

## Abstract

The inaccurate bookkeeping of deliverables can have a significant impact in a project's performance. It puts the project manager in a difficult position to track effectively and efficiently the project's progression and creates non-conformances in the company's project execution process which puts the company's quality standard at risk. To further understand this issue and reduce the number of non-conformances found by the Quality department audits, a Define-measure-analyze-improve-control (DMAIC) was performed. From the study performed, it was found that by adding a mistake proofing into the bookkeeping process, through the creation and implementation of an MS Outlook macro, the number of findings or non-compliances of inaccurate deliverables bookkeeping was drastically reduced.

## Objective

The objective set for this project is to reduce the findings of incorrect/inaccurate deliverables bookkeeping. The goal set for this objective is to achieve 100% deliverables bookkeeping compliance within the company's project execution process. This will be verified through audits performed by the Quality department once the improvements to the process are identified and implemented.

## Problem Statement

As in most engineering services companies, the documentation process is one that it is not always up to date. In most part, this is due to the fact that engineers tend to focus their attention to solving problems and put less effort into the documentation process.

The problems selected for this project has been the inaccurate tracking or bookkeeping of the deliverables evidence for the work performed. Since the company selected for this study is an engineering services one and it focuses in the aerospace industry, the work that is delivered to the customer on a daily basis is in the form of files (engineering drawings, CAD models, finite element models, data entry, Excel spreadsheets, PowerPoint presentations, graphs, simulations, etc.) and the delivery method is through e-mails.

The most common finding from the quality department is that the folder (for each project or contract) where the deliverable e-mails will be saved is not up to date or empty. This communication with the customer is the receipt that the work has been completed and delivered. For such reason, not keeping accurate bookkeeping of it creates a problem with the company's project execution process. Not having a proper bookkeeping of the deliveries of each project or contract makes it difficult to track the project's progression (# of deliveries sent vs total deliveries requested by the customer on the contract). Additionally to this, there is a big risk of losing the e-mail since the sent items folder in MS Outlook automatically deletes all e-mails that have a time span greater than three months.

All these issues put the company's quality standards at risk since proper deliverables documentation is part of the company's project execution process which is one of the areas that is cover by the quality standards. For such reasons, an action plan was underlined in order to avoid this.

## Methodology

The methodology used, was the Six Sigma Define-Measure-Analyze-Improve-Control (DMAIC) technique. Through this methodology, the company or organization identifies a problem, which will be later solved by applying a set of quality tools or techniques in a logical fashion [1]-[3]. The DMAIC is composed of 5 phases:

- Define – The problem statement is defined along with the potential resources, project timeline and scope.
- Measure – The data of the problem is collected and as well is the phase where the gaps between the current and required performance are identified. A process baseline or sigma must be defined.
- Analyze – Root cause analysis is performed on the data collected and a root cause is selected.
- Improve – This is the phase in which a solution to the problem is implemented. Mistake proofing implementation.
- Control – In order to control, the processes, trainings, work flow maps, etc., must be updated. This phase will ensure through a control plan that the solution implemented is successful and provides consistent and accurate results.

## Results

### Definition phase

Deliverables have not been tracked properly triggering findings or defects in the company's project execution process. To better understand the process, a work flow map has been developed to represent the baseline process of documenting deliverables as shown in Figure 1.

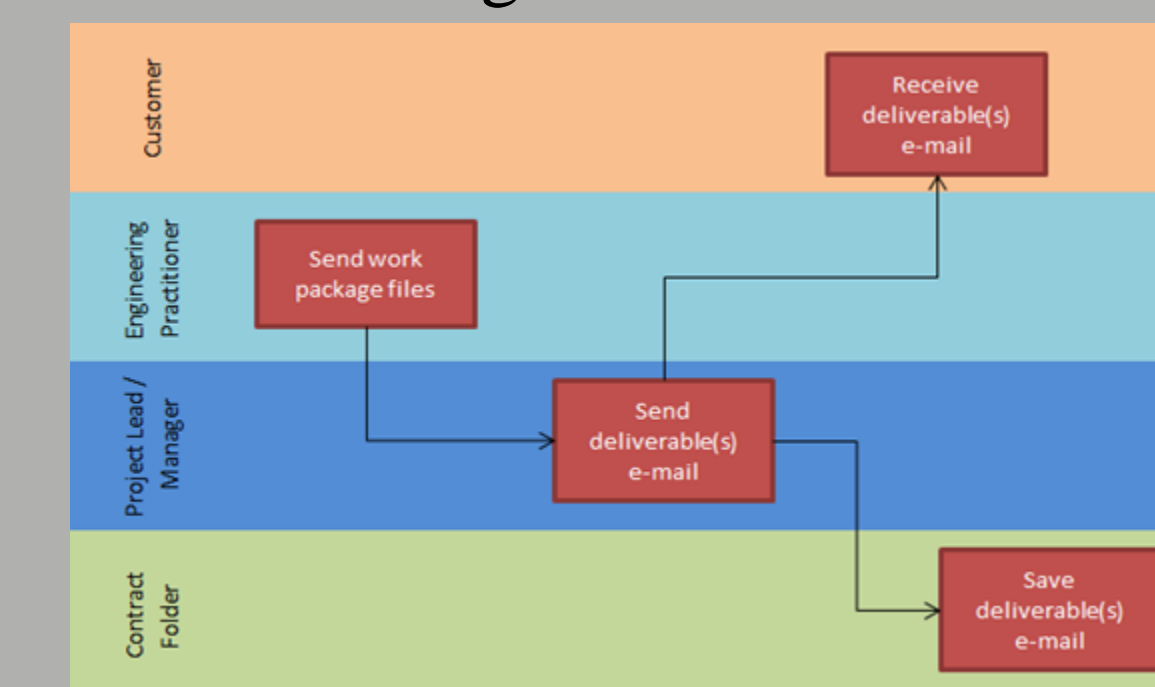


Figure 1  
Baseline work flow map

### Measuring phase

Figure 2 shows the audit findings during a three month period. With the obtained data, the baseline process capability calculated was 2.4. Table 1 shows the data used to calculate the baseline process performance & capability.

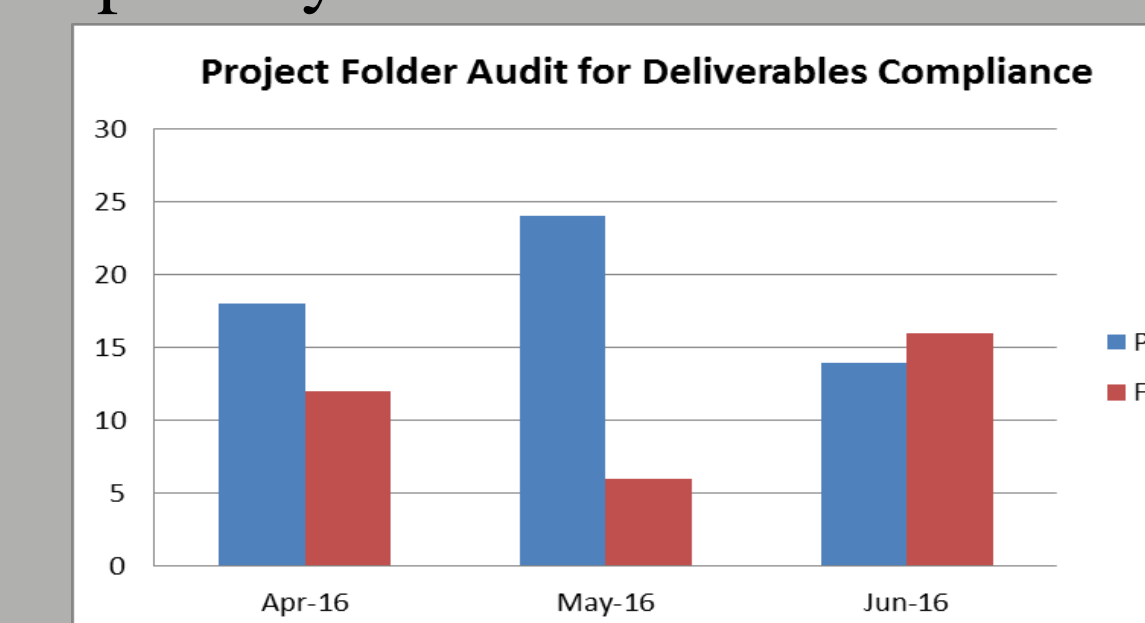


Figure 2  
Baseline work flow map

	Apr-16	May-16	Jun-16	Total
Number of Defects:	12	6	16	34
Number of Units:	30	30	30	90
Number of Opportunities Per Unit:	2	2	2	2
Defects Per Million Opportunities:	200,000	100,000	266,667	188,889
Sigma Level	2.4			

### Analysis Phase

Root cause for the problem presented was identified and confirmed. From the results of the measure phase, one of the action items identified by the process improvement team was the implementation of mistake proofing prior to sending the deliverables e-mail to the customer.

### Improvement phase

A MS Outlook macro was created to serve the purpose of mistake proofing and works as follows. When the project manager sends the customer an e-mail, it will bring a pop-up that it will ask if the e-mail is a deliverable. If yes is selected on the check box, it would enable a drop down list that will let the project manager select the contract to which the deliverable will be made. When sent to the customer it will automatically save the e-mail into the selected contract or project folder in real time, leaving the option of manually saving the e-mail out of the equation.

### Control phase

Data was collected after mistake proofing implementation, as shown in Figure 3, to calculate the new process performance and capability. From the results obtained, listed in Table 2, it can be seen that the process capability is now at 4.0

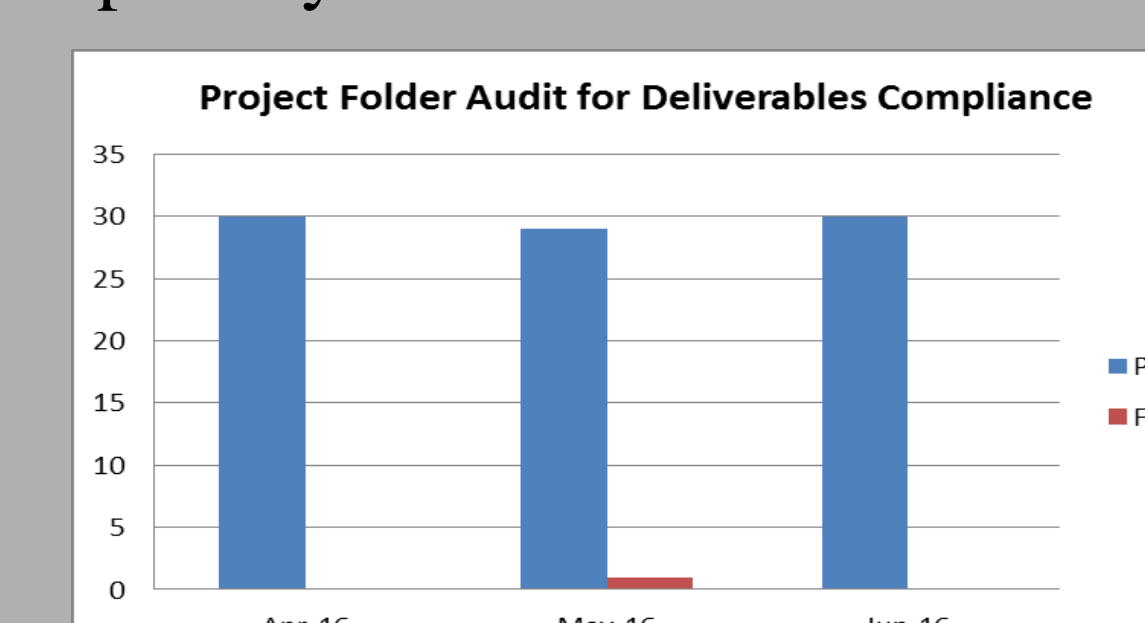


Figure 2  
Baseline work flow map

	Aug-16	Sep-16	Oct-16	Total
Number of Defects:	0	1	0	1
Number of Units:	30	30	30	90
Number of Opportunities Per Unit:	2	2	2	2
Defects Per Million Opportunities:	-	16,667	-	5,556
Sigma Level	4.0			

## Conclusion

From the study made, it has been found that the implementation of mistake proofing within the process has yield positive results towards reaching the objective's goal, which was set at 100% deliverables bookkeeping compliance.

Although the established goal hasn't been met completely, it has been demonstrated that by using the DMAIC process improvement methodology, the process has matured and its capability has increased from a Sigma level of 2.4 to a Sigma level of 4.0.

Due to time constraints, further data collection and analysis could not be performed. In order to help the process improvement team to achieve zero defects, it was recommended to include in the MS Outlook macro's drop down list a brief description of the contract next to the contract number. This way it will help the project manager identify the contract that will be selected to save the deliverable e-mail, thus avoiding a potential incorrect contract selection. As the one seen for the month of August.

## References

- [1] Pyzdek, T. (2003). The Six Sigma Project Planner: A Step-by-step Guide to Leading a Six Sigma Project Through DMAIC. New York: McGraw-Hill Professional.
- [2] Shankar, Rama. (2009). Process Improvement Using Six Sigma - A DMAIC Guide. American Society for Quality (ASQ). Online version available at: <http://app.knovel.com/hotlink/toc/id:kpPIUSSAD1/process-improvement-using/process-improvement-using>
- [3] George, M. L. (2003). Lean Six Sigma for Service: How to Use Lean Speed and Six Sigma Quality to Improve Services and Transactions. New York: McGraw-Hill Professional.