

THESIS

**IMPLEMENTING LEAN SIX SIGMA TO IMPROVE
SERVICE QUALITY IN THE DEPARTMENT OF
RADIOLOGY AT PUBLIC HOSPITAL THALIA
IRHAM GOWA**

Written and presented by:

NURUL FAKHIRA

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PERNYATAAN KEASLIAN

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Implementasi Lean Six Sigma dalam Usaha Peningkatan Pelayanan Kualitas di Departemen Radiologi RSUD Thalia Irtam

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Segala data dan informasi yang diperoleh selama proses pembuatan skripsi, yang akan dipublikasi oleh Penulis di masa depan harus mendapat persetujuan dari Dosen Pembimbing.

Apabila dikemudian hari terbukti atau dapat dibuktikan bahwa sebagian atau keseluruhan isi skripsi ini hasil karya orang lain, maka saya bersedia menerima sanksi atas perbuatan tersebut.

Gowa, 23 Agustus 2023

Yang Menyatakan Tanda Tangan,



Nurul Fakhira

LEMBAR PENGESAHAN SKRIPSI
IMPLEMENTASI LEAN SIX SIGMA DALAM USAHA
PENINGKATAN PELAYANAN KUALITAS DI DEPARTEMEN
RADIOLOGI RSU THALIA IRHAM

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PREFACE

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This thesis is still not perfect both in terms of content and the right choice of words. Therefore, researcher are very welcome to suggestions and constructive criticism from readers. I hope that this thesis will be useful for all of us.

Pulau Pinang, 14 June 2023

Nurul Fakhira



ABSTRACT

NURUL FAKHIRA. *Implementing Lean Six Sigma to Improve Service Quality in the Departement of Radiology at Public Hospital Thalia Irham Gowa* (Supervised by Ir. Kifayah Amar, ST, M.Sc, Ph.D., IPU and Dr. Nur Amalina Binti Muhammad).

Thalia Irham Hospital is a health facility for the surrounding residents of Bajeng, Panciro, Pallangga and Malino sub-districts because access to other hospitals is still quite far away. But in the review of this hospital on Google, it only gets 2.9/5 stars and some patients complain about the processing time of health services. This study used the Lean Six Sigma method in Radiology department, to improve quality by reducing service time on ultrasound checks. The results obtained NVA activity of 1154,32 s; VA activity of 448,53 and lead time of 1602,85 s with a %PCE (Percentage of Process Cycle Efficiency) of 28% with %non-value-added activity of 72%, the data shows that the hospital still has a great opportunity to improve process efficiency. After obtaining an improvement plan and obtaining an overview when implementing the plan, the results of NVA activity of 423,39 s; VA activity of 448,53 and lead time of 871,91 s with a %PCE calculation of 51%, this value has increased by 50% of the process. In addition, the percentage of non-value-added activity is reduced by 49%, which means that non-value-added activity can be handled with the right solution.

Keywords : *Lean Six Sigma, Quality, Waste*

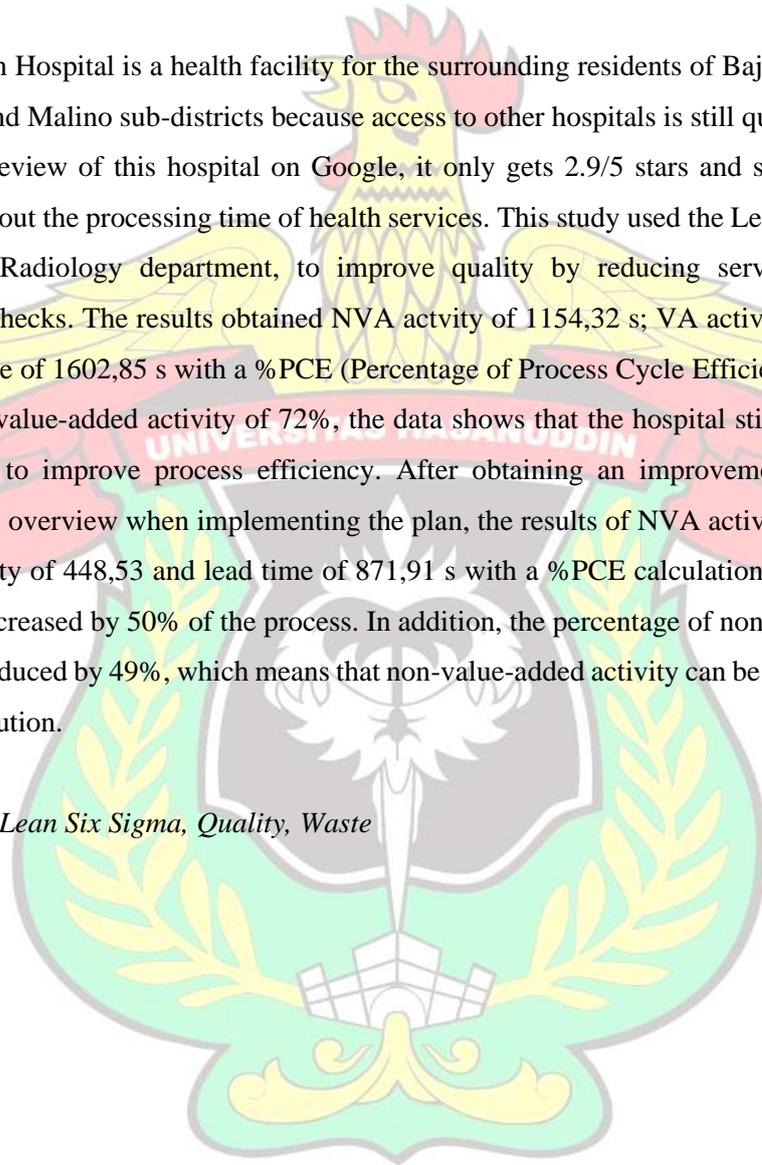


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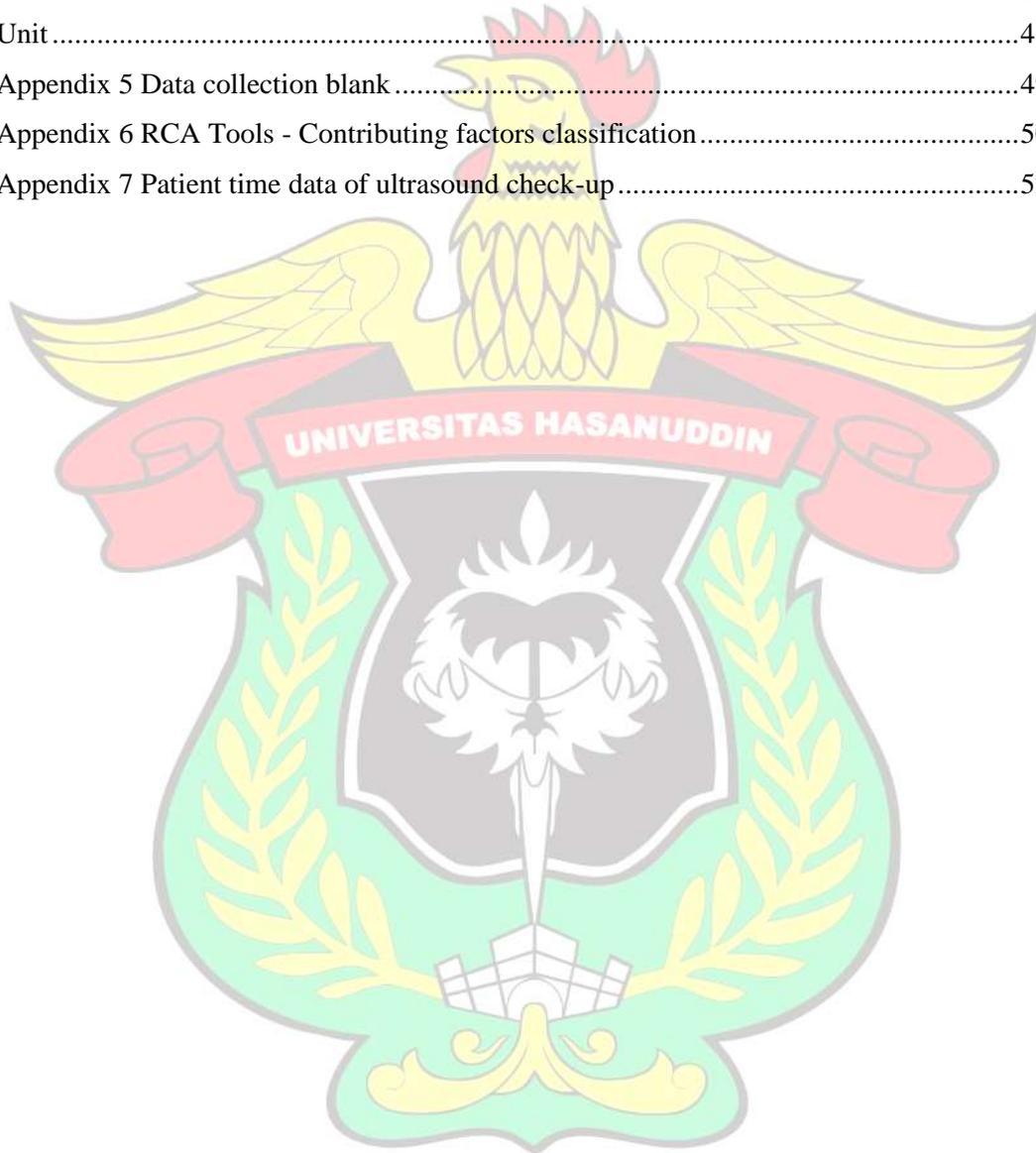
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CHAPTER I

INTRODUCTION

1.1 Background

The continued pressure on healthcare budgets has led many local and national healthcare organizations to explore methods of improving quality, safety and value in healthcare service deliveries (Sloan et al., in McDermott et al., 2022). Based on Peraturan Menteri Kesehatan Republik Indonesia No. 340/Menkes/Per/III/2010, it was explained that hospitals in Indonesia are categorized based on facilities and service capabilities into public and specialized types. It is also explained that public hospitals provide health services in all check-up focuses, while specialized hospitals only provide health services based on science, age groups, and certain diseases. In section 4, it is explained that the classification of public hospitals is divided into 4 categories based on facilities and service capabilities, including class A, class B, class C and class D public hospitals. Public hospital Thalia Irham is in class D, with a description that class D hospitals have at least 2 types of basic specialist medical services with service capabilities, namely public medicine, emergency department, basic specialist medicine, nursing, midwifery, and clinical and non-clinical supporting services. Public hospital Thalia Irham is a private hospital that has been operating since 4 December 2007 and is located on Jalan Poros Limbung Km. 15, Panciro, Bajeng District, Gowa Regency, South Sulawesi. This hospital is a health facility for the surrounding residents of Bajeng, Panciro, Pallangga and Malino sub-districts because access to other hospitals is still quite far away. There is a wide range of health services and facilities for use by all communities. Public hospital Thalia Irham is fully operational for 1x24 hours for 7 days a week. Until now, there are 22 doctors who are ready to serve patients both in the ER, outpatient, inpatient, HCU or during surgery. Several health check-up supports that have been operating such as specialist in Internal Medicine, Obgyn, Neurology, Surgery, Anesthesia, Eye, Pediatric, Radiology, Laboratory (Clinical Pathology) and laboratory.

Like most hospitals, Public hospital Thalia Irham tries to realize good service by allocating human and managerial resources. When the quality of the hospital is good or increasing, it will affect patient satisfaction, which in turn does not hesitate to come back to the hospital because it already has good awareness. One of the clinics that is very influential on Public Hospital Thalia Irham services is the radiology department, because

its patients come from patients in other clinics who need more serious examinations. According to Peraturan menteri Kesehatan Republik Indonesia Nomor 24 Tahun 2020 tentang Pelayanan Radiologi Klinik, stated in section 21 that every health care facility that organizes clinical radiology services must have an effective, efficient, and accountable Clinical Radiology Service organization. In addition, in section 27, it is stated that health care facilities organizing clinical radiology services must carry out quality control of clinical radiology services. Regardless of hospital managerial efforts that continue to improve service quality, it cannot be denied that there are some patients who complain about the quality of service of Public Hospital Thalia Irham. In the review of Public Hospital Thalia Irham on Google, it only gets 2.9/5 stars, the review contains complaints about the long service time. In Figure 1, it can be seen that some patients complain about the queuing times, service times, and information.



Figure 1 Review of Public Hospital Thalia Irham from Google

Based on the description of the problem above, it is necessary to propose improvements to hospital services, one of which is the Lean six sigma method. Over the past few years, there has been a consistent increase in case studies related to Lean six sigma

(LSS) in healthcare since 2003, with a peak of publications in the last four years. A review of several articles revealed that there are various factors for healthcare providers to implement Lean, Six Sigma and Lean six sigma concepts. Some of these factors include external factors related to compliance with national health authority regulations, standards and guidelines. In addition, continuous quality improvement in health services is also due to high competitiveness, profitability performance, reducing waiting time, improving workflow, safety, service quality and customer satisfaction. The combination of LSS with Industry 4.0 technologies can support the operational functions of healthcare. The healthcare field is unique in that it focuses on zero tolerance processes in clinical and non-clinical practice. Successful implementation of LSS across the organization can improve the efficiency and effectiveness of healthcare, thereby attracting stakeholder participation to build sustainable change. Sustainable change includes improving employee morale through training and education, enhancing team member skills, consistent communication and determining the right metrics for each strategic goal (McDermott et al., 2022).

1.2 Problem Statement

The problem statement of this research are:

- a. How to find out waste time in ultrasound check-up services at Public Hospital Thalia Irham?
- b. how efficient is the ultrasound check-up service process at Public Hospital Thalia Irham?
- c. What improvement recommendations can be implemented at Public Hospital Thalia Irham to improve the quality of ultrasound check-up services?

1.3 Research Objectives

The objectives of this research are:

- a. Identifying lead time, value added, and non-value added of the ultrasound check-up service process at Public Hospital Thalia Irham
- b. Analyze the efficiency of the ultrasound check-up service process at Public Hospital Thalia Irham
- c. Provide recommendations for improvements that can be implemented at Public Hospital Thalia Irham to improve the quality of ultrasound check-up service process

1.4 Research Benefits

The benefits of this research are:

- a. In theory, hospitals can improve service quality which ultimately increases patient satisfaction and the progress of the health industry
- b. The results of the study can be used as decision-making material for managers related to hospital services or performance. In addition, this research can be a reference and expand the object of Quality Management research in Indonesia

1.5 Problem Restrictions

In order for the research to lead to the predetermined objectives, there are problem restrictions that are applied as follows:

- a. The research was conducted at Public Hospital Thalia Irham, especially at the Radiology Department polyclinic patients
- b. The method used is Lean six sigma to identify waste time in the services of Public Hospital Thalia Irham services

1.6 Research Systematization

The research systematics is made to obtain a clear overview of this final project research. The explanation is as follows:

CHAPTER I INTRODUCTION

This chapter contains the background, problem statement, research objectives, research benefits, and research restrictions. This chapter discusses the problems faced and the objectives of this research.

CHAPTER II LITERATURE REVIEW

This chapter contains theories about service quality, Voice of Customer, Voice of Business, Lean six sigma, Process Cycle Efficiency, Value Stream Map, Cause and Effect Diagram, Kaizen, Sampling Techniques and Past Research.

CHAPTER III RESEARCH METHODOLOGIES

This chapter contains information about the time and location of research, types and sources of data needed to carry out research, techniques used to collect data, and a research framework.

CHAPTER IV ANALYSIS AND DISCUSSION

This chapter contains data processing and a description or explanation of the data processing that has been carried out.

CHAPTER V CONCLUSION AND SUGGESTIONS

This chapter contains conclusions based on the results of data processing that has been done. And also contains suggestions from researcher which are expected to be useful for hospitals in the future.



CHAPTER II

LITERATURE REVIEW

2.1 Service Quality

2.1.1 Service Quality Concept

According to Endeshaw (2020), a concept is inherently different in both definition and meaning. Some contributors define quality with various views. Crosby's definition focuses entirely on quality as conformance to specifications, while Deming defines quality as the products and services required to satisfy customers according to their needs and expectations. Based on literature studies, service quality tends to be context-bound and dependent on the type of service.

2.1.2 Service Quality in Health Care

By Upadhyai et al. (2019), the World Health Organization (WHO) states that quality in health services should be safe (avoiding injury to people receiving services), effective (providing evidence-based health services to those who need them), person-centered (providing services that match individual preferences, needs, and values), and timely (reducing waiting times and sometimes costly delays). According to Endeshaw (2020), the quality of healthcare depends on the service process, the patient, and the healthcare provider interaction. An assessment of service quality in healthcare can look at whether there is disagreement between recipients, medical staff members and policy makers about quality in healthcare.

2.1.3 Dimensions of Health Care Quality

According to Upadhyai et al. (2019), the dimensions of healthcare quality can be classified under medical and non-medical aspects. The medical aspect of care includes three types of dimensions, which are:

- a. Technical, the technical dimension of healthcare quality includes the knowledge, skills, judgment of the provider and the medical facilities available.
- b. Outcomes, the outcome dimension of quality includes effective, efficient, equitable, timely, safe and patient-centered care.

- c. Interpersonal, the interpersonal dimension includes information exchange, friendliness, caring and developing understanding and collaboration through information exchange.

While the non-medical aspects of care affect health and well-being indirectly and include three dimensions, which are:

- a. Service landscape, the service landscape dimension covers the basic facilities and physical environment in which services are provided. This can include accommodation, building appearance, landscaping, staff member uniforms, signage, cleanliness and so on.
- b. Accessibility, the accessibility dimension includes the location of the facility, time consumption to reach it and financial affordability of care, ease of registration, billing, discharge and other non-health-related processes are also included in this dimension.
- c. Responsiveness, the responsiveness dimension here relates to expectations of reasonable care as a human being. This includes patient dignity and autonomy, confidentiality of care and quality of basic facilities.

2.2 Voice of Customer (VOC)

According to Griffin & Hauser (in Aguwa et al., 2017), Voice of Customer (VOC) is an important process that accurately records customer input describing their needs and expectations for products and services. Specifically, VOC is a market research technique that generates a detailed set of customer wants and needs, organized into a hierarchical structure, and then prioritized in terms of importance and satisfaction relative to the present. VOC studies typically consist of both qualitative and quantitative research steps. They are publicly conducted at the start of any new product, process or service design initiative to better understand customer wants and needs, and as a key input to new product definition.

According to Amoozad Mahdiraji et al. (2022), VOC is a critical analysis method that provides accurate information to support inputs related to customer needs in order to achieve goods/service outputs that meet expectations. It enables decision-makers to understand customer needs, demands, perceptions and preferences. The ability to manage and analyze VOC obtained through direct and indirect inquiries, will provide a collection of information that is transformed into strategic goals and ultimately meet customer needs.

2.3 Lean six sigma

2.3.1 Lean

Based on Syah et al. (2019), Lean focuses on identifying and eliminating activities that do not add value in design, production (for manufacturing) or operations (for services), and supply chain management, which are directly related to customers. And according to Agrahari et al. (n.d.), the foundation for successful Lean implementation in a facility setting is based on five continuous cycles. The steps of Lean improvement are as follows:

- a. Specify value, identify the value of a particular product from the customer's perspective. value can only be designed by the end consumer, although it must be created by the manufacturer.
- b. Identify the value stream, identifying the entire value stream for each product usually through three types of stages along the value stream. These are stages that create value, stages that do not create value but cannot be avoided with technology and production assets, and stages that do not add value that can be eliminated.
- c. Create flow, Once the value has been precisely determined and the value stream for a particular product has been fully mapped, the next step is to create a continuous flow of work elements with minimal queues and no rework or stoppages in the next step of the Lean transformation.
- d. Establish pull, after the non-valuable steps have been eliminated, and the flow has been established, the ability to provide services according to the things that customers really need, is the fourth principle of the Lean concept: Pull. Allowing customers to pull products through the process is an indication of the organization's ability to be responsive to customer needs.
- e. Seek perfection, the fifth principle is the perfection that an organization can already achieve.

2.3.2 Six Sigma

Six Sigma is a means to reduce variation in processes, while maintaining the basic process as it is. The focus on reducing variation is motivated by cost overruns, as variation is described as a major cause of dissatisfied customers, unsatisfactory margins, various delays, and poor supply chain performance. Six Sigma is a powerful, focused and highly effective method based on quality principles and techniques. From the pioneers of quality, Six Sigma aims to eliminate errors in business performance.

According to Anderson et al. (in Syah et al., 2019), the improvement methodology in Six Sigma for existing processes is called DMAIC and consists of five phases. DMAIC stands for five processes, which are:

- f. The first phase is "D", which stands for Define, which identifies the process or product that needs to be improved, sets up the project structure, and identifies the targets desired by the customer.
- g. The second phase is "M" which is an extension of Measure, i.e. identifying the most important influence patterns, understanding the process map and determining how to measure them.
- h. The third phase is "A" which stands for Analyze, which identifies and determines the root cause of the problem and the steps that must be taken to fix it.
- i. The fourth phase is "I" which is an extension of Improve, which is designing and testing the implementation of the most effective solution.
- j. The fifth phase is "C" which is an extension of Control, which confirms that the solution is effective and ensures it lasts by setting new standards.

2.3.3 Lean six sigma

Based on Tufail et al. (2021), The goal of lean six sigma is to reduce activities that do not add value, called waste, and reduce process variability. It redesigns business processes by combining two known philosophies, lean and Six Sigma. The lean philosophy is based on reducing waste. While Six Sigma focuses on precision and accuracy. The global healthcare sector has widely adopted Six Sigma methodology because of its zero-tolerance mechanism, which helps minimize medical procedure errors. Meanwhile, several issues including procedural errors, excessive operating costs, resource management, and quality optimization, can be optimized with the proper application of lean techniques. LSS has the potential to reshape the healthcare industry, much like its contribution to the automotive industry.

According to Syah et al. (2019), Lean and Six Sigma are ultimately initiatives to improve business processes. The ultimate goal of better process improvement focuses on different process elements so that they complement each other. Six Sigma is described as a systematic methodology with the DMAIC concept to find critical elements for the performance of a process and organize them to the best level, while Lean is described as a systematic methodology to eliminate waste and reduce the complexity of a process.

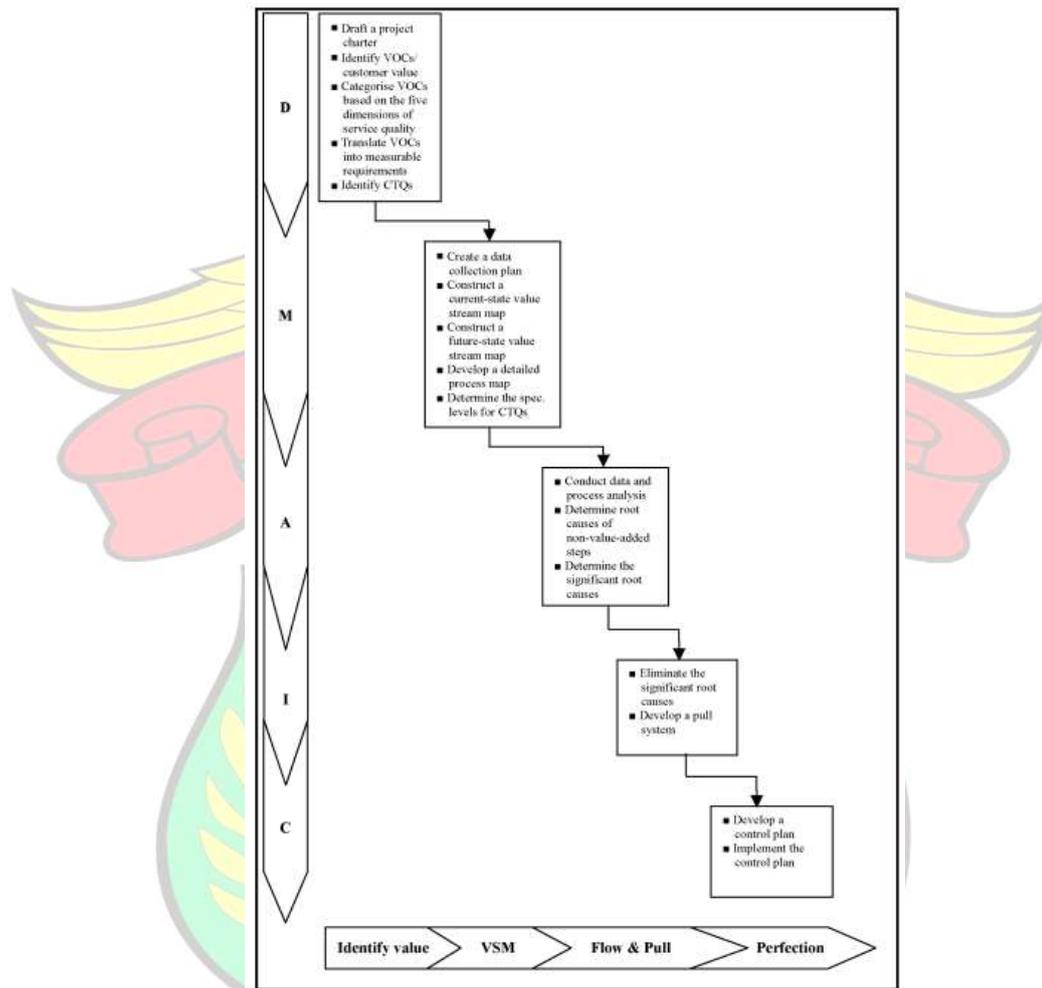


Figure 2 Conceptual Framework Lean Six Sigma for Service Quality Improvement

2.4 Process Cycle Efficiency

Taken from the VSM developed in the measure phase, PCE is an indicator applied to determine the level of waste in the process. In the analysis phase, PCE is calculated by the formula :

$$\% \text{ process cycle efficiency} = \frac{\text{value added time}}{\text{lead time}} \times 100 \quad (1)$$

According to Azelya & Thabrani (2020), the more efficient the process runs, the greater the result of the PCE calculation.

2.5 Value Stream Mapping (VSM)

According to Muniyappa (in Azelya & Thabrani, 2020), VSM (value stream mapping) is a method used to visualize, analyze, and redesign processes and supply chains for both material flow and information flow. VSM is used to analyze material flow, as well as information flow in the delivery of services to consumers, VSM can collect and analyze and present information quickly, very suitable for continuous improvement. The main purpose of VSM is to identify opportunities for improvement in the future. According to Kumar et al. (2018), VSM is a proactive approach to selecting the best technology approach at the start of a project.

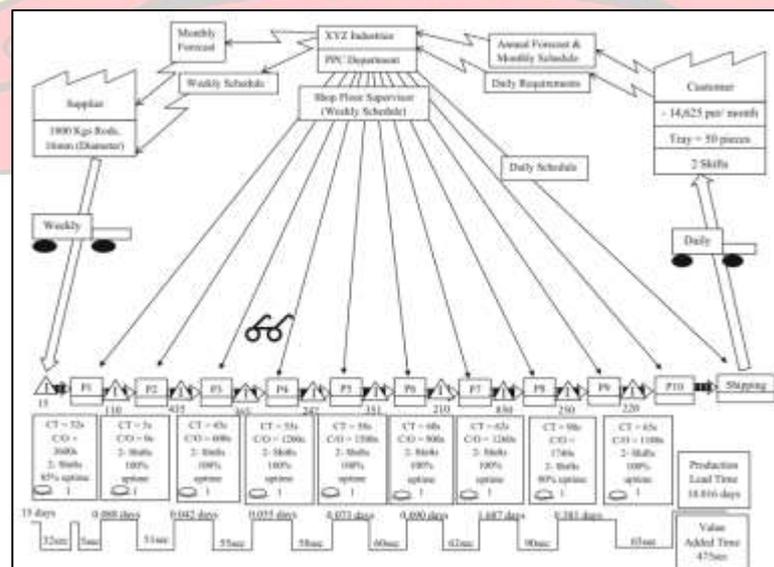


Figure 3 Example of VSM - Current State Map

2.6 Root Cause Analysis Tools

Reporting from the official website of the Government of South Australia, Root Cause Analysis (RCA) is a method used to investigate health system failures that may not be immediately apparent on initial review. The Clinical Resources feature explains that part of Safety and Quality is Governance for Safety and Quality, where RCA is part of the main South Australian Health policy framework and guidelines. The use of RCA allows organizations to actively manage and improve the safety and quality of health care for

patients. Therefore, the researcher tried to implement the system in SA to learn and improve the quality of the health system. The classification of contributing factors for health system failure includes nine categories: patients assessment, staff factors, patient factors, equipment, work environment, information, communication, policies/procedures and coordination. The file containing the contributing factors classification can be found in appendix 6.

2.7 Cause and Effect Diagram

According to Sinsu & Pangemanan (2018), this diagram is designed to look very similar to a fish skeleton. A Fishbone diagram (also called an Ishikawa diagram) is a tool for identifying the root causes of quality problems. This diagram is named after Kaoru Ishikawa. A fishbone diagram is a tool that provides a systematic and graphical way to identify the possible causes of a problem, using the 5M+1E categories (man, machine, materials, measures, management, environment) to focus and organize thinking, in order to determine the root cause of the problem.

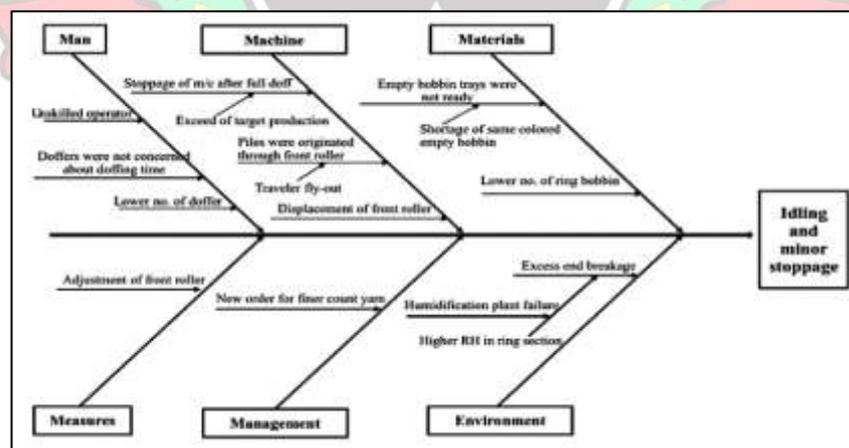


Figure 4 Example of Cause and Effect Diagram

2.8 Kaizen

2.7.1 Definition of Kaizen

In its application in the company, Kaizen includes the notion of continuous improvement that involves all workers, both upper management to lower management (Hitoshi Takeda, 2006). Kaizen or continuous improvement always goes hand in hand with Total Quality Management (TQM). Even before the TQM philosophy is implemented or before the quality system can be implemented in a company, this philosophy will not be implemented

so that continuous improvement (Just in time) is an effort that is inherent in the TQM philosophy itself. So Kaizen can also be a comprehensive and integrated view that has the characteristics of customer-oriented, overall quality control (Total Quality Management), robotics, quality control groups, suggestion systems, automation, discipline in the workplace, maintenance of productivity, kanban, quality improvement and improvement, on time, without defects, small group activities, cooperative relationships between managers and employees and new product development (Paramita, n.d.).

2.7.2 Keys to Kaizen Implementation

According to Paramita (n.d.), there are eight main keys to the implementation of just in time or kaizen in industrial activities, which are:

- a. Produce products according to a schedule based on customer demand. The kaizen system usually produces production according to customer orders with a pull production system that is assisted by using kanban cards.
- b. Producing in small lots (small lot size)
Another characteristic is that producing in small quantities according to customer demand will save costs and resources in addition to eliminating the inventory of goods in process which is a kind of waste that can be avoided by using production process scheduling in addition to using an evenly mixed production pattern (Heijunka) which means heijunka is producing various kinds of goods in one production line.
- c. Eliminate waste
To avoid waste in inventory, purchasing and scheduling by using a kanban card system that supports the pull production system, in addition to producing production well from the start, namely never accepting, never processing and never submitting defective products by cooperating with suppliers with supplies, namely reducing the number of goods coming, eliminating buffer inventory, reducing purchasing costs, improving raw material handling, achieving small quantities of inventory and getting reliable suppliers.
- d. Improve production flow
Production organization is carried out based on the five disciplines in the workplace, namely 5-S, which include:

1. *Seiri* (Sorting) concept

The concept of *Seiri* is discipline in the workplace by separating various tools or components in their respective places, so that finding them later when needed will be easier. *Seiri* is about separating the necessary items from the unnecessary ones, and then getting rid of the unnecessary ones. In fact, there are many unnecessary items in every factory. Unnecessary items mean that they are not needed for current production activities (Hirano, 2005). To find out which items need to be discarded, items must be separated into necessary and unnecessary ones. This is called "Visual *Seiri*".

2. *Seiton* concept

This concept neatly arranges and recognizes objects to make them easier to use. The Japanese word *Seiton* literally means to arrange objects in an attractive (neat) way. In the context of the 5 S's, this means organizing items so that everyone can find them quickly. To accomplish this step, sign plates are used to designate the name of each item and the place where it is stored (Yasuhiro, 1995). *Seiton* allows workers to easily recognize and retrieve tools and materials, and easily return them to a location near the place of use. Plates are used to facilitate the placement and retrieval of necessary materials.

3. *Seiso* concept

This concept always prioritizes cleanliness by keeping things tidy and clean. It is a basic cleaning process where an area is swept and then mopped with a mop. Since floors, windows, and walls must be cleaned, *Seiso* is equivalent to the large-scale cleaning activities that take place at the end of each year in Japanese households. Although company-wide cleaning is done several times a year, each workplace needs to be cleaned daily. The activity tends to reduce machine damage due to oil spills, ash, and trash. For example, if a worker complains that a machine is broken this does not mean that the machine needs adjustment. In fact, all that is needed may be a workplace cleaning program (Yasuhiro, 1995).

4. *Seiketsu* concept

Seiketsu is a continuous effort to maintain the 3 S's mentioned above, namely *Seiri*, *Seiton*, and *Seiso*. In principle, it seeks to maintain a workplace that has become good. In a well-maintained workplace, vulnerabilities and irregularities can be recognized immediately, so that various problems can be

prevented as early as possible (Kristianto, 1995). Keeping the workplace clean without trash or oil droplets is a Seiketsu activity, between *Seiso* and seiketsu are closely related.

5. *Shitsuke* concept

Shitsuke is a method used to motivate workers to continuously perform and participate in maintenance and repair activities and to get workers used to obeying rules (diligence). It is considered the most difficult component of the 5 S. For this activity, Japanese workers are expected to exercise self-control, rather than management control (Yasuhiro, 1995).

e. Improving product quality

One of them is to improve product quality by looking at the principles of management, namely maintaining process control and making everyone responsible for achieving quality, improving management's view of quality, fulfilling product quality control firmly, authorizing employees to conduct product quality control, requiring correction of product defects by employees, achieving 100% inspection of product quality and achieving commitment to long-term quality control.

f. People who are responsive

The implementation of this kaizen system no longer uses the pillars of finance, marketing, human resources, but uses cross-functional or cross-discipline so that all employees must master all fields in the company or organization according to their level and position and errors in the process are always marked by the lighting of the andon lights and the process is stopped and all employees are focused on improvements known as jidoka, namely all employees are responsible for achieving good products and preventing errors.

g. Eliminate uncertainty

To eliminate uncertainty with suppliers by establishing lasting relationships and having one supplier located close to the company who is still a relative of the company owner, while in the production process by implementing a pull production system with the help of kanban cards and mixed production evenly (Heijunka).

h. Emphasis on long-term maintenance

Characteristics of maintenance by adhering to long-term contracts, improving quality, flexibility in procuring goods, ordering in small quantities made many times, making continuous and continuous improvements. Another term that aims to balance this kaizen system is reengineering, which is holding a total business process

overhaul to its roots and this system was created by America to catch up with Japan which was once assisted economically, only when this overhaul has been carried out, then maintenance and improvement can be carried out continuously and continuously.

2.7.3 Kaizen Concept

a. 3 M concept (*Muda, Mura, Muri*)

This concept was established to reduce the number of work processes, improve quality, shorten time and achieve efficiency.

1. *Muda* defined as the reduction of waste or futility
2. *Mura* defined as the reduction of differences
3. *Muri* defined as tension reduction

b. 5 S movement (*Seiri, Seiton, Seiso, seiketsu Shitsuke*)

The 5 S concept is basically a process of changing attitudes by applying organization, cleanliness, and discipline in the workplace. The 5 S concept is a culture of how one treats their workplace properly. If the workplace is organized, clean, and orderly, then individual ease of work can be created. With this ease of work, the four main target areas of industry which include:

1. Work efficiency
2. Work Productivity
3. Work Quality
4. Work Safety can be more easily fulfilled

c. PDCA concept (*Plan, Do, Check, Action*)

The first step of kaizen is to implement the PDCA cycle (plan, do, check action) partly as a means of ensuring the continuity of kaizen. It is useful in realizing policies to maintain and improve or raise standards. This cycle is the most important concept of the kaizen process (Imai, 2005). Plan relates to setting targets for improvement, because kaizen is a way of life, there must always be improvement in all areas, and formulating a plan to achieve these targets. Check refers to determining whether the implementation is on track and monitoring the progress of planned improvements. Action relates to standardizing new procedures to avoid re-occurrence of the same problem or setting new goals for further improvement (Imai, 2005).

d. 5 W + 1 H concept

One of the mindsets for running the PDCA wheel in kaizen activities is to ask the basic 5 W + 1 H questions (what, who, why, where, when, how). The kaizen approach is usually used to develop corrective measures, once the causes are known, then select corrective measures with reference to (what) what is to be achieved, (why) why the improvement plan is being carried out, (where) where the improvement plan is to be implemented, (when) when the improvement plan is to be implemented, (who) who is responsible for the action and (how) how to carry out the improvement plan.

(Paramita, n.d.)

2.9 Past Research

Past research is information that serves as a reference or inspiration for researcher in taking the focus of research. Previous research is also useful as a theory reinforcement for the focus of further research. Here are some previous studies on improving the quality of services or services :

Table 1 Past Research

No.	Researcher	Title	Method	Results
1.	Improta et al., (2019)	Lean Six Sigma in healthcare Fast track surgery for patients undergoing prosthetic hip replacement surgery	Lean Six sigma with DMAIC implementation	<ul style="list-style-type: none"> Several variables can affect the length of hospital stay (LOS) for inpatient care, thereby increasing patient management costs due to longer hospitalization periods. Therefore, the LSS analysis of the implemented corrective measures demonstrated the efficacy and efficiency of the new protocol.
2.	Bhat et al., (2019)	Lean Six Sigma for the	Lean Six Sigma in the healthcare sector	<ul style="list-style-type: none"> Patients feel that queuing can harm their health, which can

	healthcare sector: a multiple case study analysis from the Indian context	be improved by addressing the system's cycle time.	<ul style="list-style-type: none"> • Effective leadership, data availability, team involvement and effective communication are critical to the success of the LSS method.
3.	J. Liberatore, (2013) Six Sigma in healthcare delivery	Six Sigma	<ul style="list-style-type: none"> • Several areas of inpatient care have implemented Six Sigma, including admission and discharge, medication administration, operating room (OR), cardiac and intensive care. • Only 10% reported sustained improvement and 28% reported cost savings.
4.	Chiarini & Bracci, (2013) Implementing Lean Six Sigma in healthcare: issues from Italy	Six Sigma and Lean Six Sigma in Healthcare	<ul style="list-style-type: none"> • In Italian public healthcare, there is less use of statistical tools and more use of TQM and lean tools. • The use of Lean Six Sigma models in public health services will be influenced by regulations created by law with the aim of continuous quality improvement, reducing waiting lists and increasing efficiency.
5.	Mu'tiyah dan Oktamianti, (2022) Meningkatkan Kinerja Ruang Operasi dengan	Literature study on DMAIC, DMADV, and Lean Six Sigma methods.	<ul style="list-style-type: none"> • The use of Lean Six Sigma (LSS) methods in hospitals, especially in the operating room, improves the performance of the operating

Metode Lean	room by reducing patient
Six Sigma :	care time, reducing
Literature	unnecessary use of
Review	resources, increasing patient
	and family satisfaction in
	terms of health care and
	increasing efficiency, safety
	and quality of health services
	in the operating room.

Based on previous research, the application of Lean Six Sigma concepts is not only in the manufacturing industry. Now the Lean Six Sigma concept has been implemented in the service industry, especially the health industry in different departments in a hospital in various countries. Therefore, this research will focus on the implementation of Lean six sigma on ultrasound checks in the radiology department of Thalia Irham General Hospital.

