Implementation of the Lean Service to Increase Productivity in The Procurement of Goods and Services of MRO Companies

Rahardhian Dimas Puja Kusuma
Industrial Engineering Master Student, Universitas Mercu Buana, Jakarta, Indonesia
Email: rdimaspk@gmail.com

Sawarni Hasibuan
Industrial Engineering Department, Universitas Mercu Buana, Jakarta, Indonesia
Corresponding email: sawarni02@gmail.com, sawarni02@mercubuana.ac.id

Abstract

In the Procurement Process of Goods and Services an effective and efficient process is needed in its implementation, to get the ideal process requires a system or process that is integrated with each other, therefore There are many companies that have not applied the concept of lean in the process of procuring goods and services because it is too focused on maximizing production performance. The aim of this study is to identify and analyze the performance of the process of procuring goods and services in the MRO industry using the Lean Service and VSM and DMAIC methods. This study shows that there is still waste or Waste in the process of procuring goods and services, i.e. there are still activities is manual and not integrated with this technology based on the findings of the number of waiting times Current State is 952.78 Minutes with VA time is 405.78 Minutes and Process Cycle Efficiency process is 43.83%, after repairs have been made by changing work processes and work tools with an online based system, it has been improved waiting time by 525.49 minutes and VA time is 280.49 and increased Process Cycle Efficiency to 53.37% along with increasing the output of making Purchase Orders to 951.1 a year from the beginning of 762.2. From the results of this study, it is recommended that companies apply the concept of lean to the process of procuring goods and services and try to use information technology as a tool to carry out procurement activities.

Keyword
Procurement of Goods and Services, Lean Service, Value Stream Mapping, DMAIC.

1. Introduction
At present there are many improvements made to the production line, but not many improvements or evaluations have been made to the goods and services procurement line   where the procurement of goods and services should also play a role in increasing the company's revenue through efficiency, This study aims to apply the concept of lean service to the procurement process of goods and services, during COVID-19 pandemic conditions, savings from all lines need to be made, especially the production line, this study shows that in the procurement line there is a gap to make improvements that have a significant impact on costs that come out of the company productivity and quality of the procurement process. This research was conducted on one of the aircraft MRO industries in Indonesia, where previously there was an inability to fulfill procurement requests from an average of 861 requests per year in the initial conditions, only 762 procurement per year were able to be achieved.

The objective of the project is to identify waste in the procurement process of Aircraft MRO Company. and provide suggestions for improving the process of procurement of goods and services also to increase the Output Purchase Order and reduce delays in the process of procurement of goods and services

2. Literature Review
The previous research which is the basis for this research is:
The first research was conducted by (Pradipto 2018). The proposed application of the Lean Service concept in the invoicing process, in this study there is an idea to reduce invoice input errors that cause delays in billing payments

by 60% because the input system is still manual so that double input on invoices often occurs, this results in poor company cash flow, then by applying the concept of lean service and value stream mapping by changing the system which was originally manual to application-based so as to reduce the error rate and increase process efficiency by 49%. The second research was conducted by (Nugroho et al., 2021). In this study, the implementation of the lean manufacturing concept was carried out to improve the lead time for the procurement of goods and services at the PT Krakatau Steel industry. The implementation of the lean manufacturing concept was combined with the VSM method. and the waiting time for offering prices for goods and services, there was a reduction in the procurement process for goods and services which originally took 41 days to 21 days as well as a reduction in total NVA activities from the initial 12240 minutes to 2160 minutes and an increase in the percentage of VA activities from 38% to 78% as for waste contained in this research is related to over processing then negotiation activities that are still face-to-face or manual as well as activities waiting for offers from vendors that require original or hard copy documents, based on this research it can be concluded that the lean co concept suitable to be applied to service activities and the VSM method can identify in detail the sub-processes in which there are indications of waste or waste. The third research was conducted by (Siregar et al., 2018). In this study, the implementation of lean service using the VSM method combined with 5 Why Analysis to solve hospital service quality problems, improvements were obtained in the form of a decrease in total lead time from 647.94 minutes to 340.9 minutes, The fourth research was conducted by (Baumer-Cardoso et al. 2020). using the VSM method which is added with a simulation model to solve the problem of green company implementation and material wastage, improvements are obtained in the form of a decrease in lead time by 83% and for a green company target the use of raw materials has decreased by 13%. The fifth research was conducted by (W. Guo et al., 2019) about implementation of lean in an assembly line using VSM and DMAIC method from this research concluded that From the results of the study it was found that the VSM method is good for identifying production waste but does not provide a solution to deal with it but with DMAIC the structure of waste reduction can be clearly identified, (Jimenez et al., 2019) research about improving productivity and quality using lean by utilizing VSM and SIPOC diagram resulted test shows a decrease in processing time from 73.025 seconds to 40.68 seconds and the distance between work stations is reduced from 10.9m to 6.5m, research about reducing waste using VSM From this research, PAM and VALSAT methods are used to reduce waste and the results of the reduction are a reduction in lead time of 80 minutes and a reduction in NVA from 3.10% to 1.01%.also conducted by (Zahrotun and Taufiq, 2018) through implementation of lean using VSM to reduce waste, research to see the factors that influence lean implementation was carried out by (Castro et al., 2019) From this research, it is known that the influence of employee motivation determines whether or not the implementation of lean manufacturing is effective, research conducted by (Neves et al., 2018) also shown that implementing lean tools in manufacturing saves man hours of 4 hours and increases availability time by 10%. (Kumar et al., 2018) research about process improvement of industry at india resulted Increased effectiveness and efficiency in non-capital industries in India where there are bottlenecks and high takt times, after improvement, there is a significant increase in the production process and quality produced. (Aureliano et al., 2019) research about lean implementation at 4.0 industry, the tests conducted on 3 companies showed a cost reduction of 9% for company A, 5% for company B and 7% for C, and showed a decrease in prices for customers as well as improving the quality of employees. (Pérez-Pucheta et al., 2019) research about lean implementation to reduce delivery time using VSM resulted Waste reduction efforts in the form of Non-Value-Added Activity got an increase of 24.08% and streamlined the process from 38 steps to 26 and the waiting time decreased from 8 days to 3 days. Research conducted by (Rishi et al., 2018) about lean implementation to reduce cost using VSM and kaizen resulted after lean implementation and manpower reduction was replaced with a gravity conveyor machine, we got a cost savings of 30% and time savings of 80% , research conducted by (D. Guo and Yu, 2018) about lean implementation using SAP software in automotive manufacturing shown from this research using SAP software, it can be concluded that lean can reduce inventory and duplication of items in the warehouse. Research conducted by (Diah et al. 2018). About lean implementation in middle scale industry resulted the results of this study, the lead time reduction was 440.4 seconds and the elimination of 17 NVA and increased production output by 21%.

3. Methods
3.1. Lean Service
Although initially Lean was applied to the manufacturing industry, the Lean concept can also be applied to the service sector or service industry. By continuing to use the same Lean principles, namely eliminating Non-Value-Added Activity and Continuous Improvement, Lean service is a standardized system and is made only with activities that add value to customers and focuses on customer expectations for quality and price. Lean service is very concerned about how to eliminate waste in the service process. The lean concept seeks to reduce this waste by

reducing the waste which is expected to reduce operating costs and improve the quality and timeliness of product or service delivery.

3.2. Value Stream Mapping

Value stream mapping (VSM) is a tool to identify value added and non-value-added activities in the manufacturing industry, making it easier to find the root cause of the process (Mcwilliams and Tetteh, 2009). This tool can show errors in an overview of the current state of the system. Value stream mapping is also a mapping tool used to describe supply chain networks. Value stream mapping is consisted of two mapping state, the first one is the current state map is a configuration of the current product value stream, using specific icons and technologies to identify waste and areas for improvement. The second is the future state map is a blueprint for the desired lean transformation in the future.

3.3. DMAIC

DMAIC is a methodology used in Six Sigma but can also be used in all application of the concept of improvement to solve problems that arise. This method is carried out repeatedly so that the improvement process occurs continuously. Which is divided into several stages, namely Define to describe the process and identify problems, second is Measure to collect data from the process, third is Analyze to review data from data collection that has been done, fourth is to improve or make suggestions for improvement of the problem, and the fifth is Control aims to develop continuous actions of the proposed improvements to maintain quality.

4. Data Collection
4.1. Difference Procurement Req. vs PO Release

Table 1. Difference Procurement Req Vs PO Release

Bulan	Procurement Req.	PO Release		Procurement Req.	PO Release	
	2018	2018	Diff.	2019	2019	Diff.
Jan	109	89	-20	72	52	-20
Feb	109	78	-31	70	77	7
Mar	106	106	0	76	50	-26
Apr	91	102	11	22	20	-2
Mei	96	92	-4	20	47	27
Jun	69	59	-10	16	27	11
Jul	51	72	21	41	59	18
Aug	114	85	-29	70	59	-11
Sept	39	75	36	65	55	-10
Oct	76	73	-3	71	59	-12
Nov'	79	62	-17	80	45	-35
Dec	92	78	-14	80	34	-46
Total	1031	971	-60	683	584	-99

Table 1 shows the difference between the procurement request and the purchase order made where there is an increasing trend of the difference between the request and the making of the PO, this can have an impact on the loss of opportunity to get a low price due to delays in making the purchase order, so it is necessary to repeat the process of requesting a price quote from vendors, From table 1 it can be seen in the comparison of requests every month for a period of one year there is a difference where the incoming procurement request is not the same as the issued PO, the impact of this unfinished procurement request requires the purchaser to re-RFQ to the vendor where the price offered will be 5%-10% higher than the initial offer, this will certainly increase the company's expenses if left in the long term

4.2. Time Study

Table 2: Measurement of procurement process working time

No.	Activity	Normal Time (Minute)	Standard Time (Minute)	Cycle Time (Minute)
1	Procurement Request	25.86	30.78	21.20
2	Procurement Disposition	14.27	16.99	11.70
3	Price Estimate Request	20.70	24.63	16.97
4	Create Price Estimate	34.28	40.80	28.10
5	Request for Quotation	17.45	20.76	14.30
6	Price Comparison	70.43	83.82	57.73
7	Negotiation	101.95	121.32	83.57
8	Create Proposal Of Purchase Approval	14.72	17.52	12.07
9	Approval Purchase Order	27.29	32.47	22.37
10	Submit To Vendor	14.03	16.70	11.50

Table 2 shows the results of calculations for normal time, standard time, and cycle time of the procurement process for goods and services. Measurements are made using the motion time study method and the Westinghouse adjustment factor. The Westinghouse method directs the assessment on four factors that are considered to determine fairness or not at work such as skills, effort, working conditions and consistency. Each factor is divided into classes with their respective values.
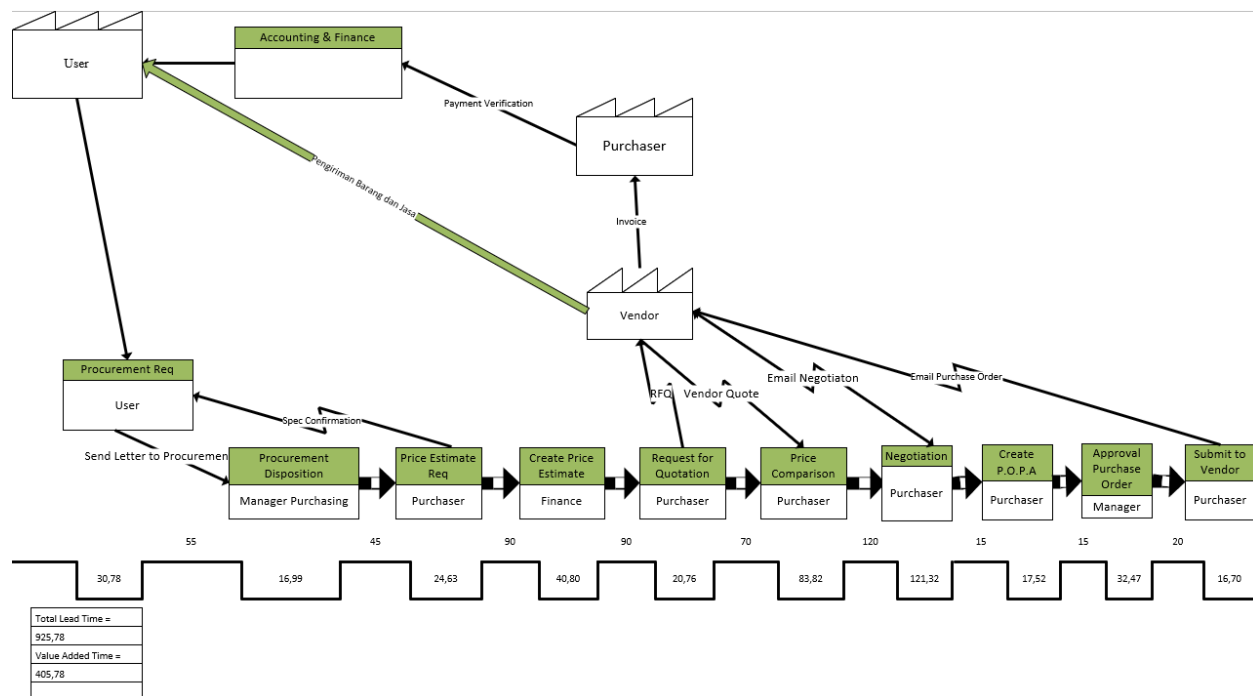
4.3. Current State Mapping

Figure 1. Current State Mapping Procurement Process

In Figure 1, Value stream mapping diagram which includes all activities that add value and do not add value needed to carry out an activity that produces goods/services from the beginning of the process to delivery to customers. required to carry out each process, it is found that the total lead time is 925.78 minutes, and the value-added time is 405.78 minutes, Current State analysis aims to be able to provide an overview of the ongoing work process, carried out several stages which are part of the VSM method,

From the results of direct observations in the field, attached Current State Mapping of the Procurement Process of goods and services, the first step of procurement starts with 1. The physical flow starts from the delivery of procurement request documents from the Planner to the Goods and Services Procurement Unit, 2. The General Manager receives a letter/document requesting goods and services and categorizes the request into a general or strategic procurement category and submits it to the Manager who is responsible for the procurement, 3. The manager regroups the procurement request into several types of procurement of goods and services to be then submitted to the capable purchaser according to the type of procurement. 4. The manager makes a disposition sheet as a sign of handing over the work to the purchaser.

From the results of observations of the flow of information that occurs in the process of procurement of goods and services are as follows:
1. The purchaser submits a request for HPS to be made to finance as a reference for the upper limit of the offer value.
2. The purchaser sends a request for a quote to the vendor with the deadline set according to the specifications and needs of the user.
3. Purchasers clarify and negotiate prices and offers with vendors,
4. Purchaser makes price and service comparisons and submits it to the manager.
5. Manager verifies the comparison of prices and services and then proceeds to make POs to the winners proposed by the purchaser.
6. Purchaser Makes approval proposals and POs for winning vendors.
7. Manager and GM sign the proposal and PO.
8. Purchaser gives PO to the winner of procurement of goods and services.

4.4. Value Added and Non-Value-Added Activity

Table 3. Value Added and Non-Value-Added Activity

Job Description	Category (Minutes)		
	VA	NVA	NNVA
Procurement Request	30.78		
Sending procurement letter request		55	
Procurement Disposition	16.99		
Submitting Procurement Disposition to Purchaser		45	
Price Estimate Request	24.63		
Sending a Letter of Request for Price Estimate Making		90	
Price Estimate Making	40.8		
Sending Price Estimate		90	
Request for quotation	20.76		
Waiting offer from vendors		70	
Price comparison	83.82		
Waiting User feedback		120	
Negotiation	121.32		
Waiting final offer from vendor		15	
Create Proposal Of Purchase Approval	17.52		
send print out to general manager		15	
Approval Purchase Order	32.47		
send approved PO to vendor		20	
Submit To Vendor	16.7		
Total	405.78	520	

Based on Table 3, the time for value-added activities based on the customer's view is 405.78 minutes, while the time for non-value-added activities based on the customer's view is 520 minutes. In general, the process of procuring goods and services begins with the user preparing a budget in the form of OPEX/CAPEX according to the type of procurement request needed, then after the user has the budget, a procurement request is made to the Planner to make a PR (Purchase Requisition) which will then be submitted to the Procurement Unit. The goods and services are then processed in accordance with the specifications and user needs that have been included in the request document for the procurement of goods or services. Then the procurement process is carried out by submitting a request for a price quote from the vendor (Request for Quotation) then after getting a price quote, the Purchaser makes a price comparison, delivery date and technical specifications and then the winner is selected to be submitted to the supervisor and made PO with the system, After making a PO (Purchase Order) with the SAP application, a print-out process is carried out to be submitted to the supervisor, in this verification process there are critical points that are considered by the supervisor in the Purchase Order verification process, including: 1) Goods Description, 2) Goods Quantity , 3) Goods Price, 4) Procurement Budget Reference, and 5) Procurement Winner Vendor. If the supervisor decides that there are no errors in the purchase order and the selection of the winner, the PO will be signed and then handed back to the purchaser to announce the results of the procurement to the procurement participants who follow the procurement process. The output that is usually produced from this procurement process is an order letter or commonly known as a Purchase Order (PO) as a sign of ordering goods or services that are recognized by both parties, both the employer and the recipient of the work in carrying out the procurement of goods and services. There is no standard form of Purchase Order so that the company can change parts of the Purchase Order as needed, The initial stages of the process of procuring goods and services in general after the fulfillment of the procurement file such as Self Estimating Prices, Terms of Reference or technical specifications include: (1) Determining the method of selecting providers, (2) Determining the qualification method, (3) Determining the bid evaluation method ,(4) Determination of bid submission method, (5) preparation of selection document.

4.5. Process Cycle Efficiency Current State

$$Process\ cycle\ efficiency = \frac{Value\ added\ time}{Total\ Lead\ Time}$$

$$Process\ cycle\ efficiency = \frac{405.78}{925.78}\ X\ 100\ \% = 43.83\ \%$$

The value of the process cycle efficiency contained is 43.83%, this value has passed 30%, this value has shown that the production process has met the lean principle. This value shows that the company's production process is quite efficient. The efficiency value can be increased to be even greater until it reaches a high level of efficiency so that the resulting production can be maximized, PCE is a comparison between Value Add (VA) and Total Lead Time. Where the greater the value of the comparison results, it can be said that the process is running more efficiently. Process Cycle Efficiency (PCE) is a comparison between Value Add (VA) and Total Lead Time.

5. Results and Discussion
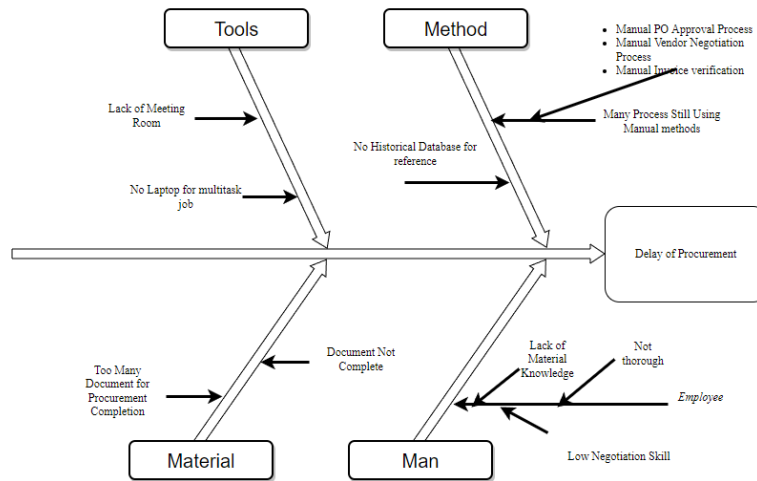### 5.1 Analysis of Procurement Process Problems

Figure 2. Fish bone Diagram of Procurement Problem

Based on Figure 2. To solve current problem related to (a) human/man is to Provide training to employees related to various materials for the procurement of goods and services, provide training in the price negotiation process also give user awareness about importance of goods specification. (b) Material, also inform user on how to properly request for procurement. (c) Method, create a database that is updated regularly containing historical procurement data along with categories of materials and service, (d) Tools, provide a platform that can be used together for the implementation of online meetings with vendors and create mapping the needs of computer facilities needed by employees.

5.2 Value Added and Non-Value-Added Activity Future State

As seen in Table 4, there is a reduction in the process of making Price Estimate activities, Price Comparison and Negotiation also there is a decrease in waiting time due to the utilization of the existing system Office Letter Automation for correspondence and document verification seen a reduction in NVA activities from the initial total of 520 minutes to 245 minutes and a decrease total VA time from 405.78 minutes to 280.49 minutes.

Table 4. Activity Future State

Job Description	Category (Minutes)		
	VA	NVA	NNVA
Procurement Request	25.23		
Sending procurement letter request		20	
Procurement Disposition	13.92		
Submitting Procurement Disposition to Purchaser		30	
Price Estimate Request	27.29		
Sending a Letter of Request for Price Estimate Making		20	
Price Estimate Making	22.37		
Sending Price Estimate		15	
Request for quotation	17.02		
Waiting offer from vendors		70	
Price comparison	53.76		
Waiting User feedback		40	
Negotiation	68.43		
Waiting final offer from vendor		15	
Create Proposal Of Purchase Approval	14.36		
send print out to general manager		15	
Approval Purchase Order	26.62		
send approved PO to vendor		20	
Submit To Vendor	13.69		
Total	280.49	245	

5.3 Current State and Future State Comparison

Table 5. Current and Future State Comparison

MP	PO Issued / Current State					PO Issued / Future State				
	Lead Time (Min)	WH Daily (CS)	PO Daily (CS)	PO Monthly (CS)	PO Yearly (CS)	Lead Time (Min)	WH Daily (FS)	PO Daily (FS)	PO monthly (FS)	PO Yearly (FS)
1	925.8	420	0.5	9.1	108.9	525.5	420	0.8	16.0	191.8
2	925.8	420	0.9	18.1	217.8	525.5	420	1.6	32.0	383.6
3	925.8	420	1.4	27.2	326.6	525.5	420	2.4	48.0	575.5
4	925.8	420	1.8	36.3	435.5	525.5	420	3.2	63.9	767.3
5	925.8	420	2.3	45.4	544.4	525.5	420	4.0	79.9	959.1
6	925.8	420	2.7	54.4	653.3					
7	925.8	420	3.2	63.5	762.2					

Based on Table 5, the results of the comparison of the current state map with the future state map of the value-added time, lead time and the number of Purchase Order outputs for 1 year. From the current state map, the value-added time is 405.78 minutes, the lead time is 925.8 and the total production is 762.2 Purchase Orders per day. Meanwhile, in the future state map, the value-added time is 280.49 minutes, the lead time is 525.5 minutes and the total output for one year is 951.1 purchase orders. Comparison of the results of the current state map with the future state map obtained significant results so that it can increase the amount of output more than before. in the table it can be seen from the initial conditions of 7 workers and With an average procurement request of 861 per year The procurement target is 7 days after the procurement request is received and with 7 employees and an effective working day of 20 days, the percentage of PO completion time to the target is 68.51% or 762.2 POs per year where there is still a difference between the average demand and the POs that can be completed, while in the condition after repair with only 5 workers and from an average PO per year of 861 with a target of 7 days and 5 MPs, the percentage of PO completion time against the target is 82.12% or as much as 959.1 PO per year.

5.4 Process Cycle Efficiency Future State

$$Process\ cycle\ efficiency = \frac{Value\ added\ time}{Total\ Lead\ Time}$$

$$Process\ cycle\ efficency = \frac{280.49}{525.49}\ X\ 100\ \% = 53.37\ \%$$

From the comparison condition of Process Cycle efficiency of current state and future state, the increase in process efficiency from the initial 43.83% to 53.37% there is an increase of 9.54%
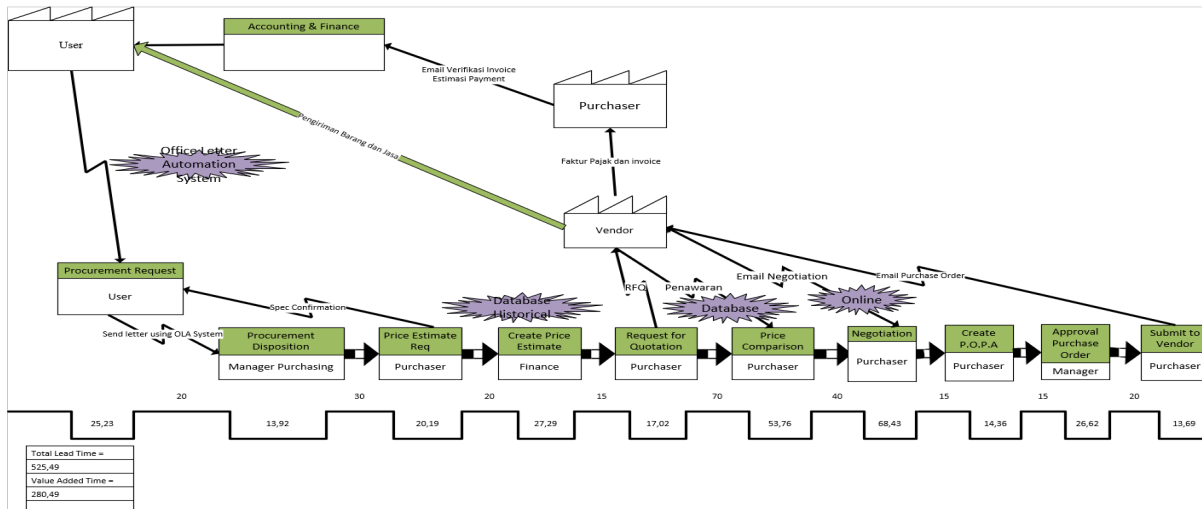
5.5. Future State Mapping

Figure 3. Future State Mapping

Improvements made in Figure 3 is the occurrence of a significant time change in the process lead time, where the time shown in the current state is 925.78 minutes and in the future state mapping improvement, the time is 525.49 minutes. This is obtained thanks to the maximum use of online-based systems in the company OLA (Office Letter Automation System) and online meeting-based activities for negotiation activities and explanations for the procurement of goods and services so that the time required is shorter because it reduces activities for preparation etc. The process improvement time is obtained for the following work:

1. Making HPS or Self-Estimated Prices of 18.8 minutes for cycle time, 22.936 minutes for normal time and 27.29 minutes for standard processing times, this can be achieved due to the implementation of using historical databases that have been made by pulling data from the system already exists and convert it to Microsoft Excel format and then upload it to a cloud-based system so that it can be accessed together.

2. In the Price and Service Comparison process, the result is 37 minutes for cycle time, 45.18 minutes for normal time and 53.76 minutes for the standard time of the service process, this can be achieved thanks to the use of historical databases that are applied to facilitate analysis of the comparison of increases or decreases. price reductions for previously purchased items.

3. In the Price and Service Negotiation process, the result is 47.1 minutes for cycle time, 57.5 minutes for normal time and 68.43 minutes for standard time, this can be achieved by starting to utilize the use of online meeting media so that it can save usage space and reduce waiting time for the arrival of vendors.

5.6. Control Improvement

To ensure that the proposed improvements can run well, it is necessary to develop/update work procedures that regulate employees, tools, and methods in the work process.

The standard Operational Procedure (SOP) must be made by the head of the department of procurement of goods and services and related units so that it can be a common reference and can be implemented properly.

The following are some work procedures that must be carried out by the head of the procurement department for the process of procuring goods and services.

1. Verify procurement request documents before they are approved and forwarded to employees

2. Supervise the ongoing procurement process.

3. Ensure that the procurement process can be completed before the predetermined TAT

4. Ensure the procurement process runs according to applicable company rules

5. Ensure that the procurement results are in accordance with the specifications and conditions provided by the User.

6. The head of the department needs to review the procedures for the procurement of goods and services so that it is in accordance with the lean concept that has been given so that it can be applied consistently, and the company can feel the benefits

6. Conclusion

Using Lean Service along with Value Stream Mapping and DMAIC can identify waste that occurs in the procurement process which is the number of shortages of documents in procurement request activities which causes a waiting process for procurement fulfillment (waiting), then the document delivery process is still manual, causing a high process waiting time (In-efficient transportation movement of information and Paperwork), then the goods procurement process and services that are still manual, for example: offline meetings, document verification is manual. Causing a large enough waiting time (unnecessary motion), then there are still deficiencies and errors in document making (defects) which causes excessive use of paper (inventory) and the lack of training provided to employees causes the procurement process to be often hampered due to lack of ability (underutilized employee abilities). Companies can optimize the process of procurement of goods and services, by using the lean service method the company can increase production results and reduce waste or waste that occurs in the procurement process, in the form of optimizing the use of online-based facilities in the document delivery process.

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Biographies

Rahardhian Dimas Puja Kusuma is a graduated student in industrial engineering faculty of engineering Institut Teknologi Indonesia, and currently pursuing a master's degree in engineering at mercubuana university, Jakarta. He is a material planner at one of Aircraft Maintenance Repair Overhaul industry in Indonesia for over 4 years specialized in aircraft component planning, he also active in technology industry activities, especially the development of application and computer-based systems.

Sawarni Hasibuan is an associate professor in the Industrial Engineering Department at Universitas Mercu Buana, Jakarta, Indonesia. She completed his master's degree in industrial engineering at the Bandung Institute of Technology and obtained a Doctorate in Industrial Engineering from Bogor Agricultural University. She has carried out several research and publications in industrial management, green and sustainable manufacturing, supply chain management, and renewable energy.