

Lean Service Applications using FMEA and VSM approaches (case study: Public Healthcare Unit in Jakarta)

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Abstract. This research aims is to design a proposed improvement in service at the public healthcare unit that is in accordance with the concept of Lean Service. The method used in this research are FMEA and VSM approaches. This research begins by finding the level of customer satisfaction using the Customer Satisfaction Index (CSI) method. The results of CSI processing showed that the speed of service was the highest element of dissatisfaction. Then proceed with focusing on the waste categories found in the system including waste defects, excess processing, and waiting. Furthermore, through FMEA analysis it is known that improvement in patient waiting time is a top priority for improvement. Then the activities in the service process after improvement are described through future value stream mapping. Before improvement, it is known that the service cycle time is 102.88 minutes. After making suggestions for improvement, the cycle time decreased to 81.89 minutes for manual registration and 76.73 minutes for online registration. Service time measurement and customer satisfaction analysis can be used as a reference for improving and evaluating the performance of public health units.

Keywords: Customer Satisfaction Index, Lean Service, Value Stream Mapping, FMEA

1. Introduction

Based on the results of research conducted in several public healthcare unit in the Jakarta area it is known that in general complaints from patients are queues during administrative arrangements, where for one visit the patient requires a waiting time of 45 minutes to 1 hour. Based on preliminary observations and interviews conducted with the public healthcare unit, it is known that many patients complain about the length of the queue when they visit for treatment.

One method of service improvement to improve performance in the service sector is to use the concept of lean. Lean is a set of tools or a set of methods or systems to reduce the time between customer orders and delivery of goods by eliminating waste that does not add value. Five lean principles as an implementation framework in an organization, among others; 1) Value: identify the value from customers perspective, 2) Value stream: identify "specific activities required to design, order, and provide a specific product, from concept to launch, order to delivery, and raw materials into the hands of the customer." 3) Flow: "progressive achievement of tasks along the stream so that the product goes from design to launch, order to delivery and raw materials into the hands of the customer with no stoppages, scrap or backflows." 4) Pull: only make what is pulled by the customer signal of need 5) Perfection: by continually removing successive waste from value stream [1,2].

To find out the quality of service, research is conducted to measure customer satisfaction. Observations and data collection were carried out on outpatients in one of the most visited public healthcare unit in the Jakarta area, starting from the registration process, the consultation process, to the patient taking drugs at the pharmacy. Based on the problems found, this study aims to analyze the stages of the procedure that have a significant effect on patient service time, as well as the efforts needed to reduce waiting time for services. Through this research it can also be seen the level of performance of public healthcare unit in the Jakarta area through questionnaires, analyze the stages of procedures that have a significant effect on patient service time, and eliminate waste and non-value added activities where all of these activities can be seen through the Current Value Stream Mapping for current condition and Future Value Stream Mapping to find out the results of the proposed improvements.

Basic Concepts of Lean

Lean is an ongoing effort to eliminate waste and increase value added products (goods and or services) to provide value to customers (customer value) [3]. The aim of Lean is to continuously improve customer value through continuous improvement in the ratio of value added to waste (the value-to-waste ratio). Gasperz also states that there are five basic principles in Lean, that is: Identifying the value of products (goods and or services) from the perspective of customers, where customers want products (goods and or services) of superior quality, with competitive prices on timely delivery; Identifying value stream process mapping for each product (goods and or services); Eliminating waste of all activities along the value stream process, which is not added value; Establish a mistake-proof system for every service process to avoid waste and delay; Striving for excellence to achieve perfection (zero-waste) through continuous improvement.

Value Stream Mapping

Value Stream Mapping (VSM) is a structured diagram or a method used in mapping related to product flow and information flow starting from suppliers, producers, and consumers in a complete picture covering all processes in a system [3]. Value Stream Mapping (VSM) is used as an underlying rationale by using a set of tools that can help in identifying waste along the value stream. VSM visualizes the process or activity in the form of a flowchart that is useful for mapping activities that provide added value in realizing lean transformation [4,5].

VSM is able to visualize service flow and identify waste. The purpose of VSM mapping is to get a complete picture of the time and each phase of activities in the process. Activities in VSM can be classified into three different types of activities, namely Value adding activity (VA) are all activities that produce products or services that provide added value in the eyes of consumers; Non-value adding activities (NVA) are all activities that produce products or services that do not add value to the eyes of consumers and Necessary non value adding activities (NNVA) are all activities that produce products or services that do not add value to the eyes of consumers but are needed unless there have been changes to existing processes. In VSM also used the several data of time such as Cycle Time (C/T) [4].

FMEA (Failure Modes and Effect Analysis)

FMEA is a structured procedure to identify and prevent as many failure modes as possible. FMEA can be applied to all fields, both manufacturing and services, as well as all types of products [6]. In general, FMEA is defined as a technique that identifies three things, namely: Causes of potential failures of the system, product design, and processes during its life cycle; The effect of the failure; The level of criticality of the effects of failure on the system function, product design, and FMEA analysis process is carried out by identifying and studying the potential causes of failure and the effects of each process.

To determine the priority of a form of failure must be defined in advance about Severity, Occurrence, and Detection. The assessment criteria used in this study were adapted from Cecelia (2006) for FMEA identification in the service sector [7].

Severity is a rating that shows the seriousness of the effects of a failure mode. Occurrence is a measure of how often a potential cause occurs. Detection is a measurement of the ability to control/control failures that can occur.

The Severity, Occurrence and Detection values are in the form of numbers 1 through 10. After the rating is given, the RPN value of each cause of failure is calculated using formula 1 below. The RPN value of each potential problem is then used to compare the causes identified during the analysis.

$$\text{RPN} = \text{Severity} \times \text{Occurrence} \times \text{Detection} \quad (1)$$

2. Methods

This research integrates the Customer Satisfaction Index (CSI) method with Lean Service. Primary data were obtained using qualitative methods through distributing questionnaires to patients and interviewing staff. It also carried out measurements and direct observation of the patient service process starting from taking a queue number to taking drugs at the pharmacy. Secondary data obtained from the public healthcare unit are data on the number of patient visits, patient time data for each visit and data on drug supply process time. Distribution of questionnaires to 150 patients selected randomly. The variable used as a benchmark in the questionnaire is the patient's perception of the 14 elements that influence service satisfaction in CSI so that the performance of public healthcare unit is known at this time. The results of the questionnaire are then processed to find out which element has the lowest value that will be searched for the root cause and its improvement.

Having known the most influential variable in service quality, the next step is to understand the most critical problem. With the waste identification method, known problems that occur and the FMEA method to determine which problems are the most critical. Furthermore, secondary data processing is carried out, which is measuring service time processing in the field using a stopwatch. After obtaining the required time data, a current value stream mapping (CVSM) can be made to provide an overall picture of the service process and to find out which activities are less productive. After a CVSM has been made, recommendations for the proposed improvements also can be made including the proposed simplification of processes by eliminating processes that are not needed to improve service value. Through the results of recommendations then Future Value Stream Mapping (FVSM) can be made where this new condition is expected to improve the performance of the Public healthcare unit in providing health services.

3. Result And Discussion

One of the latest government regulations on public services that has been issued to assess and evaluate the performance of public service units of government agencies is the Guidelines for the Preparation of the Public Satisfaction Index of Government Institution Service Units [8]. In CSI calculation there are 14 elements or indicators that are reviewed. Every service element has the same weight. To facilitate interpretation of the CSI assessment, the results of the assessment are converted and then categorized as in the following Table 1.

Based on the results of the questionnaire calculation, it can be seen that the service elements considered to be poor based on the average value per service element, namely the Ease of administrative service procedures, Clarity and certainty of administrative procedures, and Speed of administrative services. After obtaining the value of each service element, it can be seen that the CSI value is 3.203, CSI conversion is 80.075 and the service quality category is Good. After knowing the value of CSI and variable of service elements that need to be improved then a Value Stream Mapping Current State could be done where the first thing to do is observing the service time. After obtaining observational data on service time, a mapping can be made for the current state/current value stream mapping (CVSM) as can be seen in Figure 1.

Table 1. Service Unit Performance Rating Category

Perception Value	CSI Interval Value	CSI Interval Value Conversion	Service Quality	Service Unit Performance
1	1,00 – 1,75	25 – 43,75	D	Very Not Good
2	1,76 – 2,50	43,76 – 62,50	C	Not Good
3	2,51 – 3,25	62,51 – 81,25	B	Good
4	3,26 – 4,00	81,26 – 100,00	A	Very Good

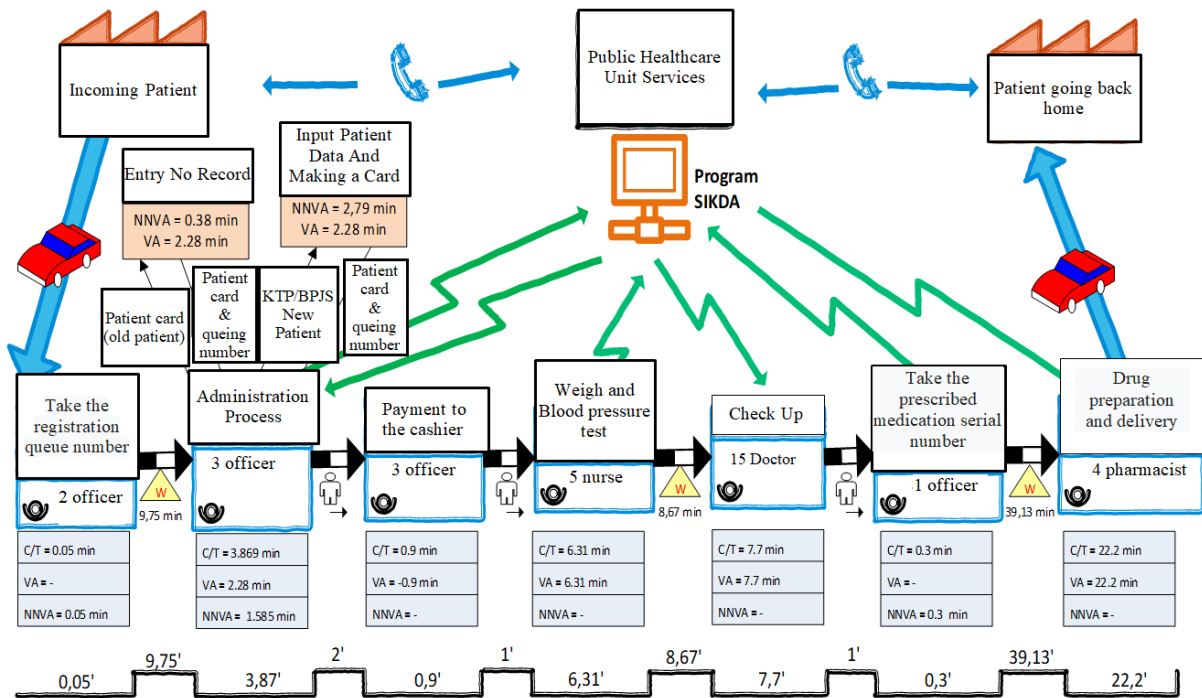


Figure 1. Current Value Stream Mapping

The next step of this research is to identify waste in several problems related to the ease of administrative service procedures, clarity and certainty of administrative procedures and speed of administrative services. Waste obtained in this research is Waste Defect, Waste Excess Processing, and Waste Waiting. For Waste Defect, the problem that occurs is that the Officer calls the patient back due to incomplete data, the Officer enters the wrong record number, the Officer enters the wrong medical record number, Failure in detecting prescription writing errors, and Failure in reading the name of the drug, dosage, and amount of the drug. For Waste Excess Processing the problem that occurs is that the Officer repeats the registration process, and the Medical Record Officer confirms the data to the registration officer. For Waste Waiting, the problem that occurs is that the patient waits for the registration serial number, the patient waits because the admin is not available, the patient waits for the taking of the drug, and the patient waits for the intended service. Furthermore, from this identification of waste will be determined the most critical problems with the FMEA method as can be seen in Table 2, Table 3 and Table 4.

After applying the proposed improvements to the service process, future value stream mapping (FVSM) is described. FVSM can be divided into two, namely for patients who register manually and patients who register online. FVSM can be seen in Figure 2 and Figure 3. Minimization of time before and after improvement in all service activities can be seen in Table 5. Based on table 5 it can be seen that a reduction in cycle time happen after applying the proposed of improvement. For the whole process in FVSM, the NVA value for manual registration was 41.26% and online registration was

42.41%, which decreased from the previous condition of 59.83%. After applying the proposed improvement, activities that are included in the value added (VA) category also experienced an increase where the percentage was higher if the patient used online registration at 57.59%. This new condition is expected to improve the performance of the Public healthcare unit in providing health services.

Table 2. FMEA Waste Defects

Process Function	Failure Mode	Failure Effect	Sev	Cause	Occ	Det	RPN	Priority
Registration Officers Identify Documents	Officers cannot identify patient documents	The officer called back the patient	4	Unable to identify patient data	5	7	140	7
Registration Officer Enter the old patient record number	Incorrect record number	Incorrect data, wrong medical record	6	Lack of accuracy in reading patient record numbers	6	6	216	3
Registration Officer doing a medical record data entry	Incorrect medical record number	Incorrect data, wrong medical record	6	Could not identify the patient's medical record number	5	7	210	4
Pharmacists prepare prescription drugs	Failure to detect prescription errors	Patients receive drugs that are not as prescribed	8	Writing a prescription from a doctor is unclear/incomplete	4	3	96	10
	Failure to read the name of the drug, dosage, and amount of the drug		8	Pharmacists are not careful in reading prescription drugs	3	5	120	8

Table 3. FMEA Waste Excess Processing

Process Function	Failure Mode	Failure Effect	Sev	Cause	Occ	Det	RPN	Priority
Patients Bring Documents for Registration	Repeat the registration process	Patients must complete the document first so that it takes longer	4	Negligence on the patient side	7	7	196	5
Medical Record/Filing Officer Receives and validates Medical Record numbers	The medical record number is not clear	The filling officer has to confirm the data with the registration officer	2	The registration officer does not write down the medical record number, the registration officer's writing is unclear	4	5	40	13

Table 4. FMEA Waste Waiting

Process Function	Failure Mode	Failure Effect	Sev	Cause	Occ	Det	RPN	Priority
Patients are waiting for their registration number	A large number of patients	Patients spend a lot of time waiting in the queue to get service	6	High population density	8	6	288	2
The patient goes to the registration window	The patient is waiting because the officer is not present	Patients need more time to get services	2	The officer gives the number to the caller officer	4	6	48	12
Registration Officer Perform data entry/ patient record number	Officers cannot enter data/record numbers	Patient data is not entered in the application so patients have to wait	4	Having error on SIKDA application	3	7	84	11
	The patient waits on the registration section	Long patients need a longer registration process	4	Entering new patient data	7	4	112	9
Registration Officer Provides a queue number for the service unit	Incorrect queue number	The medical record file is wrong, the patient is waiting at the destination service	6	Officers do not re-examine the intended service	4	7	196	7
The officer prepares a prescription medicine	Failure to meet patient waiting times according to the standard	Patients are long awaiting drug delivery	8	The number of pharmacists is still lacking, pharmacy facility settings	9	5	360	1

Table 5. Service Activity Percentage Before and After Improvement

Category	Current State		Future State			
	Time (minute)	Percent	Manual Registration		Online Registration	
			Time (minute)	Percent	Time (minute)	Percent
VA	39,39	38,28%	46,47	56,75%	44,19	57,59%
NNVA	1,94	1,89%	1,63	1,99%	-	-
NVA	61,55	59,83%	33,79	41,26%	32,54	42,41%
C/T	102,88	100%	81,89	100%	76,73	100%

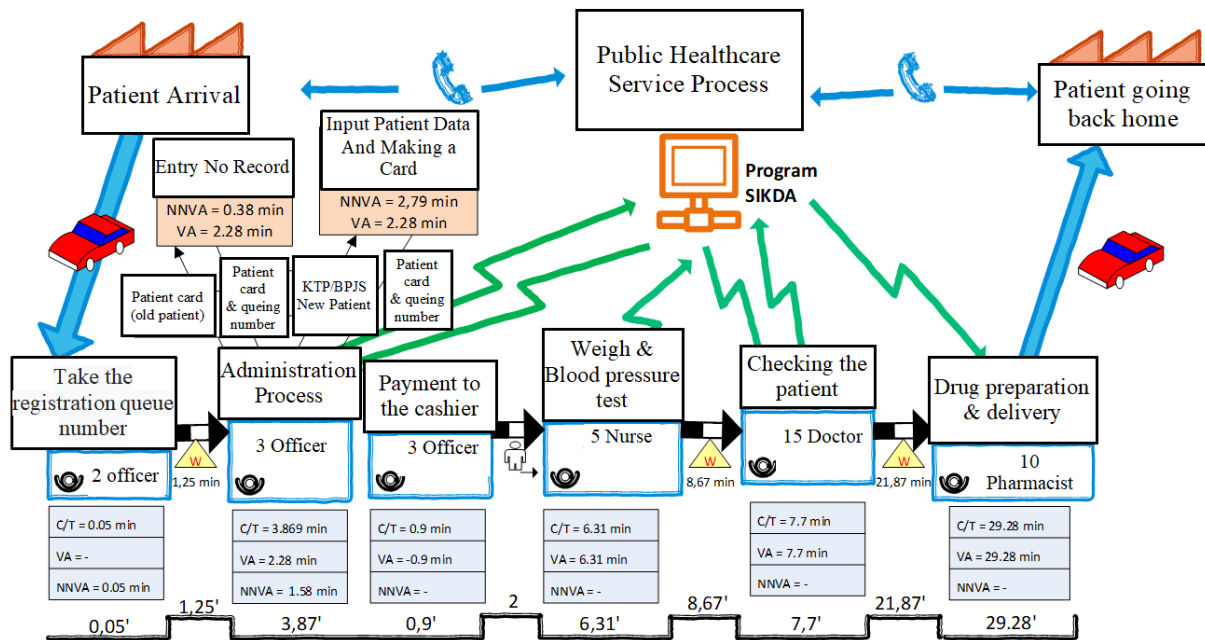


Figure 2. FVSM for manual registration

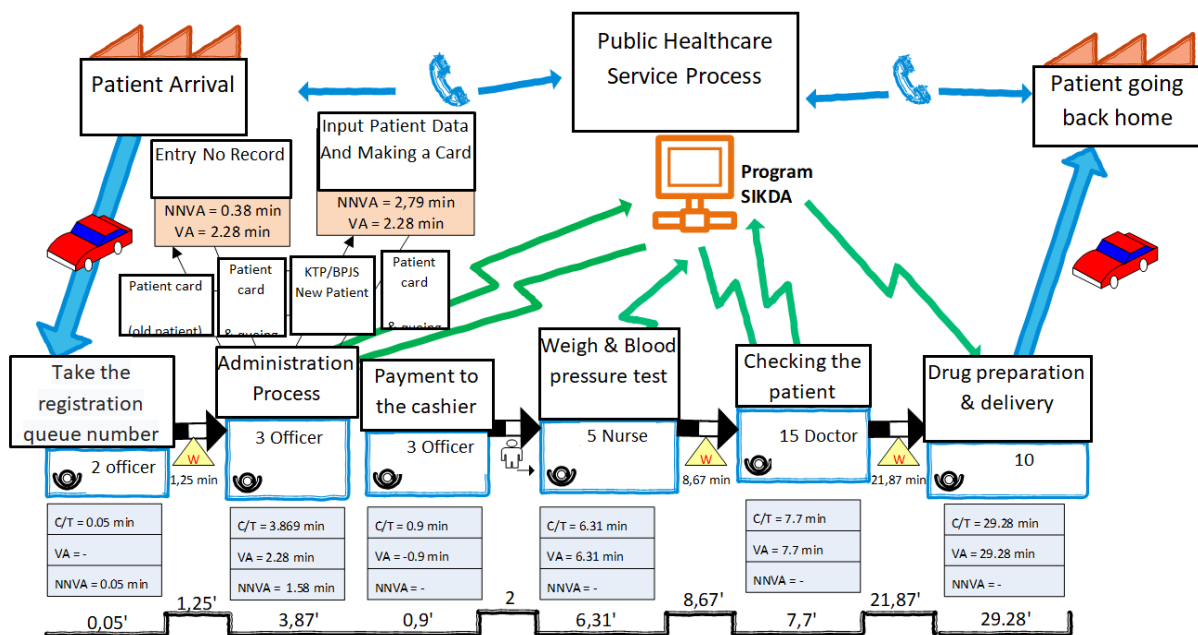


Figure 3. FVSM for online registration

4. Conclusion

There are three types of service elements that still get low scores based on the results of the questionnaire that has been distributed. Three service elements in the lowest order, namely the speed of administrative services, clarity and certainty of administrative procedures, and ease of administrative service procedures. Through this research also known that there are three types of waste categories in the service of public healthcare unit, namely waste defects, excess processing, and waiting. Critical waste is identified in existing services, namely waiting time in the part of the drug taking process and waiting time during registration. Based on CVSM, the cycle time is 102.88 minutes with non-value added (NVA) activities of 59.83%. Waiting time at the pharmacy is considered the most critical NVA activity. This activity can be reduced by increasing the number of pharmacists. After proposed the improvements, FVSM could be made with a cycle time of 81.89 minutes and NVA activity of 41.26% for manual registration, for online registration of 76.73 minutes with NVA activity 42.41%. This research have an important contribution to make an improvement in service at the public healthcare unit.

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