

Optimization of Tooling Design Process for Assembly of Motor Parts

*Yamil Abreu Machado
Master of Engineering in Manufacturing Engineering
Advisor: Rafael Nieves, Pharm.D.
Industrial and System Engineering Department
Polytechnic University of Puerto Rico*

Abstract - *this project developed a DMAIC process to start improving the results of a new task been performed in the company [1]. The project will focus on improving the quality and turnaround time of the work performed. the quality is going to be improve by looking for the areas that produce waste, study those areas and look for alternatives to eliminate the waste produced and be leaner. by improving, the quality of the work provided to the customer by eliminating waste the turnaround time that takes to deliver the task is going to improve. as this is a new task, been performed the way that it is going to be improved is by designing a new standard work for all the designers to use it.*

Key Terms: *Continuous Improvement, DMAIC, Lean, Turnaround time.*

INTRODUCTION

There is always a need for new tools to design when a motor is being build. This project is important because these types of tools help the mechanics perform their job in a much easier way and some of the parts been assembled are heavy parts. As this is a new project the proficiency, of the people performing, the designs are low and they need to learn fast and performing on the job training. This report will help to establish a more standardize process in order to reduce waste and give the customer a better product [2].

RESEARCH DESCRIPTION

This report will help to establish some guidelines and/or standardize a process that is a pilot project at this moment. The emphasis of the article is to look for the areas the project is having more waste to standardize them and look to improve where the project is having more waste.

By establishing guidelines or a standard work, the process can be maintain in control and look for opportunities to continuous improvement in the future.

RESEARCH OBJECTIVES

The objectives of the report is to standardize the process of the project in order to reduce waste. Create a standard work document or guidelines that can help the people performing the job of the requirements or where to look if some assumptions are make. Help people performing the job know how to make any type of assumptions or suggestions in order to make their design better. This type of things will help the project to be leaner and have a better product for our customers.

LITERATURE REVIEW

This report will consist of the application of quality measures to establish a process for a project that is in a pilot program and don't have any type of instructions or guidelines to follow. The creation of this instructions or guidelines will help all employees to know the requirements the customers wants in the products and be able to achieve the delivery in a very lean way.

The areas to be analyzed first are the customer requirements for example: what they are looking for? How to get the requirements? Who can help if there is any doubt? These types of questions will help the designer to establish a plan in order to develop the product the customer is looking for. After this initial steps are completed the designer needs to be able to start his process. The objectives of this background research is for the designer to have a clear understanding of what is been look for

in that request by the customer and try to be as much lean possible in the process.

After performing a research background about this topic in the university databases all of the topics that were found was about machinery design and that is not the topic that this report is about. This report will consist of performing or establish a series of processes to write guidelines or a standard work about a project that is starting and can help its designers to follow these instructions to be more efficient (lean) in the product that we are delivering to the customer.

The method that will be used to conduct this project is using a DMAIC process. The project will be defined of what the customer wants, their requirements, and a standard work will be developed. When the project start it will be measured, how much time it took for each designer to perform the job and the error found in the process will be recorded. Then the errors found will be analyzed to look for ways to improve the process and don't do the same errors in the future. And finally the process will be controlled, after the standard work gets updated another DMAIC will be run in order to validate that the errors previously made are much less than in the beginning and looks for other areas to improve.

Another tool that will be used and will help this project is Project Management [3]. This tool will help to monitor the time that takes to perform the task by each designer and will help to understand each request made and categorize it by the difficulty of it. This will make the future estimation of time to take the task more accurately based on the difficulty of the task. For example, an easy task can be estimated to take 30 hours of work while a hard task can take 130 hours of work. This time measurement will be observed and measure using the project management tool.

METHODOLOGY

The way that the goals are going to be achieve is by on the job training of the designers following a DMAIC procedure. The process that is going to

be follow is that the request is going to be analyzed, there are different types of request made with different requirements, and a series of steps or guidelines are going to be developed by the subject matter expert on how to attack each request. The subject matter expert is in charge of developing the steps and requirements that a request needs to have in order to be processed. Such steps could be to setup a meeting with a mechanics or a subject matter expert in that area, expose different ideas of how the tool should be designed with the designer. Some of the requirements that the subject matter expert should ask that the request have is where does the tool interacts with the engine, the weight of the engine at the time the tool is going to be used, how the tool needs to be assembled to perform the job that it is going to be manufacture for.

As a DMAIC process is going to take place the Define phase of this project will consist on defining the requirements, objectives goals and expected date, etc. This will be achieve by creating using the DMAIC tools that are capable of defining this project. For example, some of the tools that can be use are; Project Charter, SIPOC, Process Map, Voice of Customer, Storyboard, etc. these tools will help the designers to understand in general what the project is about and what to expect from them. Not all of the tools need to be create; the project will require only the ones necessary to establish the strategy to follow.

The phase that follow is the measure phase: in this phase the data collection will take place on the work inspection that the subject matter expert is going to do from the jobs performed by the designers. The data of the mistakes found in the inspection process is going to be stored in a database for future analysis. The data collection plan is for the subject matter expert to store all the inspections performed in a database. This will ease the way to analyze this data.

After performing the measure phase, the following phase that continues is the analyze phase. In this, phase all the data that was collect in the measure phase and stored in the data collection will

This type of lesson learned correction process would be apply when an occurrence of a defect become very usual in the team performance and the subject matter expert notices it by the inspection process applied as part of the optimization process, we are discussing in this project.

As this is, a new project the best way to improve it is to standardize the process as much as possible, the tasks related to it in order for the designers to know what the requirements are and perform the task as smooth as possible. This way the work instruction can be reviewed regularly and even updated due to a defect appearing regularly in the job of the designers and the work instructions updated to be able to eliminate it in future tasks. One of the goal to achieve in this new process is the quality of the design of each project to be the best possible in order to get the jobs done correctly and to comply with the customers' requirements with the less turnaround time and with the best quality possible for them to have the product they desire. These results are going to be explained and analyzed using a DMAC process in the following paragraphs.

The Define process of the DMAIC in this case is define in a project charter. The project was approve as a DMAIC candidate and the developed project charter. In the project charter we are going to see the information that correspond to the project in general like purpose, scope, goals , final deliverable, etc. The project charter of this project is as follow in Figure 2:

Prepared by	Yamil Abreu
Date Issued	1/29/2020
Project Name	Optimization of tooling design process for assembly of motor parts.
Purpose of Project	Improve the quality and turnaround time of the product delivered to the customer
Business Case/Need (Business reasons for the project)	Standardize the process to improve quality and turnaround time.
Team Members	Subject Matter Expert and 8 designers.
Estimated duration of the project	3 months
Suppliers to the Process	None
Project Scope (start/end)	September 30 2019 to December 22, 2019
Project Goal(s) (What is it intended to achieve?)	Improve quality and turnaround time of the tasks performed.
Estimated Cost \$	As this is a new project the cost to perform the job is not available at the time.
Timeline and estimated project completion date	3 months.
Estimated Savings \$	N/A
Final Deliverable(s)	A drawing to manufacture an assembly tool.
Approach	Kaizen

Figure 2 [5]
Project Charter

Suppliers (a)	Inputs (b)		Process (c)	Outputs (d)			Customers (e)
	Description (b1)	Quantified measure (b2)		Description (d1)	Quantified measure Delivery (d2)	Quantified measure Quality (d3)	
XYZ Co.	Engine Part Information	Correct Engine part configuration and related data (weight, loads, etc.)	Preliminary	Concept model uploaded to database. First sheet of drawing, containing ISO View, and engine part cross section.	Final drawing fully dimensioned. Correct notes, and dimensions.	Tool meets requirements stipulated in the request.	ABC Co.
	Reference Drawing	Data for design is defined by references.					

Figure 3
SIPOC

The inputs, outputs and requirements are going to be establish using a SIPOC. The SIPOC defines the scope of the project to take place. This helps the designers working on this project to understand what is in need at the start of the process in order for them to have all necessary information to begin with and what they need to do with that information to provide the ultimate delivery to the customer. By creating the SIPOC it also helps the designers working on the project to eliminate the inputs provided by the customer that are not needed. The customer creates a package of information and provides it to the team as information needed for the design but not all information is needed. This package of information that the customer provides is going to be standardize also, to what is required and this is one area that will help to improve the process and provides less waste, as the new process was design. The SIPOC created for this project by the subject matter expert and the team in charge to perform the task is found on Figure 3.

The way to measure, this project is by collecting data from the work inspection process. As a new standard work was develop to perform the task. The inspector will inspect the tasks and store the results by category in a database. This data collection time will be for 5 weeks of the total time of the project, at first. This is a continuous project for improving the process. Process flow map was develop and is shown in Figure 4.



Figure 4
Process Map

Using the database of the errors found in the measure part, a pareto chart was designed with the results of the inspections, (see Figure 5), provided by the inspector in the five weeks that the process

was active. The results of the pareto chart can be found below.



Figure 5 [6]
Mistakes Found in Work Inspection

These common mistakes that the designers committed and were found using the pareto chart are going to be analyze. Why the notes and dimensions are giving the designers trouble in the drawing of the tool they are performing? That is the question that we have to answer, in order to continually improving the process and provide the customer with the best quality possible in the tasks performed to provide the customer of the product that they want us to provide. This Pareto chart shows the area the needs special attention in order to improve the process and these areas are the missing and incorrect notes, and the missing dimensions in the drawing. The subject matter expert will have meeting with the designers in order to know why they are failing in this areas specifically and to provide them with a solution that all the team can understand and help them in the selection of the notes and dimensions needed when they are performing the task.

To improve this process in the areas where more defects were found (notes and dimensions) and after the subject matter expert finished with the interviews of the designers, the subject matter expert concluded that a need of special instructions would be develop. This new instructions will be placed in the new standard work to continue standardizing the process in order to help designers decide which notes are required per type of task and manufacturing process and will be added to the standard work that is already in place. This will ensure that the designers add to the drawing the

correct notes so the manufacturing of the tool becomes an easy job.

The established time for the subject matter expert to provide the new instructions that will be added to the standard work that is already in place will be of three weeks. In that, time span the subject matter expert will have a meeting with the designers to identify what is causing their mistakes in the decision of selecting the correct notes and develop the instructions that will help the designers improve in their future designs. The time to implement these new instructions is going to be the next phase of the DMAIC process for this project. As this is, a new project in the company data collection for this type of project is starting to get collected and looking for the areas that produce more waste in order to improve those areas.

The way that the group is going to be able to say that this project is in Control is by collecting data from the next phase of the DMAIC project and look for the biggest hitter. As this is a new project in the company, we will be doing continuous DMAIC to look for ways to continue improving the project. This is not a process of one and done it needs to be done continually and look for the biggest hitter each time to develop solutions to improve that and eliminate waste. If the biggest hitter in the measure phase is still the incorrect/missing notes and the dimensions then the process is not in control and the improvements make for this project failed. If the biggest hitter in the next phase of the DMAIC is not the notes and dimensions

CONCLUSION

The optimization of the tooling design process for assembly engine parts is a continuous process that by standardizing the process at first will help the designers and the SME to have a base knowledge of what is expected from them to perform the jobs and can use these instructions to be able to provide the customer with a high quality product at a low turnaround time. This will ensure for the customer that the job done is what the

customer look when hiring us to perform the task. This optimization process is not a thing that you do once and forget about it, this process needs to be continuous in order to optimize the process in the areas that the designers are failing to provide a good idea or missing continuously some requirements to attack that area and provide directions to them for a full understanding of what is needed and what the customer is looking for.

By continually looking to perform improvements in the process this will ensure that the designers get the job done right at this first try and with the best quality possible to minimize that the inspector returns the job to the designer for corrections. As much training is provided and improvement makes during the time the project is being done the product that will be provided to the customer is one with high quality and low turnaround time.

These new instructions to correct the missing/incorrect notes and the incorrect dimensions and the training given to them of how to use that instructions are going to help the designers when they have to select their notes and the dimensions in their new tasks. This new instructions will ensure that the process is in control and that the SME can move to look for others areas of this project to improve and maintain a continuous improvement focus on the project. Maintaining a continuous improvement focus on the project will help the customer to maintain their loyalty toward the company, maintain the project, and trust toward the group in the company.

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