Engine Instrumentation Database Optimization

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Abstract *— This paper examines the turnaround time of a database task in a company at Puerto Rico. The main purpose of the paper is identifying the main problems in order to reduce turnaround time on the delivery of a specific task. After conducting a series of analysis to the data provided by the incorporation of Value Stream Mapping, Process Flow Maps and SIPOC diagrams, two main problems were identified. The internal process fault was related to the assignation of workload to employees while the external process fault was the time spent re-doing processes due to incorrect inputs from the clients. Using the Lean Six Sigma principles and tools, two solutions were identified and implemented in order to reduce turnaround time in the Company. For the internal process fault, an employee was assigned as a focal to assign the workload appropriately within the team. For the external process fault, a spreadsheet was created which reduced the number of incorrect data inputs being added to the company's database. To verify if the solutions worked, another set of analyses was done which demonstrated that the new procedures were effective and reduced the turnaround time.*

Key Terms *— Lean Six Sigma principles, SIPOC diagram, turnaround time, Value Stream Mapping*

INTRODUCTION

Pratt and Whitney Puerto Rico, located in Isabela, Puerto Rico is an Aerospace Engineering company that provides technical engineering services for the aerospace industry. After analyzing technical data and receiving input from clients, the employees noticed that the company is exceeding the amount of time expected to complete a delivery for the Engine Instrumentation Database tasks.

OBJECTIVE

The main focus of this project was reducing the turn-around time within a specific task with the potential to become a productivity improvement project. The process of the studied task involves the management of a database system. This specific productivity improvement idea came from the suggestion of one of the main customers in respect to turn-around time of a task.

Reducing the turn-around time is expected to increase productivity and customer satisfaction. As stated before, the task consists in the data management of an instrumentation database.

The main objective of this project was to identify the problems that were causing the increase in turnaround time in order to optimize the process and thus reducing delay and wait time. This change was expected to improve customer satisfaction by reducing turnaround time on the delivery of a specific task.

LITERATURE REVIEW

Research has demonstrated that, to have an appropriate system of organization and procedures, managers should access different tools that allow them to monitor performance. With this information, companies can be aware of what their areas of improvement are [1]. There are several methods that can be used to identify these particular areas, such as the Lean, Lean Sigma and Lean Six Sigma [1]. Within these methodologies, there are tools like Value Stream Mapping (VSM), SIPOC and DMAIC [1]-[2], some of which were used as part of this research project.

The Lean Six Sigma methodology is a productivity and quality improvement tool for the managerial aspect as well as a tool for quality and process control [3]. Understanding how this process

works requires a deeper understanding of the components of tools like SIPOC and VSM, part of the Six Sigma methodology as well.

The acronym SIPOC stands for suppliers, inputs, process, outputs and customers; this tool permits the detailed visual organization of a business process step by step [2]. SIPOC diagrams allow employees to understand them without having to receive a large amount of input from the company, similar to a Process Flow Map (PFM).

Value Stream Mapping (VSM) diagrams require a more complex process for building than SIPOC diagrams, but follow a similar objective. Studies suggest that the process of integrating VSM should require several steps, beginning with the creation and training of teams, selecting products or services to use for the conduction of the VSM and drawing the first mapping with the actual state of the process [4]. After this, the maps are analyzed and conclusions are drawn.

Research has shown that the utilization of the VSM allowed the identification of where the problems occur in a particular scenario and thus providing managers with feedback that can help solve situations like reducing turnaround time and improving processes [4]-[5]. Both VSM and SIPOC [2]-[5] have been proven to be effective for the analysis and improvement of the company.

According to research, a design processes that integrates VSM, SIPOC with the basic Lean and Lean Six Sigma principles shows important implications because it integrates several different processes and methods that proved to be appropriate for a better functioning of the manufacturing process in the company [2].

When compared to a traditional methodology, Lean Six Sigma combined with SIPOC [2] and VSM [4] has been proven to increase the levels of performance, and at the same time improve the levels of customer satisfaction. Studies have demonstrated that there are differences between the methods, mainly in the decision-making process; however, they improve performance dimensions in the managerial areas [1].

METHODOLOGY

The focus of the project is reducing the turnaround time of a database task process in order to increase both productivity and customer satisfaction for the company. The purpose of this study was to analyze the process of entering information to a database in order to find a possible solution to the problem and prevent the company from exceeding the amount of time expected to complete a delivery. To achieve the proposed goal, a team meeting was held where the participants outlined the possible procedures to be completed which would facilitate the completion of the project.

In order to find the source of the problem in the process, which was exceeding the amount of time expected to complete a delivery, the development of a methodology included the creation of a Process Flow Map (PFM) (Figure 1). This particular diagram allows the researcher to understand the process of how tasks are and should be completed and provides important information in regards to this matter. After the PFM is completed, the instrumentation database service SIPOC diagram (Figure 2) will be created as well. The SIPOC diagram outlines the suppliers, inputs, processes, outputs and customers that send and receive the information within a specific process. In this case, a SIPOC analysis is to be completed for both the requester and the employees, for the same process. The third step in this first analysis process will be creating a current Value Stream Mapping (VSM) shown in Figure 3, which allows the researcher to observe where and when the faults in a process occur. Once this process was completed, the data obtained will be analyzed, possible solutions will be determined and implemented. This will lead to the creation of a Value Stream Mapping (VSM) which will allow the further study of the problem in order to observe whether the proposed solutions were effective or not.

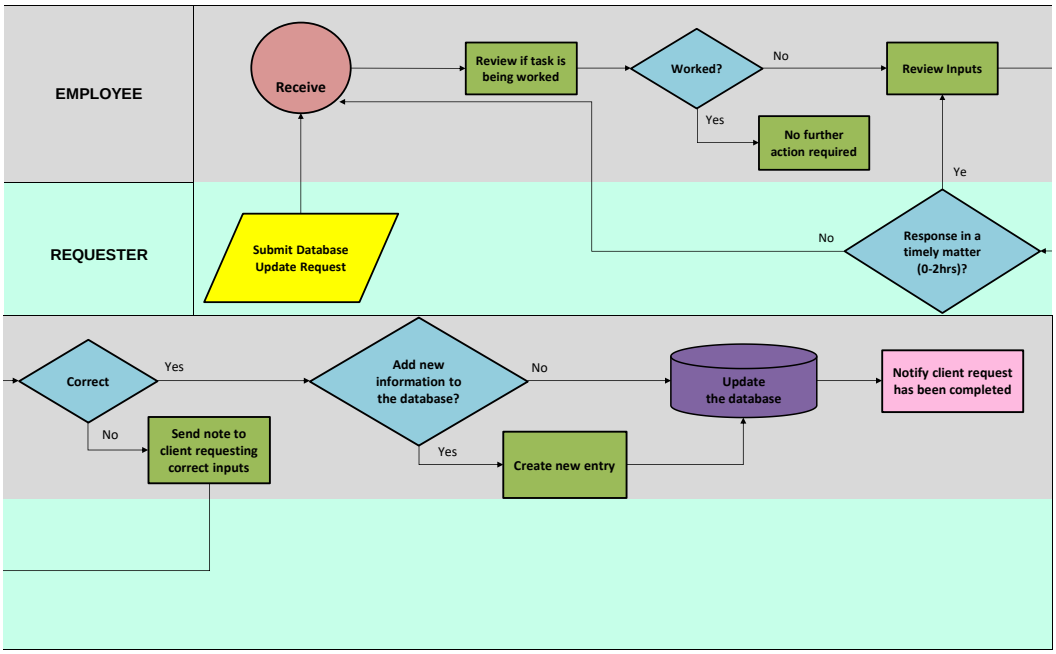

Figure 1

Process Flow Map

Suppliers	**Inputs**		**Process**
	Description	***Quantified measure***	
Requestor	Request sent via email	Instrumentation type, units, component, position, among others.	**Upload request into the Database**
Employee	Completed entries in the database admin tool.	All required fields of the database admin tool.	**Notify client that the request has been completed**
Outputs			**Customers**
Description	***Quantified measure Delivery***	***Quantified measure Quality***	
Complete entries in the Database system	All required fields of the database admin tool filled.	No typos/errors in the database admin tool.	**Employee**
Email notification	Information of where to find the requested entries in the database.	No typos/errors in email communication.	**Requestor**

Figure 2

Instrumentation Database Service SIPOC

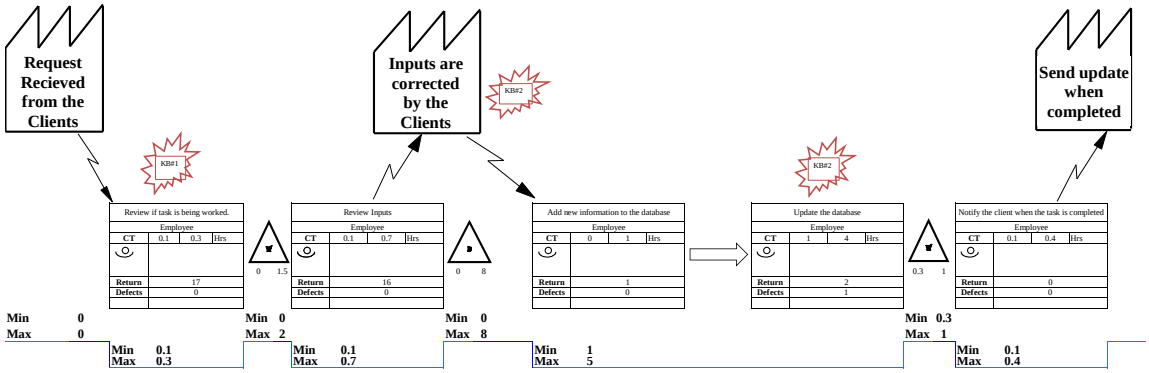

Figure 3

Current Value Stream Mapping

RESULTS AND DISCUSSION

Initial Analysis

The results of the Value Stream Mapping (VSM), presented on Figure 3, outlined the wait times for the process. The wait time for the tasks to be completed, as presented on Table 1, included a time frame going from 0.3 hours to 10.5 hours while the process hours ranged between 1.3 hours and 6.4 hours. These values give a range from 1.6 hours to 16.9 hours per task. Based on this information, it is clear that the maximum wait time is exceeding the actual process time. The VSM suggested two main faults in the process, one internal and one external fault. These two processes are the ones where the amount of time is higher when completing a task.

According to the obtained information, the internal process fault is the fact that the workload is not being assigned properly to the employees. This accounts to many tasks being stuck on queue for a substantial amount of time. On the other hand, the VSM suggests that the external process fault is the time wasted when the process needs to be redone due to incorrect inputs from the client. Both of these issues result in the increase of turnaround time for delivery the instrumentation database tasks and pinpoint the specific areas that need to be worked on in order to achieve the proposed goal of this project.

There were two proposed solutions to the problems identified by the VSM analysis. The proposed solution to the first problem was selecting a focal employee who will be assigned to keep track of all tasks in order to avoid miscommunication between the team. Also, this focal person should create work orders using a specific system and manage a spreadsheet accessible to all the team members, which will facilitate the process of assigning tasks. As for the second problem, the proposed solution was to create a spreadsheet that includes all the necessary information needed to complete tasks that will be filled by the clients who are making the work request. This spreadsheet should include prefilled data with a drop-down menu for components that are standard in all procedures that will facilitate the organization process. It is expected that both of these solutions will reduce the turnaround time. A post Value Stream Mapping (VSM) was to be developed and to be used as a comparison against the current VSM (Figure 3).

Table 1
Current State Value Stream Mapping Times

Current State VSM			
VSM Times	Min	Max	Units
Waiting Time (WT)	0.3	**10.5**	hrs
Process Time (PT)	1.3	6.4	hrs
Lead Time (LT)	1.6	16.9	hrs

Implementation of the Solutions

Once the problems and possible solutions were identified, the improvement plan was developed. The solution to the first problem, which was the internal process fault, included the assignation of a focal employee who should control the process of assigning tasks to all the employees in the team. Two spreadsheets were created for this process, one with the necessary information for the focal employee to keep track of his tasks and duties and another spreadsheet that included the tasks that was being worked on and by who, which was shared with all team members.

For the second problem, the external process fault, a spreadsheet was created as well. This document included a pre-filled form for the clients to fill out before sending a request to the company. A guide explaining how to complete this spreadsheet was also included in order to facilitate the process. Both solutions had a two week trial period which included follow up meetings and calls to clients in order to make sure that the changes in the new format were understood and implemented appropriately.

After the two-week trial period was completed, the Process Flow Map (PFM) shown on Figure 1 was re-examined to identify is any changes had to be made. The same procedure was done with the instrumentation database service SIPOC diagram shown on Figure 2. None of the diagrams demonstrated changes since the implemented solutions to the problems were part of specific

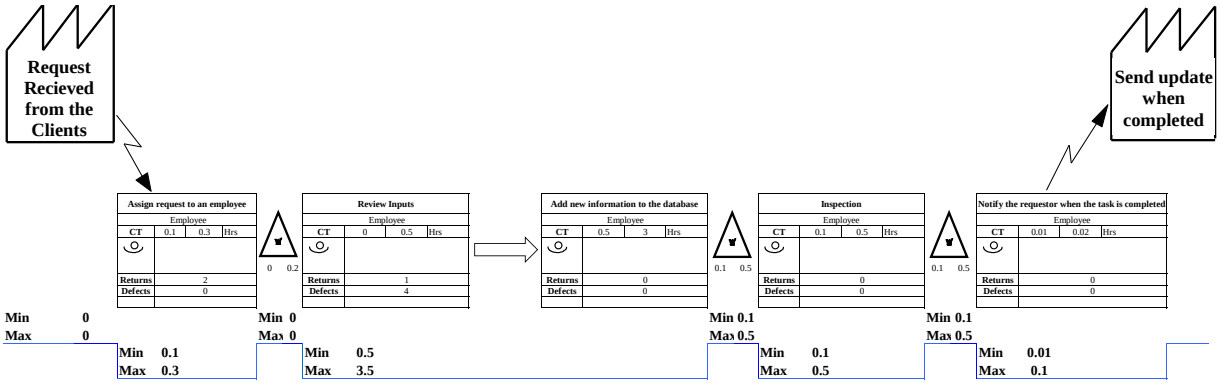

Figure 4
Future State Value Stream Mapping

processes and did not alter the steps of the database process.

A future state Value Stream Mapping, shown on Figure 4, was developed. The wait time as, shown on Table 2, presents a reduction from 0.20 to 0.71 hours; the process time had a new time value ranging from 1.20 to 4.40 hours that states the lead-time indicated a new time frame from 1.14 to 5.11 hours per task.

Table 2
Future State Value Stream Mapping Times

Future State VSM			
VSM Times	Min	Max	Units
Waiting Time (WT)	0.20	0.71	hrs
Process Time (PT)	1.20	4.40	hrs
Lead Time (LT)	1.40	5.11	hrs

CONCLUSION

The main objective of this project was to reduce the turnaround time of a task related to a database process. After analyzing the current state Lean Six Sigma tools incorporated in the project compared to the initial stage processes, there was a substantial decrease in the lead-time per task, specifically. This demonstrates that the implemented changes did in fact increase the level of efficiency by reducing wait time. Also, these changes did not represent an extra cost to the company, and with decreased amount of hours there is an improvement in the productivity of the employees. Therefore, it is implied that both the main objective of the project and the optimization goal were met.

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