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Analysis of Waste in Electronic ID Card Services with Lean Service and Root Cause Analysis Methods

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Abstract

Optimal service is essential to ensure citizen satisfaction in managing population administration. This study analyzes waste in the Electronic ID Card (KTP Elektronik) service process using the Lean Service and Root Cause Analysis (RCA) methods. The research was conducted at Office X through direct observation, interviews, and the distribution of questionnaires to eight respondents directly involved in the service process. The collected data included service process flows, activity durations, waste identification, and their root causes. Using the Value Stream Mapping (VSM) method and VALSAT tools, it was found that the total lead time was 1,953 seconds, but only 238 seconds (13%) were categorized as value-added activities. The dominant types of waste identified included waiting, duplication, defects, and unnecessary movement. Based on the score calculation results, Process Activity Mapping (PAM) was selected as the main VALSAT tool. RCA analysis using fishbone diagrams and the 5 Whys method revealed root causes such as inaccurate queue time estimates, repeated data entry, lack of supporting facilities, and inefficient workplace layout. The improvement recommendations include optimizing the online queuing system and adding supporting equipment such as tripods and printers. After improvements were implemented, the service time was reduced to 898 seconds, and the proportion of value-added activities increased to 27%, indicating that the application of Lean Service and RCA was effective in improving service efficiency.

Introduction

Optimal service is very important to ensure citizen satisfaction in taking care of population administration. If the quality of service does not meet expectations, people can feel disappointed and dissatisfied, which can ultimately reduce their level of trust and loyalty to the institution. A service can be said to be of quality if the services provided by employees are in line with the wishes of the community (Miftahul & Meirinawati, 2022; Zysman & Costinot, 2022; Seale et al., 2022; Sutaguna et al., 2023; Karidakis et al., 2022). Quality service or commonly referred to as excellent service is the best service that meets service quality standards (Handika & Rostyaningsih, 2020; Naini et al., 2022; Balinado et al., 2021; Fared et al., 2021; Wijaya et al., 2021; Ridwan, 2022).

Public services provided by the government still have various weaknesses, so they have not fully met the quality standards expected by the community (Ojogiwa, 2021; Otia & Bracci, 2022; Rocca et al., 2022). This can be seen from the many complaints submitted by the public through the mass media, which has the potential to cause a negative image of public services.

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In the context of service, waste can be in the form of long wait times, redundant processes, or wasted resources. Waste is an activity that has no added value. In the study (Mira & Kuşakcı, 2022) identified and classified the types of waste that occur in the service industry as follows: 1. Delay/waiting, 2. Duplication, 3. Unnecessary movement, 4. Incorrect inventory, 5. Error/Defect, 6. Lack of customer, 7. Overproduction, 8. Underutilized people, 9. Variation. Lean is a collection of tools or techniques intended to remove waste, shorten wait times, increase productivity, and cut expenses. The goal of the lean methodology is to maximize process efficiency and eliminate waste from certain operations (Dewi et al., 2024; Taher & Bashar, 2024; Basiru et al., 2023; Shaturaev & Bekimbetova, 2021).

Initially lean was developed for the manufacturing industry, but the concept of Lean can also be applied in the sector or service industry. Lean service is very concerned about how to eliminate waste in the service process. The lean concept seeks to reduce waste, by reducing waste which is expected to reduce operational costs and improve the quality and timeliness of delivery of products or services (Kusuma & Hasibuan, 2022). *Lean service* according to (Anggraini et al., 2020) is to generate added value from activities, eliminate waste in the service process, and increase the flow of value.

Value stream mapping (VSM) is a visual tool used to map the production flow of a product, including data and materials from each workstation (Dewi et al., 2024; Ahmad et al., 2022; Noto & Cosenz, 2021; Bugvia et al., 2021; Wang et al., 2022; Al-Rifai, 2024; Shabeen & Krishnan, 2022). Value stream mapping is depicted with a symbolic symbol representing the activity. Where there are two activities, namely value added and non value added (Setiawan & Rahman, 2021), VALSAT is a tool used to map in detail the flow of material values and the value of information flows that focus on activities that provide added value/VA (Anam & Nurkertamanda, 2024).

Based on these seven *tools* , it is based on the right selection according to the company's situation and is held using the VALSAT table:

Set up *a table of seven stream mapping tools*

Tabel 1. Seven Stream Mapping Tools

Waste	PAM	SCRM	PVF	QFM	DAM	DPA	PS
Overproduction	L	M		L	M	M	
Waiting	H	H	L		M	M	
Transpors	H						L
Over Processing	H		M	L		L	
Unnecessary Inventory	M	H	M		H	M	L
Unnecessary Motion	H	L					
Defects	L			H			

Source: Hines dan Taylor (2000)

Information:

H : *High correlation and usefulness*

M : *Medium correlation and usefulness*

L : *Low correlation and usefulness*

Account VALSAT

"VALSAT = Weight *Waste* × Correlation Values (H, L, M) .....(1)

H = 9

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M = 3

L = 1”

The *weight of waste* is obtained from : $\frac{X1+X2+X3+\cdots+Xn}{n}$ =.....(2)

Recap of VALSAT score calculation into one table

Decide on VALSAT tools according to total value weight and increment

Novitasari & Rochmoeljati (2021)

Long service times, long queues, and inefficient activities are the main issues. Lean Service is chosen to analyze and reduce non-value added activities. To identify the root of the problem, the Root Cause Analysis approach is used, so that the proposed solution is on target and effective. Root Cause Analysis has the main objective of identifying the factors expressed in their natural form, magnitude, location and time as a result of certain habits, actions and conditions that must be changed to avoid unnecessary mistakes (Redantan, 2023). Fishbone diagram and 5 whys are tools that can be used to solve the problem of waste with problem-solving techniques used to find the root cause of the problem. A cause-and-effect diagram focuses on the emphasis on the problem or symptoms that address the root cause of the problem. The cause and effect diagram also displays the causes of the problem by connecting the causes together (Thahira, 2023; Abdelghany & Tahar, 2021; Golewski, 2023; Singh et al., 2021). Then an analysis *of the 5 whys* must be carried out until an answer is obtained that is not floating and in accordance with actual conditions and can no longer be sought for deeper answers (Devega, 2024).

Methods

The case study was done in Office X between the months of March and June 2025 when the Electronic ID Card services process was studied in its natural setting. The investigation was based on the real encounter with the service setting whereby the information gathered was based on the real field events and not just on records. The rationale behind picking this location was that the office receives unending Electronic ID Card applications, which makes it a relevant background to the study of the existence of waste in the public administrative service chains. Field research allowed researchers to obtain first hand exposure to service routines, physical layout of workflow, and how officers react during peak hours and non-peak hours.

The main basis of this study was the primary data. The data were received with the help of field observation, informal and official negotiations with officers and questionnaires given to the eight people directly engaged in the service activities. Observations helped to trace all the steps that are used by the applicants and officers starting working with the service point and finishing with the production of identification documents. The observation was supplemented with interview sessions to provide more detailed narratives about the operational habits, the strong dependence on technology, and the procedural bottlenecks, which are not easily noticeable to the uninvolved members of the system. Questionnaires then recorded the perceptions of the respondents on the activities they considered as inefficient and the rate at which waste was expressed in their day to day activities. The combination of these three strategies allowed the study to engage both with waste numerically and through the lived working knowledge.

All the collected data have been gradually converted into analytic processes. The first thing that was done is to build a preliminary Big picture Mapping that would illustrate the current service process. All the movements, wait time, verification, and print sequences were drawn in a logical manner such that the process could be viewed and analysed in its detail. This mapping then acted as a benchmark to determine which parts of value were to be added to

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citizens and which parts of value addition only served to delay. The mapping of the digital identity issuance flow also encouraged a more comprehensive grasp of the way time accretion creates long queues and how non-quantifiable administrative gestures, like document re-checking, subtly eat up seconds, which add up into minutes.

At the end of the baseline mapping, the results of the questionnaire were processed so that the most frequent types of waste could be revealed. Due to the fact that it was impossible to determine the levels of waste only through observation, the study used the Value Stream Analysis Tools matrix. All the forms of waste were rated according to the average score and corresponded with the correlation value of the VALSAT framework. This calculation made Process Activity Mapping the most appropriate instrument to be used in depth analysis of service inefficiencies. PAM was chosen on purpose, allowing the researcher to divide the activities into three significant groups: those that truly contribute to the value added to the service users, those that do not contribute to the output, and those that have to be present but do not necessarily create direct value.

Each activity was recorded in predetermined frequency and duration with PAM being the central lens. The result showed an unequal relationship. Added value activities took only a small proportion of the total processing time but activities that do not add value were totaling and made up a big percentage of the complete timeline. At this point, information no longer comprised of raw numbers but rather of a set of facts that indicated that inefficiency was not in the number of tasks but in the amount of time it takes to pass through a series of procedural delays. At this point, the research took a step to the stage of the root cause analysis to unravel the reasons why waste existed and what would cause its occurrence.

The Five Whys questioning method and fishbone diagrams were the two means of conducting the Root Cause Analysis. The fishbone diagrams enabled the problems to be followed through numerous dimensions which included human factors, procedures, equipment preparedness and settings. Five Whys interrogation was then used to break down each problem until the root problem was identified. To illustrate, a long waiting time did not just come about in response to applicants waiting, it was influenced by the lack of devices, disproportionate apportionment of officers, wrong queue estimation, and unnecessary checks. In like manner, wastage of duplication was determined as a result of the necessity to input information again that had been inputted earlier online. These observations were used to shape the improvement framework and to give guidelines on what causes needed swift action.

The last part of the methodology was to build a proposed Big picture Mapping to reflect the improved service flow in the future. The proposed map excluded a number of non value activities and minimized the time-consuming activities that were not necessary hence a balance between processing and administrative support activities was achieved. This new mapping was further compared to the old one to assess the time saved in the service and the increase in Process Cycle Efficiency. The comparison of the two states helped the study to confirm the effectiveness of Lean Service and Root Cause Analysis as not a hypothetical assumption but a valid one. These findings proved that the time of service and the growth of value-added portions declined considerably, which proves that the systematic elimination of waste can improve the Electronic ID Card services.

Results and Discussion

Data was collected through direct observation, interviews with officers, and the distribution of questionnaires to eight respondents who were directly involved in the service of making Electronic ID cards. The data collected includes the flow of the service process, the time of each activity, the identification of waste, and the causes of waste. The preparation of current big picture mapping is based on previously collected data. This map shows the actual

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condition of the service process flow, including activities that have added value and those that do not, as well as the duration of time at each stage, as shown in Figure 1.

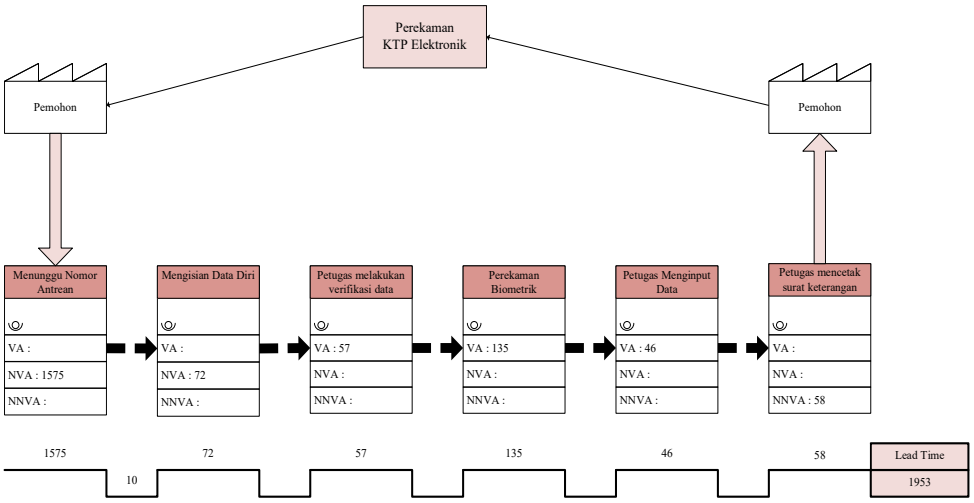

Figure 1. Current Big Picture Mapping

The total service time or lead time of the Electronic ID Card service is 1953 seconds or 33 minutes. Overall, out of the total lead time of 1953 seconds or 33 minutes, only 238 seconds or 4 minutes were included in the value-added activity (VA) category. Meanwhile, non-value-added activities (NVA) reached 1674 seconds or 27.5 minutes, and activities that were necessary but did not immediately provide value (NNVA) reached 58 seconds. a Process Cycle Efficiency (PCE) value of 13% was obtained.

Then the questionnaire that has been distributed will then be calculated for scores and rankings according to the waste that has been obtained through answers from respondents. The questionnaire distributed was a questionnaire with a likert scale of 1 to 5 which represented the frequency with which the type of waste occurred. The following presents the results of the recap, calculation, and ranking of the questionnaire related to waste in the service process.

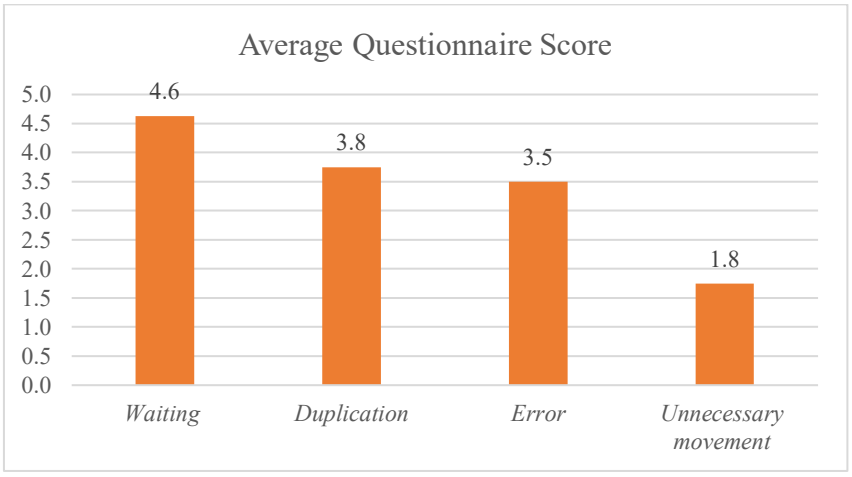

Figure 2. Average Questionnaire Score

Based on the results of the weight of the waste questionnaire, the following ranks 1 to 4 were obtained as follows: waiting with a score of 4.6, duplication with a score of 3.8, defect with a score of 3.5, and unnecessary movement with a score of 1.8.

Value Stream Analysis Tools (VALSAT)

The weight obtained from the results of the identification of waste will be multiplied by the degree of association between each VALSAT tool and the type of waste identified. This

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process generates a score for each tool. The selection of analysis tools is based on the highest score, where in general one tool with the highest score will be selected to be used in the next stage, namely data processing.

Table 2. Calculation of VALSAT Scores

Types of Waste	Average	VALSAT						
		PAM	SCRM	PVF	QFM	DAM	DPA	PS
Waiting	4.625	41.63	41.63	4.63		13.88	13.88	
Duplication	3.75	33.75						3.75
Defect	3.5	3.50			31.50			
Unnecessary Motion	1.75	15.75	1.75					
Total		94.6	94.63	43.38	4.63	31.50	13.88	13.88

Based on the results of the calculation using the VALSAT matrix, the rankings of each VALSAT tool are obtained. The matrix with the highest score or first rank is Process Activity Mapping (PAM) with a total score of 94.63. The second place is occupied by the Supply Chain Response Matrix (SCRM) with a total score of 43.38, followed by Quality Filter Mapping (QFM) in third place with a score of 32.50. The fourth rank is Demand Amplification Mapping (DAM) and Decision Point Analysis (DPA) which have the same score, which is 13.88. Furthermore, Product Variety Funnel (PVF) is ranked sixth with a value of 4.63, and Physical Structure (PS) is ranked seventh with a value of 3.75. Of the seven tools, the tool with the highest rating, namely Process Activity Mapping (PAM), was selected for further analysis.

The results of data processing with Process Activity Mapping (PAM) are in the form of the number of all activities in the process of recording Electronic ID cards. The results of the calculation of the percentage of frequency and time for each activity are presented in table 2. next.

Table 3. Percentage of Frequency and Time of Each Activity

No.	Activity	Frequency	Percentage	Time (seconds)	Percentage
1	Operation	7	70%	306	16%
2	Transportation	1	10%	15	1%
3	Inspection	1	10%	57	3%
4	Storage	0	0%	0	0%
5	Delay	1	10%	1575	81%
Total		10	100%	100%	100%

After identifying the number of activities and the time required, the next step is to categorize them based on the type of activity. These activities will be separated into three main types: value-added activities, non-value-added activities, and necessary but non-value added activities. The results of the time percentage calculation for each activity are presented in table 3.

Table 4. Percentage of Frequency and Time of Activity Type

No	Activity	Frequency	Percentage	Time (seconds)	Percentage
1	Value Added Activity	7	70%	248	13%
2	Non Value Added Activity	2	20%	1647	84%
3	Necessary but Non Value Added Activity	1	10%	58	3%
Total		10	100%	1953	100%

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Based on the results of the calculation of the percentage of frequency and time, it is known that Value Added (VA) activities have the highest frequency of 70%, but only account for 13% of the total processing time. This indicates that although most activities are aimed at producing the required output, they take relatively short. Meanwhile, Non Value Added Activity (NVA) accounts for only 20% of total activities, but takes up the most time, at 84%, which indicates a lot of time wasted on activities that do not add value, such as waiting and duplication. The Necessary but Non Value Added Activity (NNVA) has a frequency of 10% and only takes up 3% of the total processing time.

Recommendations for Improvement with Root Cause Analysis (RCA)

Root Cause Analysis (RCA) was carried out on problems that occurred in the process of Electronic ID Card services. With fishbone diagram method, it can help to identify the factors that cause waste, so that a targeted solution can be formulated.

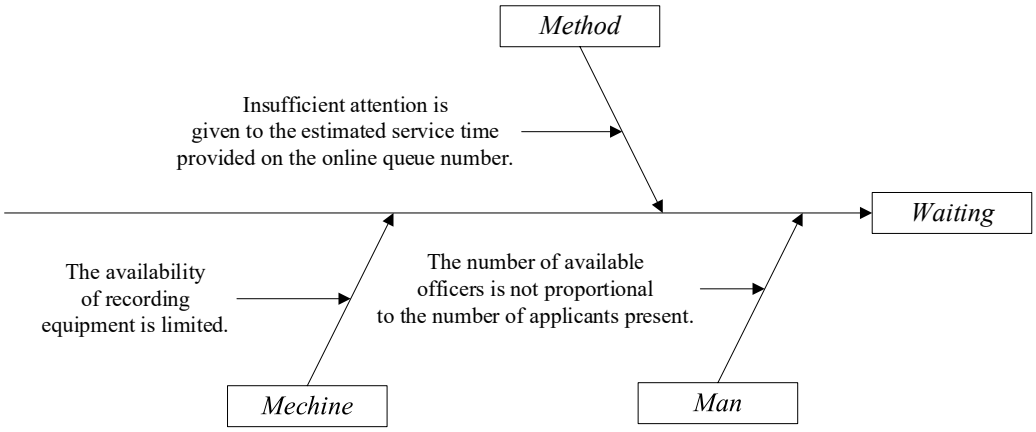

Figure 3. Fishbone Diagram Waste Waiting

Waiting waste was identified due to a mismatch between the estimated time on the queue number and actual conditions in the field. The long waiting time in the Electronic ID Card service is influenced by several factors. From the man aspect, the number of officers is insufficient compared to the number of applicants. From the machine aspect, limited recording equipment prevents the opening of additional service counters. These issues lead to longer wait times and reduced customer satisfaction.

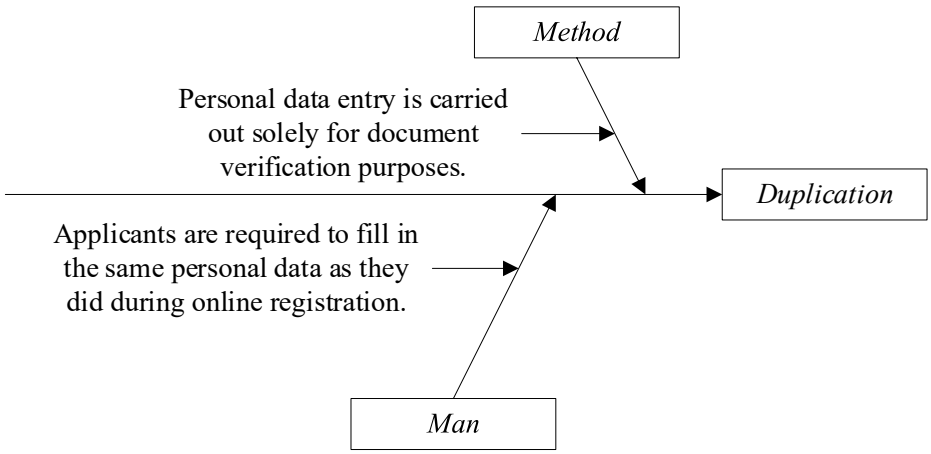

Figure 4 Fishbone Diagram Waste Duplication

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Duplication waste occurs when applicants are required to re-enter personal data already submitted during online registration. This repetitive process, driven by both method and human factors, adds no value and increases service time.

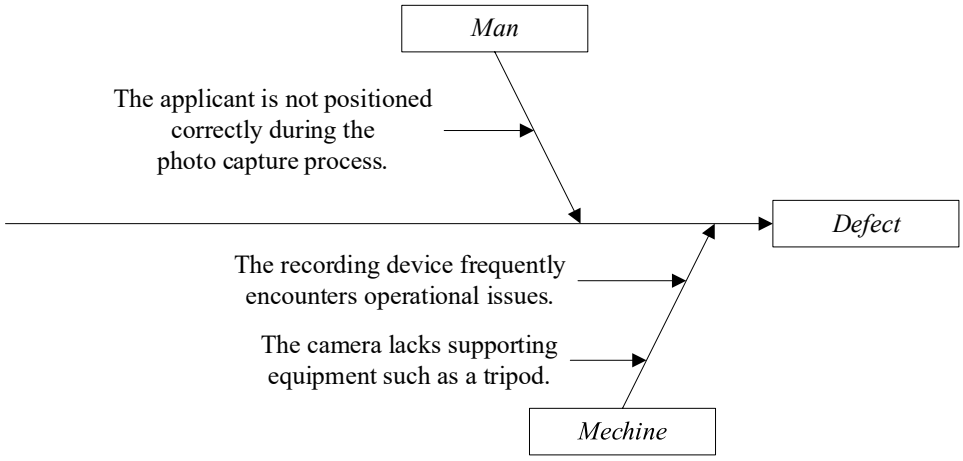

Figure 5. Fishbone Diagram Waste Defect

Defect waste in the recording process is caused by both human and equipment factors. Applicants often stand incorrectly during photo capture or have wet fingers during fingerprint scanning. Meanwhile, recording devices frequently fail to detect biometric data, and the absence of supporting tools like tripods worsens the issue. As a result, recordings must be repeated, extending the overall service time.

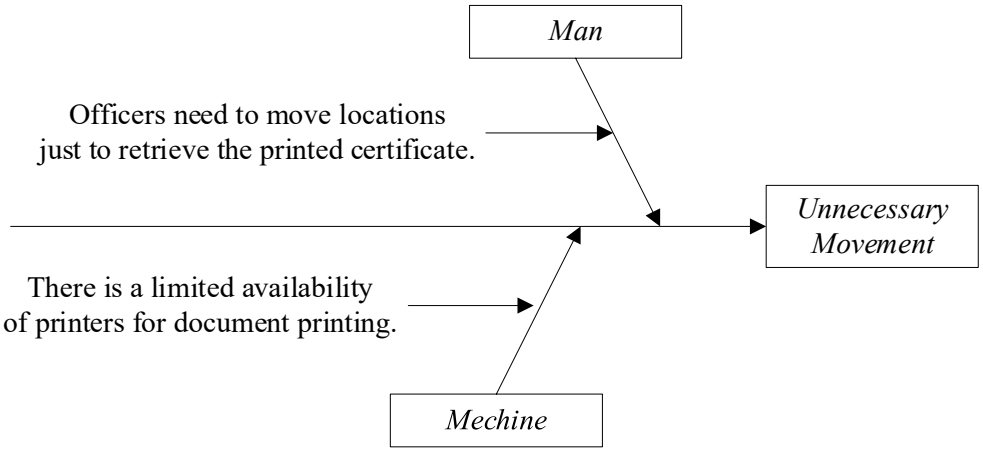

Figure 6. Fishbone Diagram Waste Unnecessary Movement

Meanwhile, unnecessary movement occurred because officers had to change places to print certificates due to printer limitations. Waste occurs as officers must move to collect printed certificates. This is due to limited printers (machine) and unnecessary movement (man), leading to longer service time.

Based on the identification of the root cause, several recommendations for improvement were prepared, including adjusting the online queue system to be more accurate in estimating service times, as well as adding additional devices such as tripods and printers. After improvements were made to the service flow, a proposed big picture mapping was made that showed improvements in process efficiency.

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After simplification of the previous process, a remapping was made using a new big picture mapping to describe the stages of service after the repair, as well as showing an increase in time efficiency and a reduction in wasteful activities as seen in Figure 7.

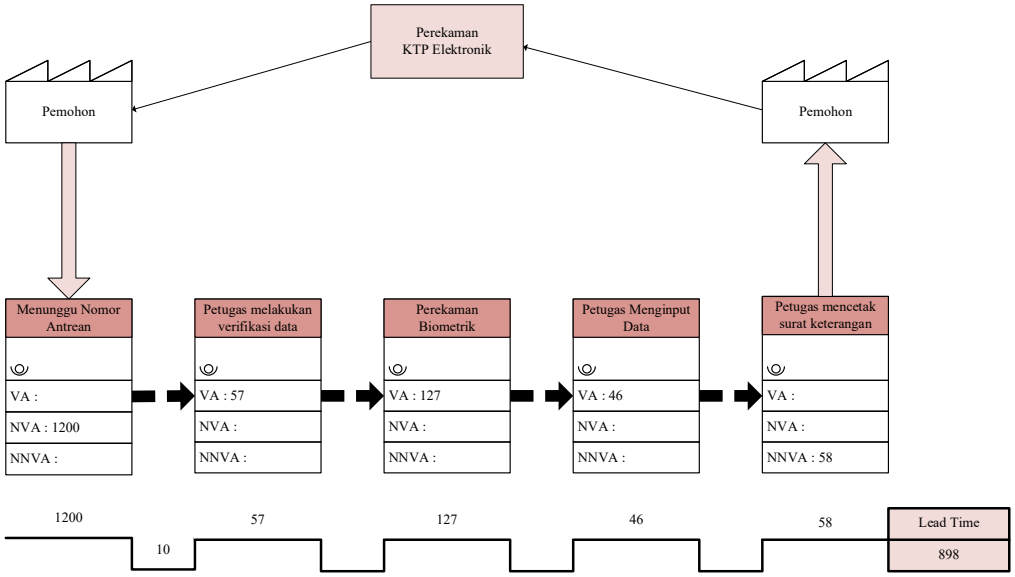

Figure 7. Current Big Picture Mapping

After repairs, the total service time will be 898 seconds or 15 minutes, with details: value added of 240 seconds, non value added of 600 seconds, and necessary but non value added of 58 seconds. From this data, a Process Cycle Efficiency (PCE) value of 27% was obtained. Furthermore, a comparison was made between the time before and after the repair.

Table 5. Comparison of Total Service Process Time Before and After

Initial Time	Time After Repair
1953 second	898 second
32 minute	15 minute

The service time, which previously reached 1953 seconds, was successfully reduced to 898 seconds. In addition, the percentage of value-added activities increased from 13% to 27%, and non-value-added activities decreased significantly. Thus, the implementation of Lean Service and RCA has proven to be effective in identifying, analyzing, and reducing waste to improve service efficiency.

Conclusion

Electronic ID card services still contain several types of waste that affect time efficiency and service quality. The waste with the biggest impact is waiting, duplication, and errors. The analysis conducted using the Value Stream Mapping (VSM) method and the Value Stream Analysis Tools (VALSAT) approach showed that before the improvement, the service lead time was recorded at 1953 seconds or 33 minutes. After the improvement of the service lead time to 898 seconds or 15 minutes. The efficiency of value-added activities increased from 13% to 27%. By using Root Cause Analysis (RCA) through fishbone diagrams, recommendations with 5W+1H method for improvement in this study can be proposed to improve service efficiency. The proposed improvement recommendations are the adjustment of the online queue system to be more accurate in estimating service times, as well as the addition of devices such as tripods and additional printers.

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