Analysis of Fire Response Time with Lean Service Method in City of Medan Fire and Prevention Service

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Abstract. Protection of the population from fire hazards has become a mandatory business and a basic service for citizens. This study aims to improve the quality of fire management services by speeding up the service response time of fire fighting fleets at the Medan City Fire Department. The research method in this paper is based on the use of Lean Service principles to determine non-value added activities using value stream mapping analysis and fishbone diagrams. The results of the research conducted showed that there was an increase in response time by 107 seconds and an increase in process cycle efficiency to 81.08% from 72.64% previously, which means that the current service is not efficient and can still be improved. This is due to several factors, including repetition of information when receiving information on fire incidents, location of gathering for standby officers which is far from the standby location and irregular storage of PPE.

1. Introduction

“Never go home, before the fire is extinguished” [1] is the motto of the fire department which guides the implementation of duties for every fire fighter. Fire suppression is a mandatory basic service at government affair in accordance with Law Number 23 of 2014 concerning Regional Government. Thus, fire fighting becomes an obligation that must be carried out by the government, just like health and education affairs.

Figure 1. Graph of fire incidents that occurred in Medan City in the period 2009-2019
Chainey and Ratcliffe [2] wrote that densely populated urban areas contribute to increased urban fire vulnerability. This opinion is comparable to the data on fires that occurred in Medan City in the last 11 years which shows an increasing trend as shown in the figure 1.

Fire events cause material loss due to loss of property such as houses, furniture, vehicles and others. Based on available data [3], material losses (in rupiah) also have a tendency to increase with each year.

As the impact of fires that tend to increase, the Medan City Fire Prevention and Service (DP2K) as the Regional Apparatus Organization (OPD) is responsible for fire affairs in Medan City, has the duty to serve the people of Medan City as recipients of fire prevention services guided by in the Regulation of the Minister of Home Affairs Number 114 of 2018 concerning Basic Service Technical Standards at Minimum Service Standards (SPM) for the District / City Fire Affairs Sub-Department, which has determined the response time is 15 minutes. Response time is the time required in response to fire information, which is measured from the information received until the fleet arrives at the location of the fire incident and extinguishes it.

\[
\text{Response time} = \text{Length of Time for Receiving Information} + \text{Duration of Transportation} + \text{Length of Time to Deploy Equipment} \quad (1)
\]

In 2019, out of 283 fire suppression and rescue events that were carried out, 168 times the response time obtained was less than 15 minutes so that the achievement of response time less than 15 minutes was 59.36%. This achievement is still far from the minimum service standards target which was set at 100% response time less than 15 minutes.

Fire management management in achieving response time is influenced by external factors such as the distance to the fire location and traffic conditions, and internal factors such as receiving fire information, submitting information to standby teams and departing fire engines out of the fire station. Lean analysis in this study is carried out on internal factors that aim to find waste so that a solution can be suggested to.

This research is carried out to find waste in the process of receiving fire information services until the fire engine departs from the fire station and provides solutions to reduce this waste.

2. Literature Review

Lean is an effort related to waste reduction and value creation for customers and was presented in three reviews. The first review aims to determine objectives, the second review to apply the five principles of
Lean and the third review concentrates on tools and methods that can be applied in implementing Lean [4]. Lean has been applied to service companies to eliminate waste and improve service to consumers according to research. Health organizations have succeeded in applying lean principles and producing continuous improvement. Graban [5] discusses that various hospitals have been able to reduce waste in operations by applying Lean principles. There are 5 basic principles of lean service [6], namely:

- Finding and pursuing excellence to achieve perfection (zero waste) through continuous improvement.
- In order for added value to flow without a hitch, it can be done by eliminating all the waste in the service process flow (moment of truth).
- In order for the product to captivate the hearts of customers, it is possible to carry out the product and service specifications appropriately to obtain maximum value.
- Identify the transformation (Value Stream) at each process services.
- Establish and implement an anti-error system in each service process.

**Value Stream Mapping**

Value Stream Mapping is a method used to map the production lines of products in which the materials and information from each work station are contained in the production process of a service. Value Stream Mapping can be divided into several stages [7], as follows:

- Identify groups of products / services.
- Creating a value stream from the current state to determine the problems faced from the perspective of the organization and customers.
- Determine the ideal mapping for the future.
- Identify the corrective actions needed to close the gap between the current state and the ideal state for the future.
- Take corrective action.
- Create a new mapping to check if the problem in point 2 has been removed.

The description of the steps of the research as a framework for solving problems so that the research carried out runs systematically and structurally is made in the form of a flow chart as follows:
3. Research Methods

An overview of fire management services, starting from receiving fire information, processing information, gathering troops to leaving the troops from the fire station, will provide an actual picture of the service process that occurs and then the mapping is carried out. The following is the average data from the measurement results for the response time starting from the information received until the fleet leaves the fire station for the period from May to July 2020 (20 fire events) can be seen in the following table:

| No. | Recapitulation                                                                 | Time (second) |
|-----|--------------------------------------------------------------------------------|---------------|
| 1.  | Receipt of information by telephone                                            | 55            |
| 2.  | Confirmation of information received                                           | 45            |
| 3.  | The ringing of the fire bells                                                 | 12            |
| 4.  | Firefighters move towards the PPE storage location                             | 95            |
| 5.  | Firefighters using PPE                                                        | 55            |
| 6.  | Fire fighting personnel moved towards the fire fighting vehicle                | 35            |
| 7.  | Fire-fighting vehicles move out of the post                                   | 32            |
|     | **Total**                                                                      | **329**       |
Based on the table above, there are 7 process activities for the departure of firefighters at the Medan City Fire Prevention and Service Office. The following is an illustration of the value stream mapping service for the deployment of firefighters.

![Value Stream Mapping](image)

**Figure 4. Current value stream mapping**

Based on Figure 4, current value stream mapping, it can be obtained a measured lead time of 329 seconds with a total value time of 239 seconds. Furthermore, the process cycle efficiency can be calculated. The calculation of the process efficiency is carried out by calculating:

\[
\text{Process cycle efficiency} = \frac{\text{Value added time}}{\text{Lead time}} \times 100% = \frac{239}{329} \times 100% = 72.64\%
\]

From the above calculations, it is found that the service process cycle efficiency is 72.64%, so it can be concluded that in the service process there is still waste. Then, efforts can be made to minimize processing time that has no added value.

Then an analysis of the causes of waste was carried out by identifying it through interviews with firefighters and then the results of the identification were analyzed using a fishbone diagram as shown below.

![Fishbone Diagram](image)

**Figure 5. Fishbone diagram**
From the data performed in the analysis using a fishbone diagram, the following is presented (in tabular form) problems and recommendations for solutions to these problems.

**Table 2. Proposed improvements to reduce non-value added activities in the flow of fire fighting service processes at the Medan City Fire Prevention and Service Office**

| Factor   | Problems                                      | Proposed Improvement                                                                 |
|----------|-----------------------------------------------|--------------------------------------------------------------------------------------|
| **Man**  | Number of personnel still not enough of necessity | Addition of qualified fire fighting personnel as needed                               |
|          | Lack of motivation                             | Refreshing and coaching personnel                                                    |
|          | Training has not been organized as needed       | Conduct training evenly to all personnel                                             |
| **Tools**| Work equipment not complete                    | Complete work equipment according to standard needs                                   |
|          | PPE does not meet standards                    | Complete PPE according to standards                                                  |
|          | Special locations for PPE storage not available | Provide a special location for PPE storage                                           |
|          | Conventional telephone set                     | Provides a call center device capable of detecting the location of the caller (geotagging) |
| **Management** | Not yet selected according to technical competence | Education and training are carried out so that management has technical competence |
|          | Minimal supervision against the standby officer | Increased supervision of standby officers so that they do not leave standby locations while on duty |
|          | Have not implemented reward and punishment      | Providing a reward and punishment system                                              |
| **Metode**| Minimum of safety knowledge                    | Increased training so that you understand safety                                     |
|          | Procedure not yet available                     | Provide procedures and conduct socialization so that all personnel understand the procedure |
|          | Inadequate access to standards                  | Provide a library so that personnel have access to applicable standards               |

After making the suggestions for improvement, the following is submitted the proposal in the form of a Future Value Stream Mapping.
Figure 6. Future value stream mapping

Based on Figure 6, the future value stream mapping can be seen that the lead time is 222 seconds with a total value time of 180 seconds. Furthermore, the process cycle efficiency can be calculated. The calculation of the process efficiency efficiency is carried out by calculating:

$$\text{Process cycle efficiency} = \frac{\text{Value added time}}{\text{Lead time}} \times 100\% = \frac{180}{222} \times 100\% = 81.08\%$$ \hspace{1cm} (3)

4. Conclusions

Based on the analysis of the reduction in non-value added activity in the service of firefighting fleets with a lean service approach at the Medan City Fire and Prevention Service, the total lead time has decreased to 222 seconds from 329 seconds previously, which means there is a time reduction of 107 seconds. The waste factor occurs due to several factors, such as repetition of information when receiving information on a fire incident, location where the standby officers gather far from the standby location and irregular storage of PPE.

Suggestions are made to reduce non-value added activities in the service process flow of firefighting fleets, namely adding fire fighting personnel, continuous training for firefighters, providing an information system for receiving fire reports using geo tagging facilities, and providing a special location for storage of PPE for firefighters.

References

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