming increasingly popular worldwide, with many countries establishing robotic centers and some surgeons expanding their surgical practices to keep up with the trend. Urology, which uses a lot of ability to dissect in deep cavities and many nerves in that location, is currently the specialty that has had the most success with robotic surgery. As a result, this operation requires use of a very precise device as well as a high level of ability. That is why robotic surgery is a good fit for URO surgeons. In Thailand, robotic surgery is only now being offered in medical schools and high-end private hospitals. Many surgeons have given positive feedback on this technology, although there is still a real challenge involved in using the robot. In terms of social acceptance, robotic surgery is well accepted, yet some procedures consider that Laparoscopic surgery is still superior to robotic surgery in terms of timing. In addition, the cost of robotic surgery is prohibitively high, which is the first barrier for customers and patients. This factor presents a significant difficulty for this technology in every country, as it must find a balance between the outcome and the cost of operation. Although public hospitals in some countries provide reimbursements, they are insufficient to cover the costs of robotic surgery. However, Thailand is only getting started in terms of new healthcare innovation. If our country establishes more robotic centers and makes them a standard of surgical care, prices will drop and patient experiences will shift to the next generation.

Initially, robotic surgery was brought to Thailand, but it was not effective in terms of healthcare provider implementation. Because of the patient's knowledge and behavior, they continue to assume that the traditional must be better and refuse to change. As Thailand's population ages, robotic surgery continues to be a concern for many patients. Will Thailand's robotics center be as successful as those in other countries? In terms of the surgeon, it is beneficial to advance to new technologies, but the patient must also understand.

1.3 Research Objective

The purpose of this study is to provide the reader a better understanding of how robotic surgery affects the surgeon's perspective in Thailand. Especially moving toward an elderly culture, and digital healthcare plays an important role in the society. The surgical practice will evolve in order to keep up with the worldwide health trend. In the future, the reader will be able to see the healthcare industry's trend. To demonstrate the element and potential of this technology in Thailand, this research writer will focus on a customer who has the opportunity to utilize the service in the hospital and a surgeon who is a user of robotic surgery. The study will concentrate on the factors that demonstrate robotic surgery's acceptance and potential in Thailand. And this research can demonstrate an opportunity in terms of management for a hospital that is planning to open a robotic center in order to assess the attractiveness and client segment.

At the conclusion of this study, the author would like to discuss the customer target group and acceptability in the qualitative with interviews with surgeons and patients who have had the opportunity to use the service at the hospital. This paper can assist readers who work in the healthcare industry and have an interest in robotic centers in saving time and focusing on the right place to classify when compared to the target group of the reader's business and determining whether or not it is worthwhile to invest in robotic surgery.

1.4 Research Question

Robotic centers are very popular around the world, and they move healthcare technology to the next level of surgery, with numerous advantages for the user, facility, and patient. However, robotic surgery has yet to be successfully implemented in surgical techniques in Thailand, and many patients are unaware of this technology. The writer would like to know that

1. What are the factors that influence the surgeon to use the robotic surgery and why?
2. What is the benefit of robotic surgery for surgeon and patient?
3. What is the concern or pitfall when use robotic surgery from both surgeon and patient's perspective?
4. What experience is required for the surgeon to use robotic surgery?
5. What is the current and future state of robotic surgery in Thailand?

CHAPTER II

LITERATURE REVIEW

2.1 Medical device

2.1.1 Definition of medical device

In general, World Health Organization define the meaning of medical device as any instrument, apparatus, implement, machine, appliance, implant, reagent for in vitro use, software, material or other similar or related article, intended by the manufacturer to be used, alone or in combination for a medical purpose. (WHO, 2020)

Moreover, the description of the medical device has various depend on type of device and regulatory definition in each device also. It can divide the definition by country in 2 perspective as European union (EU) and USA (US) According to EMA (European medicine agency) define medical device by the usage in specific medical purpose, the trait to use and its stay in human body or not. Also, the type of the product can be meaning the medical device such as device to control or support function and sterilization device. And for USA, the FDA (Food and Drug Administration) define the meaning similar as EMA but different in the definition of combination product. (Aronson, 2019)

For conclusion the definition of medical device can summarize in to “the innovation design and manufacture to use in healthcare and not be a medicine or supplement diet” In term of regulatory for the device is very complex in each country but it has same purpose to classify product to use in healthcare organization. (Aronson, 2019)

2.1.2 Development of medical device

The development of the medical device depends on the usability of device to use in specific procedure. The developer will use issue to consider in design and feature in which device such as in term of ergonomic design or outcome to capture the need of the customer. In term of the industry, it should develop reasonable product cycle, step to use and match with customer's behavior to satisfy the user with the appropriate device. (Martin, 2008) The medical device also develops align with the technology in that period to improve the medical outcome and satisfy need of customer.

2.2 Acceptance in medical device

Aging and gender are factor of the acceptance in the new technology of medical device it's depend on the vision to see the usefulness in the medical device. The gender will affect directly to the behavior of the user but the different aging is not reflected to the attitude in the usefulness of the device. So, the acceptance in the new technology it can be cause in many aspects by the vision, attitude, behavior and readiness with the gender can be influence their thought process in the same time. Moreover, from the research that in the medical device the men have more positive in term of acceptance than women. (Gaul, unknown) In addition to diversity of user it has diversity of technical system that change all the time. It effects to young and old, women and men which consider in term of the acceptance in that product. In the big picture of the acceptance in the technology it consists of 3 dimensions as utility, usability and likeability. According to Technology acceptance model it can use to predict and explain the user's acceptance by the step in this model (Holzinger, 2010)

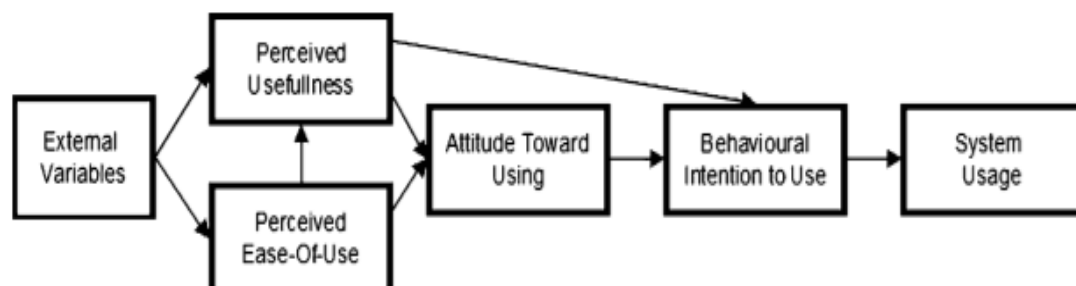


Figure 2.1 Technology acceptance model (TAM)

2.2.1 Technical expertise

For the medical device, the technical expertise is identified to considerable in the acceptance as interest in technology, the understanding, skill and doubtful. The higher in technical expertise will has higher acceptance in technology. Another part is about the emotional, the emotion will affect to the feeling of the user to consider their thinking such as if they motivate, they will have willingness to use the new technology and it will establish the acceptance in the device later. This is the most importance part to reflect user's perspective. (Ziefle, 2010)

2.3 Robotic surgery

The new approaches of minimal invasive surgery (MIS) with the feature as magnified view, improve ergonomic and dexterity to increase safety to the patients and help surgeon to deal with the difficult area to operation (Diana, 2015) The concept of the robotic surgery is site remote from the surgeon. That mean the surgeon can control by don't have to access in the operating room. (Mack, 2001) This innovation will be developed to be tele-surgery in the future. Robotic surgery was getting more acceptance can be seen from the robotic center establish in many countries and many evidence base was publish that change the surgeon practice to the future. (Franasiak, 2014)

2.3.1 Customer acceptance

The customer need is the most importance to make them acceptance the product or service by the value can satisfy the customer and meet their specific goal (Herbig, 1992) The customer acceptance will decreasing by the customer's barrier in the new innovation or product because they don't know about the benefit of the innovation and the capability of it. Also, the external stakeholder or environment can be cause to improve customer's barrier too. (Herbig, 1992)

2.3.2 Cost effectiveness

Cost of robotic surgery divide into 4 factors; First is fixed cost (equipment and maintenance) and variable cost (instruments) Robotic surgery is higher when compare with conventional laparoscopic and open surgery. Second is OR cost that depend on the time when do the procedure and robotic surgery use shorter time than conventional laparoscopic surgery. Third is total cost that include fix, variable, OR cost and length of hospital stay. In this part robotic surgery achieve in total cost saving. Last is robotic surgery has shorter learning curve than conventional laparoscopic surgery. In long term robotic surgery will be cost effective for both hospital and patient by reduce length of hospital stay to the patient and allow surgeon to do more procedure with a shorten time to complete the learning curve (Leddy, 2010)

2.3.3 Safety in robotic surgery

The robotic surgery is a new surgical technique that the user has to change the system model such as task, team, technology, environment, patient and outcome which the surgeon who has knowledge and skill is not enough. It has to develop the new thinking process, create different demand and awareness to use these surgical techniques. Although the robotic surgery can provide many benefits overcome the human capacity but the lack of learning curve and understanding of the technology can be cause of high risk and injury also. Therefore, the safety in robotic surgery will improve when user understanding and welcome the new technology by training to pass the learning curve, set the team with specific surgical type, robot model and patient characteristics. These factors will improve intra-operative performance and outcome with the robotic surgery. (Catchpole, 2015)

2.3.4 The evolution of robotic surgery

The robotic surgical platform has consistency growth in the global with several model to use in specific procedure. Initially robotic platform has the highest barrier from the healthcare organization in term of safety and efficiency but this market growth very quickly and invent with the high technology until Intuitive surgical corporation establish the high performance robotic surgical platform with an FDA approve call “da Vinci system” that create the new era of robotic master-slave systems

to compete with the other robotic surgical platform in the market. The da Vinci system provide the minimal invasive surgery with the improving of surgical ergonomics and outcome when compare with the conventional surgery. (Gosrisirikul, 2018)



Figure 2.2 Da Vinci SP Surgical System

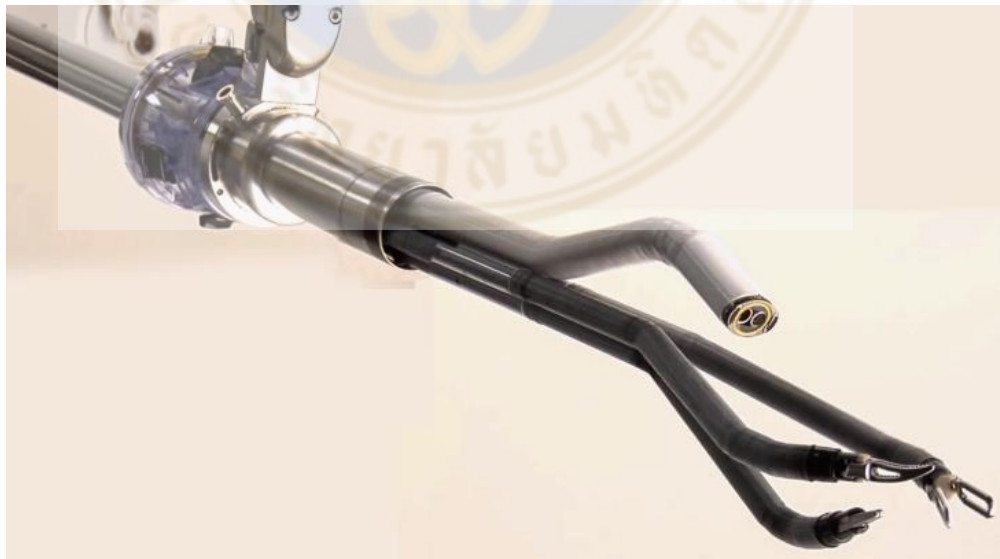


Figure 2.3 Da Vinci SP Surgical Port

CHAPTER III

METHODOLOGY

In-depth interview is qualitative research technique that involves precise interviews with the interviewee in small amount of respondent to explore their opinion, perspective or attitude in the research topic by choose the interviewee who relate with the topic of research to find their concern, idea or outcome and use that to analyses to be a result in research. This method is useful when the research topic needs to find out a personality thought and behavior of the participants in depth.

The benefit of an in-depth interview is that it provides more information and detail than survey approaches while also allowing the interviewee to relax because they are not required to fill out as much information as in a survey. The interviewee only has a one-on-one interaction with the interviewer about a single topic. However, this method has certain limitations, such as interviewee bias, time constraints, ungeneralizability, and inability to work if respondents just answer yes or no. As a result, the interviewer's preparation system is very important. (Boyce, 2006)

The method of conducting an in-depth interview is divided into five sections, as shown below

1. Plan – Identify key stakeholders who will participate in this study and describe the information that must be relevant to the study's issue. After that, make a list of all the stakeholders and group them according to their skill, facility, or benefit level. Ascertain that the study question or method adheres to the ethical standard.

2. Develop instrument – Create an interview protocol by asking simple questions that the interviewee can follow in each session. This will ensure that the interviewee and the study topic are on the same page. Also, create an interview guide that lists the precise sequence in which the questions should be asked in order to investigate the major issue of each question. There should be no more than 15 key questions in the query.

3. Train data collectors – Before interviewing the stakeholders, the interviewer must first identify and understand data collecting.

4. Collect data - Set up an interview with a stakeholder and obtain their informed permission. When the interviewer receives an answer after a conversation, the collector must summarize the information obtained throughout the interview.

5. Analyze the data – to analyze the information gathered during the interview and come to a conclusion on the research.

The rationale for choosing this methodology is that this study requires information on the acceptance of robotic surgery in Thailand from a surgeon who performs surgical procedures in a hospital as a user. And from the patient who takes the surgery by robotic surgery in terms of qualitative. Moreover, this method can show the potential of the implementation of robotic surgery in Thailand such as Robotic centers in private hospitals and medical schools. To evaluate the effectiveness of new technologies in healthcare organizations as well as new aspects of patient treatment. Furthermore, the information gathered by the author can be used in a commercial setting for a hospital that is evaluating the possibility of establishing a robotic center to discuss the potential for investing in new healthcare technologies.

The author splits the interviewees into 2 groups as a technique of determining the outcome. The first is a surgeon (user) who has used robotic surgery previously in any procedure and has been divided into 3 tiers to conduct a triangle interview with a senior surgeon, an intermediate surgeon, and a young staff member. The number of surgeons is 9, each with a distinct level of expertise, with the goal of analyzing the many perspectives on robotic surgery. Patients who have robotic surgery in any institution are the next group to be evaluated in terms of emotion in terms of service recipients with patients grouped combined with age, gender, and complication. Before and after the procedure, the patient will be interviewed and to be ethical in research, both the surgeon and the customer's personal data will be kept private.

The writer separates the level of the surgeon into three levels: young staff, intermediate staff, and senior staff based on their experience with the operation case, which the writer expects to affect the surgeon's expertise, perspective, and vision for robotic surgery. For the young staff, a surgeon who has completed a fellowship program and is capable of performing open and conventional laparoscopic surgery but has limited

experience with robotic surgery is expected to perform 2-10 cases. The surgeon who is skilled in open surgery and conventional laparoscopic surgery with 11-50 cases of robotic surgery is considered intermediate. The surgeon at the senior level is an expert in both open and traditional laparoscopic surgery, with a large number of robotic surgery cases (about 50-100 cases). The level can clarify the perspective in robotic surgery in several aspects and provide a large amount of information to examine in terms of acceptance and potential in this study.

The guide question to ask the surgeon during the interview will be on the user and bearer's perspectives on robotic surgery, as well as their concerns about the technology. Though this research will gather the information in terms of the experience from the surgeon who has experience about robotic surgery in different institutes such as Chulalongkorn hospital, Ramathibodi hospital, Siriraj hospital, Rajvithi hospital and Police hospital. With a limited of time, the writer will interview a medical teacher who is skilled and knowledgeable in surgery from each institution. As a result, the outcome will be qualitative, containing confidential personal information from each participant. The following is the main guide question as follows What are the factors that influence the surgeon to use the robotic surgery and why?

1. In your opinion, what is the benefit of robotic surgery for surgeon and patient?
2. From your experience, what is the concern or pitfall when use robotic surgery in term of user? And how about in term of the patients?
3. What is the necessary experience for the surgeon to use the robotic surgery?
4. In your point of view, what do you think about the robotic surgery technique in Thailand currently and future?

CHAPTER IV

FINDINGS AND ANALYSIS

The focus of this thesis is to assess the acceptance and potential of robotic surgery in Thailand by conducting an in-depth interview with a surgeon who has previously performed robotic surgery. The writer has divided the interviewees who are surgeons into the following groups as Description of the group interview respondents in Table 4.1

Table 4.1 Description of the group interview respondents

Respondent	Group description
A ₁ – A ₃	This group is the young staff who has a few experiences with robotic surgery by use the robotic surgery to do an operation around 2-10 cases
B ₁ – B ₃	This group is the intermediate staff who has skill to do laparoscopic surgery and have experience with the robotic surgery by do the operation with this system around 11 - 50 cases
C ₁ – C ₄	This group is the senior staff who expert in laparoscopic surgery and robotic surgery as well. This group almost use robotic surgery to operation in every case. It has amount of case upper than 50 cases

4.1 Presentation of case

4.1.1 Young staff

In this study, the term "young staff" refers to surgeons who have completed the surgeon department of any medical school and have a basic understanding of laparoscopic surgery procedures such as cholecystectomy and appendectomy. And I'm interested in learning how to perform robotic surgery, which is currently the most cutting-edge surgical procedure. The young personnel must employ robotic surgery in at least two cases and be knowledgeable with robotic surgery. This group has three surgeons who work in various hospitals and medical schools including Police hospital, Rajvithi hospital, Ramathibodi hospital.

4.1.2 Intermediate staff

In this study, an intermediate staff member is described as a surgeon who graduated from the surgery department and has remarkable skill in laparoscopic surgery in complex procedures such as laparoscopic low anterior resection, laparoscopic prostatectomy, and many others. Furthermore, the surgeon wishes to advance their skills by getting recognition for their ability to perform robotic surgery, which is in line with the worldwide healthcare trend. In any surgery, this group must have a minimum of 11 to 50 cases of robotic surgical experience. This group will typically be a medical school teacher and have more experience than the younger staff.

4.1.3 Senior staff

The surgeon who is an expert in the surgical method is defined as senior staff in this study. The senior staff has extensive experience in open, laparoscopic, and robotic surgery. Senior staff are mainly professors at Thailand's major medical schools, such as Chulalongkorn Hospital, Ramathibodi Hospital, and Siriraj Hospital. This group has performed up to 50 cases by using robotic surgery's technique and has the most experience with any patient complication. In addition, they are well-known for adapting their approach and style to accommodate the surgeon's conduct in Thailand.

4.2 Factor of the robotic surgery in Thailand by In-depth interview method

Table 4.2, Table 4.3, and Table 4.4 are the results of the guide questions used by the writer to approach interviewees in order to identify the factor, perspective and vision of the surgeon in each group.

Table 4.2 A summary of relating factors toward robotic surgery in Thailand by young staff

Key factors	Respondents
Perception of surgical approach	<p>“It is a novel and new technology to help the surgeon to operate easier than conventional laparoscopic surgery. And align with the trend of minimal invasive surgery.” Surgeon (A₁)</p> <p>“The robotic is the new innovation to improve ergonomic for the surgeon and help surgeon to access into the difficult cavity in the body when surgery.” Surgeon (A₂)</p> <p>“Robotic surgery is the new technology that will be general approach in the future.” Surgeon (A₃)</p>
Functionality and capability of robotic surgery	<p>“The approach in this system can reduce the fatigue during operation because surgeon has station to sit and command the robot that will improve efficiency for the surgeon also.” Surgeon (A₂)</p> <p>“The angle movement of robotic surgery vary than laparoscopic surgery. It seems like do minimal invasive surgeon in the feeling of open surgery that make the surgeon work more effectively. Surgeon (A₃)</p>

Table 4.2 A summary of relating factors toward robotic surgery in Thailand by young staff (cont.)

Key factors	Respondents
Precision in surgery	<p>“Better to preserve nerve and less pain than laparoscopic approach because the robotic surgery has more flexible angle and movement in the operation.” Surgeon (A₂)</p> <p>“Robotic surgery has a module to reduce the trembling hands when compare with human’s arm. This future will improve stability and increase precise in operation.” Surgeon (A₃)</p>
Set the specific team for robotic surgery system	<p>“For the robotic surgery, it has to set the specific team to work together because this is different approach from other surgery such as the circulate has to learn new skill and step to docking, anesthesia has to set operation table to compatible with the system. This is very importance part. Surgeon (A₃)</p>
Patient outcome	<p>“The result is same as the conventional laparoscopic” Surgeon (A₁)</p> <p>“Depend on operation, but from the observe comparison the outcome from the robotic surgery is equal or better than conventional laparoscopic surgery” Surgeon (A₂)</p> <p>“First is the satisfaction from the patient who get the service with the newest innovation of medical device. It gains trust to the patients. And in deep cavity of the body the robotic surgery can perform well to create better outcome than laparoscopic surgery” Surgeon (A₃)</p>

Table 4.2 A summary of relating factors toward robotic surgery in Thailand by young staff (cont.)

Key factors	Respondents
Readiness of the hospital	<p>“The vendor will evaluate the hospital in term of the readiness before installation if the hospital doesn’t match with their requirement, they will reject to sell the system.” Surgeon (A₁)</p> <p>“I believed that the hospital where has the robotic surgery they evaluate their capacity already because it is a lot of cost to invest and it has to be value especially in private hospital. The nurse team and surgeon are very importance to implement robotic surgery.” Surgeon (A₃)</p>
Learning curve of the new technique	<p>“Normally the conventional laparoscopic has very long learning curve in this technique. but for the robotic surgery, it shortens the learning curve with the same approach to do minimal invasive surgery.” Surgeon (A₁)</p> <p>“The robotic surgery has different skill from conventional laparoscopic surgery such as step to docking, using control panel at the station etc. Therefore, the learning curve depend on each personal skill but normally it takes time to pass the learning curve amount 5-10 cases.” Surgeon (A₂)</p> <p>“The learning curve is equal as the conventional laparoscopic surgery” Surgeon (A₃)</p>

Table 4.2 A summary of relating factors toward robotic surgery in Thailand by young staff (cont.)

Key factors	Respondents
Experience and ability requirement	<p>“The vendor (Intuitive company) they don’t allow the surgeon to use this system without training from them. And the surgery who would like to use robotic surgery, they must certify and registered form the company only.” Surgeon (A₁)</p> <p>“Actually, in another country it has syllabus to study in robotic surgery department after graduate from surgery department but in Thailand at least the surgeon has to pass the minimal invasive surgery course before learn the robotic surgery.” Surgeon (A₂)</p> <p>“Robotic is a new science that differentiate from the past approach because conventional surgery it uses hand and arm to do operation but robotic surgery it uses the finger and wrist to control the robot. And robot has many platforms that surgeon have to adapt themselves all the time” Surgeon (A₃)</p>
Technology accessibility	<p>“In Thailand has only 7 systems almost locate in big medical school that why many surgeons don’t have a chance to acknowledge this technology.” Surgeon (A₂)</p>

Table 4.2 A summary of relating factors toward robotic surgery in Thailand by young staff (cont.)

Key factors	Respondents
Operation time	<p>“After pass the learning curve the operation time will equal with the conventional laparoscopic surgery but normally, the robotic surgery still should take more time because the process of docking and other it needs specific team to set up.” Surgeon (A₂)</p> <p>“Use the total operation time more than laparoscopic surgery and open surgery for sure because the process of preparation is very long such as docking the system. But for the intra-operative’s time is faster than other technique.” Surgeon (A₃)</p>
Cost effectiveness	<p>“The robotic surgery is not available for Thai citizen in term of commercial but it values to invest for academic at the medical school and develop healthcare organization in Thailand.” Surgeon (A₂)</p> <p>“For the private hospital, Robotic surgery can improve their population and promote as the innovative hospital. Moreover, robotic surgery has provided more benefit to the patient outcome that can increase value for this approach and encourage patient to pay.” Surgeon (A₃)</p>

Table 4.2 A summary of relating factors toward robotic surgery in Thailand by young staff (cont.)

Key factors	Respondents
Cost of technology	<p>“The cost of the robotic surgery is very high. Therefore, many surgeons in Thailand cannot access to this technique with the limitation of the budget” Surgeon (A₁)</p> <p>“Total operation cost adds on from the laparoscopic surgery to 200k – 400k Thai baths” Surgeon (A₂)</p> <p>“The cost is very high because after installation the system the hospital has to pay amount 5 million Thai baht per years to maintenance the system. This exclude of instrument which use in the operation.” Surgeon (A₃)</p>
Perceived benefit	<p>“The patient divides into 2 levels, first the patient who gather the information of the approach to do operation and know which one is the best for them. Second is the patient who accept any approach by recommend from surgeon. Surgeon (A₂)</p> <p>“It is not value because the price is very high and it has many variable costs that hospital has to afford.” Surgeon (A₃)</p>

Table 4.2 A summary of relating factors toward robotic surgery in Thailand by young staff (cont.)

Key factors	Respondents
Reimbursement	<p>“The insurance company they aren’t set this technique to be a standard procedure therefore if the patient uses this technique, it will partial support the cost of the operation.” Surgeon (A₁)</p> <p>“Currently in Thailand, Robotic surgery cannot reimburse in any scheme except some hospital has funding by themselves to support the patients.” Surgeon (A₂)</p> <p>“This technique cannot reimburse like another country that why this technique is not famous.” Surgeon (A₃)</p>
The patient accessibility	<p>“The high cost of operation is the main barrier that make the patient cannot access in this technique although they know it is the best but the patient cannot afford total cost.” Surgeon (A₁)</p>
Government policy	<p>“Not support at all.” Surgeon (A₁)</p> <p>“Currently, the surgeon society is planning to request to the ministry of public health for reimburse in NHSO scheme.” Surgeon (A₂)</p> <p>“The government policy is behind from the healthcare global trend that make our country lose opportunity to improve healthcare innovation. Because they do not support the new technique at this time.” Surgeon (A₃)</p>

Table 4.2 A summary of relating factors toward robotic surgery in Thailand by young staff (cont.)

Key factors	Respondents
Healthcare global trend	“Robotic surgery is the global trend but in Thailand is has a few systems from overall country” Surgeon (A ₁)
Direction of the robotic surgery in Thailand	“Difficult to implement robotic surgery center in all of country because many factor such as cost, regulation, patient and economic” Surgeon (A ₃)



Table 4.3 A summary of relating factors toward robotic surgery in Thailand by intermediate staff

Key factors	Respondents
Perception of surgical approach	<p>“Currently robotic is a highlight in healthcare global trend to use in many procedures by different platforms to response the usage of the customer and it will be the general approach in the future.” Surgeon (B₁)</p> <p>“In other country, the robotic surgery is acceptable widely and list to be goal standard of the surgery to treat the patients.” Surgeon (B₂)</p>
Functionality and capability of robotic surgery	<p>“The system provides 3-dimension visualization to see narrow-depth of the organ in the operation. Therefore, Robotic surgery has safer and more certitude than laparoscopic surgery which provide only 2-dimension on the monitor.” Surgeon (B₁)</p> <p>“The robotic has a feature call freedom of motion that develop their robot arm to be very small and flexibility same as the human wrist. This is more advantage than laparoscopic surgery and improve clinical outcome in post-operative.” Surgeon (B₂)</p> <p>“It’s very useful to use robotic surgery in the deep cavity procedure and have limitation to access such as to dissect the tumor in pelvic cavity and it can perform very well to reconstructive organ in the human body.” Surgeon (B₃)</p>

Table 4.3 A summary of relating factors toward robotic surgery in Thailand by intermediate staff (cont.)

Key factors	Respondents
Precision in surgery	<p>“Robotic surgery has more accuracy when dissect or cut the tissue in the body especially when suturing it perform as well as hand suture that improve efficiency in surgery” Surgeon (B₁)</p> <p>“With the design of robotic, it provides more precision when do the surgery and improve stability when do the procedure.” Surgeon (B₂)</p> <p>“Robotic surgery it helps surgeon to operate like an open surgery meanwhile it provides the minimal invasive to the patients. As a result, the operation will be more precise because the improving on detail of the visualization make the surgeon decision easier.” Surgeon (B₃)</p>
Set the specific team for robotic surgery system	<p>“For this technique, it necessary to have an assist surgeon who has laparoscopic skill in the operation room to docking and access trocar ports.” Surgeon (B₁)</p> <p>“Create the special team for robotic surgery by educate and set protocols for the new technology together because this system will be success by collaboration with all healthcare professional such as anesthesia, nurse, assist surgeon and technician.” Surgeon (B₃)</p>

Table 4.3 A summary of relating factors toward robotic surgery in Thailand by intermediate staff (cont.)

Key factors	Respondents
Patient outcome	<p>“The patient outcome from the robotic surgery is better than laparoscopic surgery but it’s not significant.” Surgeon (B₁)</p> <p>“Patient outcome depends on many factors such as experience of the surgeon, the difficult of the case, patient’s complication etc. therefore if the case is not complicate the outcome will be same as laparoscopic surgery but if case is very complicate the robotic will perform better than laparoscopic surgery.” Surgeon (B₂)</p>
Safety in technology	<p>“The robotic surgery can prevent the human error from the surgeon with the artificial intelligence that will help to evaluate the situation in the operation.” Surgeon (B₁)</p> <p>“The user has to acknowledge the system about the chance to error or the caution of this system. Although, robotic surgery design with the high safety but the technology still has chance to be malfunction.” Surgeon (B₃)</p>

Table 4.3 A summary of relating factors toward robotic surgery in Thailand by intermediate staff (cont.)

Key factors	Respondents
Learning curve of the new technique	<p>“The surgeon who can do open surgery as well, they can shift to the robotic surgery by don’t have the skill of laparoscopic because in field of robotic surgery (From the monitor in the station) it similar with open surgery field. Moreover, the learning curve is shorter than conventional laparoscopic surgery such as in lap prostatectomy the robotic surgery need only 10-15 cases to pass learning curve but laparoscopic surgery needs up to 40 cases.” Surgeon (B₁)</p> <p>“The learning curve to do the robotic surgery is faster than laparoscopic surgery when compare with the starting of the surgeon who can operate with open surgery technique.” Surgeon (B₂)</p> <p>“Laparoscopic surgery uses longer learning curve than robotic surgery because the instrument is rigid and fix the angle to operate that is the limitation of laparoscopic surgery. The robotic surgery has automatic and design to flexible in any degree of rotation with the console that allow surgeon control in the operation. Therefore, the learning curve of robotic surgery will be pass easier than laparoscopic surgery by operate around 50 cases” Surgeon (B₃)</p>

Table 4.3 A summary of relating factors toward robotic surgery in Thailand by intermediate staff (cont.)

Key factors	Respondents
Experience and ability requirement	<p data-bbox="624 461 1393 551">“The necessary skill is laparoscopic skill and train to use the robotic surgery by stimulator.” Surgeon (B₁)</p> <p data-bbox="624 622 1393 824">“This technique has specific requirement from the user before use the robotic surgery by the surgeon have to complete all training session and register by Intuitive company.” Surgeon (B₂)</p> <p data-bbox="624 896 1393 1097">“The surgeon must have basic skill and knowledge in that procedure before use robotic surgery. This is the standard requirement then robotic will support operate to be more effective.” Surgeon (B₃)</p>
Operation time	<p data-bbox="624 1182 1393 1384">“Depend on the learning curve of the surgeon who use robotic surgery if they pass the learning curve to be an expert the operation time will shorter than laparoscopic surgery.” Surgeon (B₁)</p> <p data-bbox="624 1456 1393 1597">“Depend on surgeon’s experience and team if the team’s readiness and capability of the surgeon is high, it could be reducing the operation time significantly.” Surgeon (B₃)</p>

Table 4.3 A summary of relating factors toward robotic surgery in Thailand by intermediate staff (cont.)

Key factors	Respondents
Fast recovery	<p>“The robotic surgery, it uses small incision to surgery with a precise instrument to operate in the human body. Therefore it will provide less tissue damage and nerve injury that make the patient recovery faster with the less pain.” Surgeon (B₂)</p> <p>“Because robotic surgery is fine dissection, the tissue will not get more damage during surgery then the organ will recovery faster.” Surgeon (B₃)</p>
Length of stay in the hospital	<p>“The robotic surgery has less length of stay than open surgery and laparoscopic in some case.” Surgeon (B₂)</p> <p>“According to the benefit of fast recovery, the hospital stay will be decreasing also.” Surgeon (B₃)</p>

Table 4.3 A summary of relating factors toward robotic surgery in Thailand by intermediate staff (cont.)

Key factors	Respondents
Cost effectiveness	<p>“Total operation cost of robotic surgery is higher than laparoscopic in some procedure with the same patient outcome that why the surgeon has to select to use the robotic surgery in each procedure.” Surgeon (B₁)</p> <p>“In Thailand is difficult to declare in term of cost effectiveness because the overall cost is weight to the robotic surgery not for the hospital stay that make the cost of robotic in Thailand is vary.” Surgeon (B₂)</p> <p>“It depends on operation case per year in each hospital because this system has maintenance yearly with the high cost. So, the number of cases will prove the cost effective in Thailand.” Surgeon (B₃)</p>

Table 4.3 A summary of relating factors toward robotic surgery in Thailand by intermediate staff (cont.)

Key factors	Respondents
Cost of technology	<p>“Nowadays, Cost of robotic surgery is still high but when look from the past the cost is decreasing consistency that mean in the future many hospitals will have more chance to invest with the robotic surgery.” Surgeon (B₁)</p> <p>“Cost of robotic surgery is the main issue in any hospital because both private and public hospital have limit budget that mean they have to analyze the worthiness in this technology. From this issue some hospital decides to hold robotic center implementation.” Surgeon (B₂)</p> <p>“For Thailand, the cost of robotic surgery is very high but when compare with the performance that we get. It’s value.” Surgeon (B₃)</p>
Perceived benefit	<p>“The robotic surgery has many benefits that can keep on to the next generation of the surgery such as Tele-surgery to use the robotic surgery with high frequency network to operate from the distant area. This model will save time for the patient and improve access for the treatment.” Surgeon (B₂)</p> <p>“The benefit has 2 aspects for patient’s side and user’s side. For the patient they will get the newest technology of surgery with more effective and safer. In term of user, this technology supports the surgeon to improve outcome and performance of the surgery. Also, reduce the issue from fatigue that can happen in everybody.” Surgeon (B₃)</p>

Table 4.3 A summary of relating factors toward robotic surgery in Thailand by intermediate staff (cont.)

Key factors	Respondents
Technology complexity	<p>“Although the robotic surgery is the newest technology and provide many benefits to the user and patient but this technology still complicates to use because the user has to understand the function, user interface, control button and step to docking. This is very novel for every surgeon.” Surgeon (B₁)</p> <p>“The surgeon has to open mind to learn the new technology. Actually, for the beginning it is very difficult to understand all the system but they must to take the effort to pass the learning curve and adapt with the new innovation of healthcare.” Surgeon (B₃)</p>
Reimbursement	<p>“It has potential provide partial reimbursement from the government refer to the policy from neighboring countries and SEA.” Surgeon (B₁)</p> <p>“Every reimbursement is not allowed in Thailand. So, the government should pay attention in this technology to increase the patient accessibility.” Surgeon (B₃)</p>

Table 4.3 A summary of relating factors toward robotic surgery in Thailand by intermediate staff (cont.)

Key factors	Respondents
Direction of the robotic surgery in Thailand	<p>“Currently the trend of robotic surgery in Thailand is increasing continuously because the healthcare organization have developed to align with the global trend.” Surgeon (B₁)</p> <p>“From the trend of minimal invasive surgery to provide the small incision with less pain to the patient. It can say that many patients they don’t want open surgery anymore if it not necessary and robotic still better perform than laparoscopic for user and patient also but the cost of this technique is a big barrier in Thailand to access this technology.” Surgeon (B₂)</p> <p>This is the future of healthcare treatment in Thailand and the hospital from distance province can access the better quality of surgery care but the main problem is the reimbursement that stop the process to implement more system in the country. Once the competitors access more in the market, the price of the robotic will be decreasing and every district will have this system.” Surgeon (B₃)</p>
Academic in Thailand	<p>“It has to provide dry run and stimulator in the academic at least 25-30 hours for the surgeon who interest in robotic surgery to let them understand the function and ability of the robotic surgery. Also, create awareness in the new technology.” Surgeon (B₃)</p>

Table 4.3 A summary of relating factors toward robotic surgery in Thailand by intermediate staff (cont.)

Key factors	Respondents
Vendor in the market	<p>“Nowadays, robotic surgery was retained by only 1 company (Intuitive company) that make the power of customer is very low. If it has more competitors in the market the price will be more reasonable.” Surgeon (B₂)</p> <p>“Currently, the robotic surgery is monopoly below the development of Intuitive company.” Surgeon (B₃)</p>
The patient accessibility	<p>“The patient accessibility will increase after the government allow to reimburse because many patients, they don’t have budget to pay for the robotic surgery.” Surgeon (B₁)</p> <p>“When the cost is decreasing, the patient will have more chance to access this technology.” Surgeon (B₂)</p>
Government policy	<p>“In the future, Thailand ministry of public health will support to the robotic surgery in some procedure because in has many research to ensure that this technique provide better outcome and it will improve the quality of life to the patient.” Surgeon (B₁)</p>

Table 4.4 A summary of relating factors toward robotic surgery in Thailand by senior staff

Key factors	Respondents
Perception of surgical approach	<p>“Robotic surgery is the emerging of healthcare technology to improve patient outcome and surgeon’s performance to reach the goal in term quality of life to the surgeon and patient’s benefit. Moreover, this system overwhelms the limitation of laparoscopic surgery with the better ergonomic and efficacy.” Surgeon (C₁)</p> <p>“The robotic surgery supports the surgeon to operate easier without complication and improve patient outcome when compare with the traditional surgery.” Surgeon (C₂)</p> <p>“The robotic surgery develops to overcome the limitation of laparoscopic surgery by provide the patient outcome same as laparoscopic and enhance capability of surgeon with more stability, dexterity and reduce fatigue.” Surgeon (C₃)</p> <p>“The robotic surgery can help the surgeon to operate easier and reduce the blood loss to the patient. Also, it can be spare nerve better than other technique in the present. It provides better outcome for the patient and enhance the performance of the surgeon to overcome limitation in laparoscopic surgery” Surgeon (C₄)</p>

Table 4.4 A summary of relating factors toward robotic surgery in Thailand by senior staff (cont.)

Key factors	Respondents
<p>Functionality and capability of robotic surgery</p>	<p>“Robotic surgery provides high definition with 3-dimension monitor that relate with the human eye to have point of view similar as open surgery. And the robotics’ arm design similar as human wrist to allow the operate in the curve organ or upside down of the abdominal cavity. The position to operate with the robotic is more ergonomic to the surgeon because surgeon just only sit at the console outside the operation room. It effects to increase focus in operation and reduce fatigue from the user.” Surgeon (C1)</p> <p>“Robotic surgery provides more dexterity and accuracy with the fine movement arm. Moreover, it provides the 3-dimension vision in the monitor that make the visualization same as the reality.” Surgeon (C2)</p> <p>“The design of joint in robotics’ arm is similar as a human wrist to move align with the curve of human anatomy and can suturing in the difficult angle as well.” Surgeon (C4)</p>

Table 4.4 A summary of relating factors toward robotic surgery in Thailand by senior staff (cont.)

Key factors	Respondents
Precision in surgery	<p>“The system of robotic surgery provides very accurate movement relate with the surgeon’s finger move at the surgeon console button. It increases access to minimal invasive care for the patient with the precise operation.” Surgeon (C₂)</p> <p>“This technique has less pain and fast recovery because the robotic surgery uses minimal invasive approach to the patient that mean the tissue will get less trauma and focus only the target tumor to remove it without injury any organ inside the patient that effect to the healing process to be faster. Moreover, the hospital stay will relate with the healing process that mean patient can discharge faster too. This will increase the turnover bed process in the hospital to accept more patient and cut down the waiting list.” Surgeon (C₃)</p>
Set the specific team for robotic surgery system	<p>“It must have the specific team for robotic surgery to work together especially in part of preparation and change the instrument during case.” Surgeon (C₃)</p>

Table 4.4 A summary of relating factors toward robotic surgery in Thailand by senior staff (cont.)

Key factors	Respondents
Patient outcome	<p>“Get the newest technology of the surgery with improve the outcome in post-operation.” Surgeon (C₁)</p> <p>“It depends on the procedure when compare with laparoscopic surgery but from the overall the patient outcome of robotic surgery is better or equal with laparoscopic surgery (less pain, fast recovery, small wound)” Surgeon (C₃)</p> <p>“The patient outcome is better than traditional surgery significantly because the patient can recover in 1 day after surgery when compare in the same difficult procedure between robotic and laparoscopic.” Surgeon (C₄)</p>
Safety in technology	<p>“From my experience, I does not see the technical error from the robotic surgery in any case that I have done” Surgeon (C₁)</p> <p>“It provides more safety to the patient especially in some procedure that have to spare nerve or working closely with critical vessel, the robotic can manage the operation as well because the stability is very high, the surgeon can control with high focus on the target.” Surgeon (C₃)</p> <p>“It reduces the human error that cause from fatigue, hand shaking or no concentration etc. And improve the accuracy in the surgery that make the patient safer with the support from this technology.” Surgeon (C₄)</p>

Table 4.4 A summary of relating factors toward robotic surgery in Thailand by senior staff (cont.)

Key factors	Respondents
Readiness of the hospital	<p>“Nowadays, the hospital in other province they don’t have the readiness to implement robotic surgery in many factors such as staff, physician, budget and more. So, the government should support this issue to promote the equality to the people.” Surgeon (C4)</p>
Learning curve of the new technique	<p>“Learning curve depend on the type of procedure if the procedure is very complicate the learning curve will use long time to pass. So, this difficult to compare the learning curve between robotic and laparoscopic.” Surgeon (C1)</p> <p>“The learning curve of robotic and laparoscopic is not different too much but it has potential about the robotic will use learning curve fast as the open surgery.” Surgeon (C2)</p> <p>“Robotic surgery has shorter learning curve than conventional laparoscopic surgery for sure but the surgeon who start to learn robotic surgery technique they must have some skill of laparoscopic surgery before to know the procedure step and direction. Approximately the learning curve of robotic surgery is amount 20 cases” Surgeon (C3)</p> <p>“The learning curve is very short especially for the resident who just graduate in surgery department they can shift to do minimal invasive surgery by use robotic” Surgeon (C4)</p>

Table 4.4 A summary of relating factors toward robotic surgery in Thailand by senior staff (cont.)

Key factors	Respondents
Experience and ability requirement	<p data-bbox="624 461 1391 663">“The surgeon should know the surgery’s principle and learn laparoscopic skill to know the position and complex of minimal invasive surgery. Moreover, the learning curve will be faster if surgeon have this skill.” Surgeon (C₁)</p> <p data-bbox="624 734 1391 987">“Surgeon has to train with the stimulator and pork lap to get the certificate by Intuitive company. After that they has to join the mentoring program to follow up and consult the operation with robotic surgery amount 5-10 cases then they will allow to do the operation by themselves.” Surgeon (C₂)</p> <p data-bbox="624 1059 1391 1485">“Laparoscopic skill is not requirement to be a robotic surgeon but laparoscopic skill can help the surgeon in unexpected event such as the malfunction of the system, technical problem etc. The laparoscopic can use to convert from the robotic surgery and continuous the operation to save the patient’s life. For additional, the surgeon must have to expert in open surgery skill this is the standard approach for shift to robotic surgery.” Surgeon (C₃)</p>

Table 4.4 A summary of relating factors toward robotic surgery in Thailand by senior staff (cont.)

Key factors	Respondents
Operation time	<p>“According to the feature of the robotic surgery, it makes the surgeon work properly in field and it will effect to the operation time because less incident during operation when compare with the traditional surgery.” Surgeon (C₁)</p> <p>“The robotic surgery uses longer operative time than laparoscopic surgery because the preparation process is complicate and need specialist to support in this step.” Surgeon (C₃)</p>
Fast recovery	<p>“According to the system design to enhance surgeon capability then the outcome in postoperative will less complication when the complication is less, patient will recovery faster.” Surgeon (C₂)</p>
Length of stay in the hospital	<p>“Shorter than traditional but exchange with the high cost that patient have to absorbed.” Surgeon (C₁)</p> <p>“The hospital stay almost as long as laparoscopic surgery except some procedure is very complicate the robotic surgery will manipulate better outcome than laparoscopic surgery.” Surgeon (C₃)</p>

Table 4.4 A summary of relating factors toward robotic surgery in Thailand by senior staff (cont.)

Key factors	Respondents
Cost effectiveness	<p data-bbox="624 461 1391 658">“In this situation, the amount of operation case from the robotic is very less that impact to the hospital to absorb the budget for the patients and it’s not cost effectiveness at all.” Surgeon (C₁)</p> <p data-bbox="624 734 1391 987">“When the robotic system’s price is reducing the robotic surgery will substitute to laparoscopic surgery then the number of cases by robotic will shooting from the trend of this technique it can be cause to be more cost effective in the future.” Surgeon (C₃)</p>
Cost of technology	<p data-bbox="624 1068 1391 1265">“Currently the cost of robotic surgery is lower than the past but it still difficult to access this technology because some hospital it lacks of the readiness in healthcare professional.” Surgeon (C₁)</p> <p data-bbox="624 1344 1391 1653">“Cost is the main concern for this technology because not only the system that hospital has to invest but the hospital has to pay for maintenance fee yearly it cost amount 5 million Thai baht. And the instrument to use in the operation is almost disposable that add more cost per one operation.” Surgeon (C₂)</p> <p data-bbox="624 1731 1391 1877">“The total cost is very expensive. This issue is a main concern in this technology and many hospitals does not want to invest in this system” Surgeon (C₄)</p>

Table 4.4 A summary of relating factors toward robotic surgery in Thailand by senior staff (cont.)

Key factors	Respondents
Technology complexity	<p>“The age effect the skill to acknowledge the new technology especially the robotic which it like a new platform in the world the surgeon has to start at the beginning.” Surgeon (C₁)</p> <p>“Almost pitfall is come from the user that don’t understand the technology and not practice to pass the learning curve. This factor could be danger and harmful to the patient because the system is complex and novel for every surgeon. Therefore, they must train to know the complex of this technology before use with the patient to prevent a complication.” Surgeon (C₃)</p> <p>“The size of system is too big that effect in some operation” Surgeon (C₄)</p>

Table 4.4 A summary of relating factors toward robotic surgery in Thailand by senior staff (cont.)

Key factors	Respondents
Reimbursement	<p data-bbox="624 461 1390 712">“This is the main point that the surgeon who use robotic discuss to find the solution for the patient because the government does not support technique and it affect to the patient’s accessibility to a good treatment in Thailand.” Surgeon (C₁)</p> <p data-bbox="624 790 1390 987">“Almost health insurance can reimbursement but not fully support (Depend on insurance limit). The patient has to co-pay some charge when get service from robotic surgery.” Surgeon (C₂)</p> <p data-bbox="624 1066 1390 1317">“In Thailand the reimbursement is not cover for this technique. Many surgeons difficult to offer the robotic surgery for the patient because almost patient in public hospital they don’t have money to pay for the surgery.” Surgeon (C₄)</p>

Table 4.4 A summary of relating factors toward robotic surgery in Thailand by senior staff (cont.)

Key factors	Respondents
Direction of the robotic surgery in Thailand	<p>“The new generation of the surgeon is interested in the robotic surgery and the popularity is increasing every year. Additional of the price is decreasing from the factor of the resource and accessibility. In the future, the robotic surgery will be goal standard for treatment in every hospital and it help in term of economy in the country to reduce the waiting list of the patients also.” Surgeon (C₁)</p> <p>“The acceptance is increasing from the past because the patient who get service by robotic surgery, they perceive the benefit of this technology and to be a word of mount that make this technique well known widely. Therefore, robotic surgery will substitute other minimal invasive technique in the future.” Surgeon (C₂)</p> <p>“The robotic develop to overcome all limitation of laparoscopic surgery and improve in many aspects but it stuck with the issue about cost that is very high. For 1 system the hospital has to pay up to 100 million Thai baht exclude maintenance fee and instrument cost that why the robotic surgery in Thailand has slowly growth when compare with another country. If the price is more reasonable, the robotic surgery will be widely used for sure” Surgeon (C₃)</p>

Table 4.4 A summary of relating factors toward robotic surgery in Thailand by senior staff (cont.)

Key factors	Respondents
Direction of the robotic surgery in Thailand (cont.)	<p>“Thailand government should support to develop robotic surgery platform in the country to increase technology accessibility. Moreover, the patient should to get the service with the reasonable price and equality for everyone.” Surgeon (C₄)</p>
Academic in Thailand	<p>“Currently, robotic surgery is like a premium technique that cannot implement in every medical school because the total cost is very high.” Surgeon (C₂)</p> <p>“The surgeon in academic have to train with the standard system to know the approach involve understand advantage and awareness of robotic surgery. Moreover, in academic the surgeon can observe with the professor to see the step to handle with the complication that can happen during operation.” Surgeon (C₃)</p> <p>“In the future every medical school must have robotic system to adopt with the healthcare trend in the global and improve capability of healthcare in Thailand” Surgeon (C₄)</p>

Table 4.4 A summary of relating factors toward robotic surgery in Thailand by senior staff (cont.)

Key factors	Respondents
Vendor in the market	<p data-bbox="624 461 1378 607">“It has only one company who develop robotic surgery in the market with the high innovation and many model to support in each procedure.” Surgeon (C₁)</p> <p data-bbox="624 680 1378 938">“Currently, the Intuitive company is monopoly in this market but the copyright is already expired. So, many company would like to entry in this market and the price will be decreasing to compete with the other. This is a good opportunity for the user.” Surgeon (C₃)</p>
The patient accessibility	<p data-bbox="624 1016 1378 1218">“Patient can access this technology at some hospital where has the funding from the foundation to support them or the patient who has the budget to self-pay for this technique.” Surgeon (C₁)</p> <p data-bbox="624 1292 1378 1494">“From the last two year the growth of robotic center is increasing significantly especially in the medical school and big private hospital. From this trend the accessibility in this technique will increase for all patient.” Surgeon (C₃)</p> <p data-bbox="624 1568 1378 1713">“When fully implement of robotic surgery in Thailand. The patient will be access easier and it will turn to be goal standard for a surgery in the future” Surgeon (C₄)</p>

Table 4.4 A summary of relating factors toward robotic surgery in Thailand by senior staff (cont.)

Key factors	Respondents
Government policy	<p>“Thai government overlook the healthcare global trend and focus only the traditional surgery that make the country behind to the global. Especially, for laparoscopic surgery in some procedure still cannot reimbursement. The policy should support more to improve the access for the Thai citizen.” Surgeon (C₁)</p> <p>“Every reimburse scheme in Thailand cannot reimburse in this technique. In the other hand, many procedures to do with laparoscopic skill can fully reimburse that make the surgeon choose laparoscopic technique to save cost for patient.” Surgeon (C₂)</p>

Table 4.4 A summary of relating factors toward robotic surgery in Thailand by senior staff (cont.)

Key factors	Respondents
Healthcare global trend	<p>“Nowadays, many countries try to use Tele-surgery to surgery the patient who stay at another province in the same country by use the high telecommunication (5th generation technology) to combine with the robotic surgery but it has to align with the ethical and regulation in each country.” Surgeon (C₁)</p> <p>“Tele-surgery is the model that many surgeons interesting to use robot to operate across the world but now it’s during in trail process about the safety and effective because it depends on the efficiency of the network in the present.” Surgeon (C₃)</p> <p>“In military, Tele-surgery is adapt to use for save the patient’s life from the long distance such as in battle field.” Surgeon (C₄)</p>

Table 4.5 Comparative findings from the three cases

	Young staff	Intermediate staff	Senior staff
User perspectives	<ul style="list-style-type: none"> • New technology • Change behavior of the surgeon • Health global standard • Substitute the traditional surgery 	<ul style="list-style-type: none"> • New technology • Change behavior of the surgeon • Health global standard • Substitute the traditional surgery • Improvement of minimal invasive approach • International acceptance 	<ul style="list-style-type: none"> • New technology • Change behavior of the surgeon • Health global standard • Emerging healthcare technology • Develop to overcome the limitation • Improvement of minimal invasive approach • Standard for healthcare academic • Substitute the traditional surgery
Experience requirement	<ul style="list-style-type: none"> • Open surgery skill • Set the robotic surgery team • Robotic training program • Principle of surgery 	<ul style="list-style-type: none"> • Laparoscopic surgery skill • Robotic training program • Authorized by Intuitive company • Principle of surgery 	<ul style="list-style-type: none"> • Laparoscopic surgery skill • Robotic training program • Authorized by Intuitive company • Principle of surgery • Mentoring program • Observe in workshop

Table 4.5 Comparative findings from the three cases (cont.)

	Young staff	Intermediate staff	Senior staff
Patient outcome	<ul style="list-style-type: none"> • Fast recovery • Less pain • Small wound • Preserve nerve 	<ul style="list-style-type: none"> • Fast recovery • Less pain • Small wound • Preserve nerve • Shorten length of stay in the hospital • Shorten operation time 	<ul style="list-style-type: none"> • Fast recovery • Less pain • Less blood loss • Small wound • Preserve nerve • Shorten length of stay in the hospital
Issue affecting implementation	<ul style="list-style-type: none"> • Technology complexity • Limited budget • High cost • Readiness in the hospital 	<ul style="list-style-type: none"> • Technology complexity • High cost • Readiness in the hospital • Less support from the government • Surgeon's mindset • Cost effective 	<ul style="list-style-type: none"> • Technology complexity • High cost • Readiness in the hospital • Less support from the government • Surgeon's mindset • Cost effective • Less research in the country
Concern on the learning curve	<ul style="list-style-type: none"> • Takes about 5-10 cases to go through the learning curve 	<ul style="list-style-type: none"> • Takes about 10-15 cases to go through the learning curve 	<ul style="list-style-type: none"> • Takes about 20 cases to go through the learning curve

Table 4.5 Comparative findings from the three cases (cont.)

	Young staff	Intermediate staff	Senior staff
Technology accessibility	<ul style="list-style-type: none"> • Small amount of installation site • Only locate in big medical school • Expensive price 	<ul style="list-style-type: none"> • Small amount of installation site • Only locate in big medical school • Expensive price • Limited of reimbursement scheme • Monopoly 	<ul style="list-style-type: none"> • Small amount of installation site • Only locate in big medical school • Expensive price • Limited of reimbursement scheme • Monopoly • Currently not available on curriculum
Technology benefit	<ul style="list-style-type: none"> • Enhance capability of surgeon • Improve ergonomic • Improve clinical outcome 	<ul style="list-style-type: none"> • Enhance capability of surgeon • Improve ergonomic • Improve clinical outcome • Increase stability during operation • More dexterity 	<ul style="list-style-type: none"> • Enhance capability of surgeon • Improve ergonomic • Improve clinical outcome • Increase stability during operation • More dexterity • Further development to Tele-surgery

Table 4.5 Comparative findings from the three cases (cont.)

	Young staff	Intermediate staff	Senior staff
Policy and regulation	<ul style="list-style-type: none"> • Not support to reimbursement • Insurance not fully support this technique 	<ul style="list-style-type: none"> • Not support to reimbursement • Insurance not fully support this technique • Government rejects to add this technique to treatment protocol 	<ul style="list-style-type: none"> • Not support to reimbursement • Insurance not fully support this technique • Government rejects to add this technique to treatment protocol • Lack to support the research of robotic in country

4.3 The factors toward robotic surgery in Thailand by patients

Patients who receive services from a hospital usually choose a technique based on a surgeon's recommendation, especially in public hospitals, where the patient's goal is to recover from their disease using any technique available, making it easier for the surgeon to choose the most appropriate technique for them. Patients who receive care at a private hospital are different from the patients at public hospitals because they are already aware of the most appropriate technique for them. As a result, patients can be divided into two groups: those who accept any method because they lack knowledge about treatment methods, and those who gather information about treatment techniques and then choose which one they want to receive service from. The writer will discuss in terms of before and after getting the service by robotic surgery as TABLE 4.6 in part of the emotional and perspective from the patients who get the service by robotic surgery.

Table 4.6 The perspective from the patients who get the service by robotic surgery

Perspective to get the service	Before get the service	After get the service
Patient who doesn't have the knowledge about robotic surgery	"This group almost the patient doesn't know the benefit of this technology but they ensure that they will get the best outcome from the surgeon's recommendation but some of them feeling worry about the robot."	"The patient feels comfortable and satisfy because of the outcome is better than they expectation by less pain and get a small wound. Also, use less time to stay at the hospital."
Patient who gathers information and know the benefit of robotic surgery	"The patient in this group they trust in this technology and satisfy to get the service by robotic surgery which the newest technology in the surgery approach. All of this group are very confident in this technique."	"The outcome is excellent for them same as their expectation and the information that they research before get the service by robotic. Moreover, the patient in this group they feel satisfy like they get a premium service in this treatment."

Overall, in terms of surgeon and patient acceptance and potential, robotic surgery in Thailand has a mixed impact. On the one hand, almost all patients benefit in terms of feeling and outcome from the surgery by feeling more confident, relaxed, and having a good clinical outcome, but on the other hand, the final decision to choose the technique to treat depends on the surgeon. The surgeon must select a technique that is compatible with all aspects of the patient's condition, including procedure, budget, and complication. The surgeon is the user who performs the surgery and controls the robotic system in order to treat the patient. According to the interview analysis, there are several factors that influence the surgeon's productivity, including learning curve, technology complexity, technology accessibility, and country policy. Many surgeons are aware of

the benefits that this technology can provide, as it improves a variety of clinical outcomes and overcomes limitations in surgery, all of which have an impact on the patient's life by increasing survival rates, reducing complications, and improving their quality of life. Although robotic surgery has numerous advantages in the modern era of surgery, the main issue is the expense of the system, which limits the accessibility of many healthcare organizations because the hospital must spend a significant amount of money to install the robot and pay annual maintenance costs. Furthermore, every procedure requires the use of a disposable instrument, which increases the hospital's costs. By the way, the Thai government does not allow reimbursement policies for this technology in any treatment, thus patients who want this service must pay for it themselves. As a result of this aspect, the country's healthcare innovation lags behind the worldwide trend.

4.4 Summary of the key factor affecting to the acceptance in robotic surgery

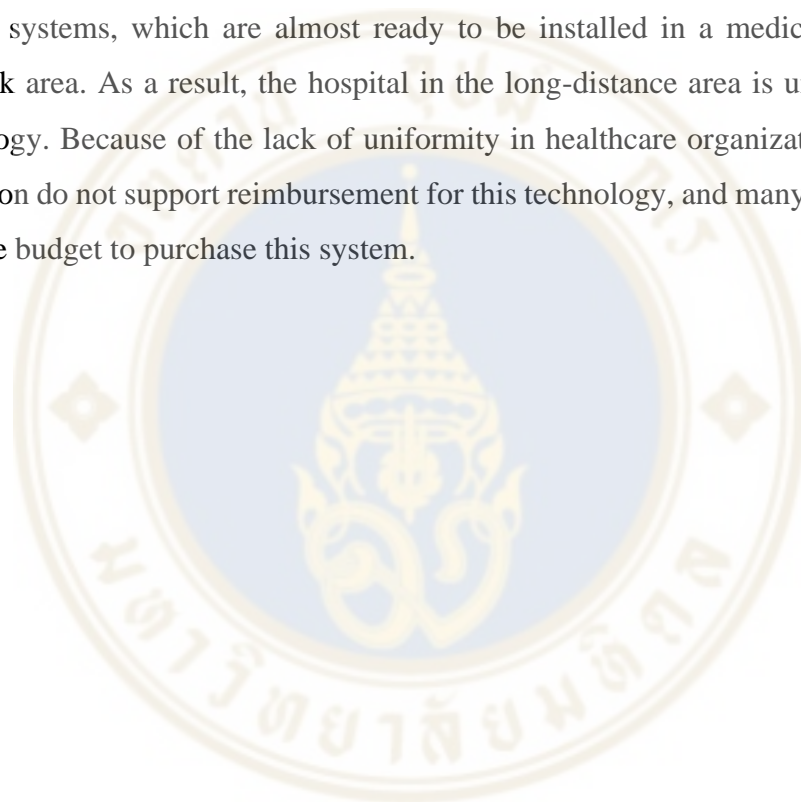
According to the group interview, the writer discovered that varied experiences influenced robotic surgery perspectives. The young who are new to robotic surgery will concentrate on the features and outcomes that robotic surgery offers to the user and the patient. Also fascinating is the new era of surgery, which has arrived to transform the treatment platform and catch up with the global healthcare trend. Despite the fact that this group initially found the technology to be complex, they have learned to use it and have adapted to it in order to improve clinical outcomes and expand their capabilities. This group does not place a high value on learning curves and experience requirements because they believe that in order to adapt to a new technology, the user must adjust their mindset. For the intermediate surgeon, this group focuses primarily on expertise, particularly in laparoscopic skills, as well as the robotic company's training program. This group's vision is that, in the long run, robotic surgery will be the standard procedure since it provides a better outcome for both the patient and the physician. In addition, they believe that the benefits they receive from this technology are worth investing in and promoting in order to enhance Thailand's healthcare system. The last group consists of senior surgeons, practically all of whom are experts in robotic surgery

and have performed a large number of operations. They predict that in the future, robotic surgery will be used to replace laparoscopic surgery in a minimally invasive approach because this technology overcomes surgical limitations. Furthermore, because the function is designed to increase the surgeon's dexterity and stability, which has a direct effect on the patient's outcome, robotic surgery can improve patient survival rates and reduce complications. These characteristics have an impact on Thailand's healthcare economy in terms of improving quality of life and lowering long-term re-operation costs. The senior staff also mentioned that medical schools should include this technique in their usual curriculum to ensure that new surgeons are well-versed in all approaches to patient treatment.

Every group has the same concern, which is that the expense of investing in a robotic system is prohibitively expensive. And, as a result of the high cost, patients' accessibility is impacted because they must pay for a large number of operation's cost in the treatment program. There is still no support for this technique in both public and private hospitals. This is a major drawback that prevents Thailand from adopting robotic surgery. The insurance company does not have a plan that includes this approach as a regular therapy, but it will cover a portion of the cost for patients who receive this service in a private hospital. Although many surgeons' societies raise this matter to demonstrate the superior clinical outcome and long-term value, government policy does not pay attention to this new procedure. However, some public hospitals receive funds from foundations to help patients, but this is not a long-term answer for the healthcare system.

Through a comparative analysis, practically most surgeons have a positive attitude toward robotic surgery, which has evolved to improve clinical outcomes and shape the future of surgical treatment with cutting-edge technology to prevent complications during surgery. Another aspect of experience requirements, it is still variable because it depends on each capability and technological adoption. As a result, each surgeon's learning curve will be different. For example, a surgeon with laparoscopic skills will have a quick learning curve when switching to robotic surgery. In terms of patient outcomes, according to the interview discussion, all of the surgeons found that using this approach in the operation resulted in faster recovery, shorter hospital stays, and less blood loss. The surgeon is almost concerned about the

complexity of the technology because it is novel and changes the surgeon's entire behavior. The surgeon must begin learning this technology from the beginning, and the cost of robotic surgery is extremely high, which has a negative impact on its implementation in Thailand. Furthermore, the government does not have any policies in place to promote this technological approach, which makes surgeons uncomfortable giving robotic surgery to patients in public hospitals. The next factor is technological accessibility, which is related to the expense of technology and is the most significant obstacle to robotic surgery in the country. Currently, Thailand has only seven robotic surgery systems, which are almost ready to be installed in a medical school in the Bangkok area. As a result, the hospital in the long-distance area is unable to use this technology. Because of the lack of uniformity in healthcare organizations, policy and regulation do not support reimbursement for this technology, and many hospitals do not have the budget to purchase this system.



CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1 DISCUSSION

5.1.1 Integrating Technology Acceptance Model into the analysis framework

After identifying the key factors, the author analyzes the factors that influence the surgeon's acceptance and develops a model based on the Technology Acceptance Model (TAM) to explain the adoption behavior of users who choose to use robotic surgery, which is a relatively new technology in this generation. The TAM model is derived from the theory of reasons and actions (TRA), which demonstrates the factors that influence a user's willingness to receive new knowledge. According to the TAM model, the most important aspect is behavior intention, which is critical for actual use of the technology. The behavioral intention is created by the user's mental intention, which is influenced by their attitude and perceived usefulness. The user's perception of the benefit of robotic surgery will also influence their attitude, and the system must be user-friendly. In addition, external variables such as user interface, ergonomics, and convenience of handling in robotic systems will have an impact on the utility and ease of use. As a result, perceptions of utility, convenience of use, and attitude are significant factors in generating acceptance in robotic surgery using the Technology Acceptance Model. (In figure 2.1)

In this study, the writer constructs a mental model that uses analysis in the factors affecting robotic surgery in Thailand, using the TAM model and data finding analysis. This model synthesizes the surgeon's perspective and attitude in the three groups, including their experience with robotic surgery in the operation case, to explain the surgeon's acceptance of robotic surgery.

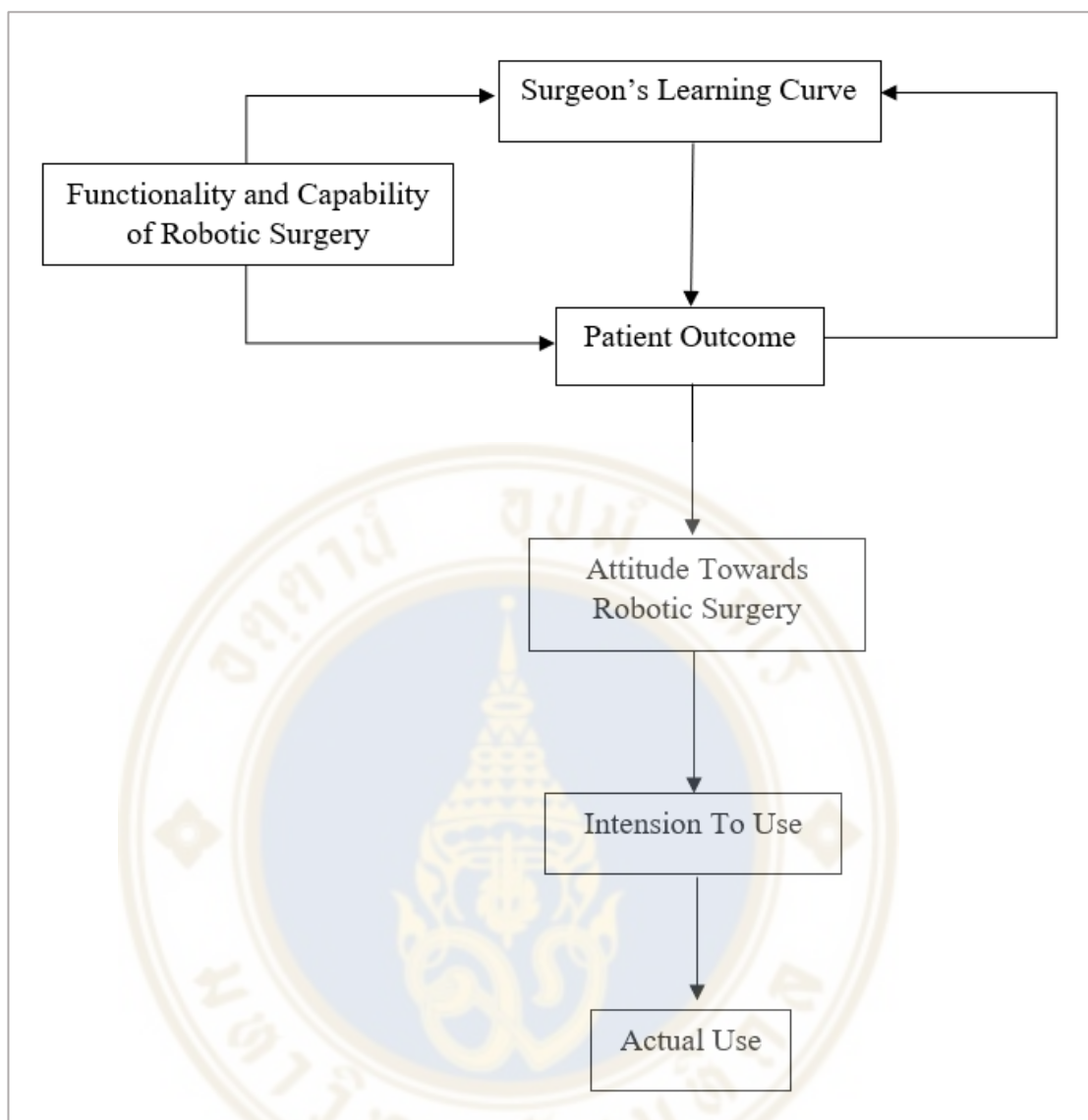


Figure 5.1 Proposed Mental Model

As demonstrated in the mental model, the acceptance of robotic surgery is triggered by the technology's functionality and capabilities, which provide an innovative platform and remarkable results for the user. After that, the user must train with a simulator and dry lab to pass the learning curve, which will affect the technology's ease of use and make it more practical. When a surgeon has a positive patient outcome, his or her learning curve also improves as well. The patient's outcome is used to determine the technology's usefulness. These factors will establish in the user a positive attitude about robotic surgery and persuade them to utilize robotic surgery as a general treatment option.

According to the findings, the patient outcome is the most important aspect influencing the acceptance of robotic surgery. This is because the outcome after using the system is used to demonstrate its effectiveness. Many respondents indicate improved outcomes such as reduced pain, faster healing, shorter hospital stays, and less blood loss. The result is a physical object that allows the user to directly assess the system's performance. Furthermore, the robotic functionality overcomes surgical care limitations, allowing the patient's performance in the surgery to increase. Additionally, facilitate surgeons in working to be more efficient and with less fatigue, enhance ergonomics, and enable surgeons to operate in difficult angles and in dimensions where laparoscopic surgery cannot work properly. With a better patient outcome, patients are more satisfied with a quick recovery and less pain, which they can feel in the post-operative period. The acceptance of robotic surgery will expand as the number of cases increases and it is proved that it improves the patient's quality of life through clinical outcomes.

Because robotic surgery is a new surgical technology, its acceptance and potential are determined by technology adoption. Almost every issue, according to the respondents is linked to human factors such as learning curves, experience and the user's perspective. According to the proposed mental model (Figure 5.1), the patient outcome reflects the usefulness of this system, and better patient outcomes will generate more skill for the surgeon then increasing the ease of use of this technology before it is adopted for actual use in the healthcare organization. When compared to research on healthcare technology acceptance in Thailand, Gerd Sri and Suebsin conducted qualitative research on IT system adoption among healthcare staff in four hospitals to identify the factors that influence technology adoption and came up with the same conclusion that attitude toward technology is influenced by perceived usefulness and generates actual use of the new technology. (Gerd Sri, 2020)

The potential to implement robotic surgery in Thailand is constrained by a lack of government assistance, as the government is unable to reimburse for the cost of the procedure, and long-distance public hospitals lack the funds to invest in this system. This is a barrier to entry for this technology, and it prevents the surgeon from completely implementing the approach. However, the potential is slightly increasing as a result of

the pressure from the global healthcare trend that continues to emerge in surgical care, and the country must adapt to keep up for the sake of the country's citizens' health.

5.2 Recommendation

In terms of the recommendation, the author uses a neutral perspective to provide a solution based on the interview findings to improve robotic surgery acceptance and potential. The writer divides the research into three pillars: healthcare company, medical school, and policy regulation, in order to cover all aspects in a multi-perspective approach.

5.2.1 Healthcare company

Because of the global healthcare trend, many countries have adopted this procedure as a general surgical treatment, healthcare companies should pay attention to this technology in order to capitalize on this opportunity. Because this market is now monopolized, there is an opportunity to take the lead and overtake the market leader. Furthermore, because today's resources and technology are so innovative, a newcomer can create something unique and increase performance to outperform the market leader. Additionally, the pricing should be reasonable in order for the buyer to provide more access to the products due to the economies of scale. Also, the corporation should offer a hire purchase program to make robotic surgery more accessible to customers who have a restricted budget but are willing to upgrade their hospital.

5.2.2 Medical school

Almost every medical school is located in a large public hospital that receives significant government financing. As a result, medical schools have a high potential to implement robotic surgery, so they should prepare healthcare professionals to be ready to support the new surgical technique by supporting their education by observing in hospitals that already use robotic surgery or acknowledging to people who work closely in this field. When robotics is implemented in the hospital, this strategy will shorten the learning curve for the professionals. Furthermore, the institution should form a robotic surgeon team to develop a strategy for implementing this technology in

the hospital and set up a lab for surgeons who are interested in robotic procedures to practice on themselves. This strategy will transform the hospital into an innovative hospital, similar to those found in other countries. Also, a collaboration with another hospital to exchange robotic surgical experience in order to expand accessibility in Thailand. For the academic sector, the principles of robotic surgery should be included in the medical school curriculum in order to broaden medical students' perspectives in the new era of surgical care and boost robotic surgery's acceptance in Thailand.

5.2.3 Policy regulation

It should have a policy that supports robotic surgery as a standard procedure in surgical care, because reimbursement is a major obstacle to this technology's accessibility. To have a beneficial impact in the healthcare organization, the government should provide greater support and promote this technique. Furthermore, the benefit of this technology is that it can be cost effective as the number of cases grows, and it can increase the capabilities of the country's hospitals, thereby resolving the issue of long waiting lists at public hospitals.

5.3 Limitation

The writer discovered that the number of directly experienced surgeons to interview is a limitation to gathering information because there is now a limited group of users in Thailand who utilize the robotic surgical approach, and almost all of them are professors in medical schools. The author's limited study time is a limitation because if the writer had more time, the writer could employ other methods to locate another component. So, if this study has a larger number of directly experienced surgeons to interview, more user perspectives and other factors that influence their decision to employ robotic surgery in Thailand could be discovered. The research findings will get more information in terms of experience and concern in this approach with different levels of surgeons. If this research is given more time to complete, it will be able to reach out to a larger range of surgeons, such as those in Bangkok and those from other provinces, who will offer different perspectives. Furthermore, because patient data is confidential, some hospitals do not allow interviews. As a result, some information has been concealed, and the writer is unable to fully interview the patient who is in conflict with hospital protocol.

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