

Engine Cooling Flow Assessment Documentation Automation

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Abstract — This project consisted of the process automation of the documentation for the engine cooling assessment executed in a department of Company X. The objectives were to automate the cooling flow assessment documentation process within a period of 10 weeks, reduce execution time by 50%, execution cost by 80% and manpower by 75%. This process improvement was achieved within the proposed 10 weeks, with a reduction of the execution time of 81%, a reduction of the execution cost by 90% and a reduction of the manpower of 81%. These results confirmed that the objective of the projects were accomplished.

Key Terms — Automation, Cost, Improvement, Reduce

INTRODUCTION

As part of their daily work, a department of the Aerospace Company X executes an engine cooling flow assessment to validate their models predictions using an in-house software. These validations are performed using real data obtained in the field that involves lengthily and detailed documentation. The company's high management is requiring the automation of the process to reduce cost and allocate manpower resource to other important work areas within 10 weeks.

Objective

The objectives of this project were as follow:

- Automate the cooling flow assessment documentation process within a period of 10 weeks.
- Reduce execution time of the cooling flow assessment documentation process by a 50% once the automation is completed.
- Reduce cost of the cooling flow assessment documentation process by 80% once the automation is completed.

- Reduce manpower resource used on the cooling flow assessment documentation process by a 75% once the automation is completed.

BACKGROUND

The documentation automation is a common continuous process improvement technique used, not only on the engineering industry, but on other professions as well. This automation processes are considered very efficient, with superior accessibility and accuracy, with a reasonable implementation costs [1]-[2]. Specific information about document automation on the aerospace industry is very limited, as most of the information and /or documents are considered proprietary information.

The evaluation engine cooling flow using field engine data requires a high level of accuracy, time and cost reduction. Third party software are commonly used for their efficiency, low cost implementation and for their versatility interacting with other software. Precaution should be taken when using this third party software due to the sensitivity information that are managed on the aerospace industry.

METHODOLOGY

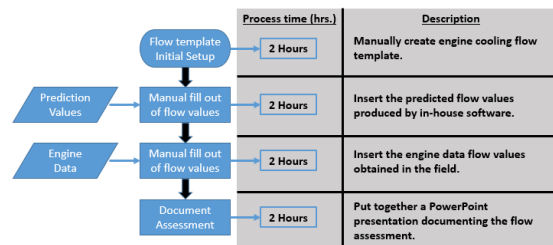
Aerospace Company X used the Achieving Competitive Excellence (ACE) system as the Quality Operational System. The ACE system focuses in several areas such as process improvement and waste elimination tools, decision-making tools, and problem solving tools.

For this project, process improvement technics will be implemented following the steps described below:

- Flow Assessment Process Diagram – Identify and provide a detailed understanding of the current process. Additionally, it will provide an overview of the process execution time.
- Process Improvement Ideas - Brain storming and selection of improvement ideas to achieve project objective.
- Development and Implementation of Automation Tool – Provide detail information of development and implementation of the automation tool.
- Flow Assessment Improved Process Diagram - Identify and provide a detailed understanding of the improved process and execution time.
- Cost and Benefit analysis – Economic impact and benefit of the automation process.
- Objective Verification – Validate if the process improvement achieve the proposed objective.

RESULTS

The engine cooling flow assessment consisted of four manually executed process that resulted in the utilization of four Full Time Employees (FTE's), for a total process time of 32 hours per day to complete four flow assessments documentation. Taking into consideration that the company cost rate for an engineer is \$62.00 per hour, the total cost per day for the assessment process is \$1984.00. Figure 1 shows the overview and important details of the current process.



Note: Process times are for a single engine flow assessment. Four engine flow assessment are documented per day, utilizing a manpower of 4 Full Time Employees (FTE's), at a rate of \$62 per hour.

Figure 1

Current Flow Assessment Documentation Process

As a result of the brainstorming techniques, it was decided to implement the automation of the process using common third party software such as Excel and PowerPoint. To customize these

software, a Company X proprietary code using Visual Basic for Applications (VBA) was written and used to enable the desired output and format of the assessment documentation. The automation process is described in Figure 2, without showing the details of the VBA code as it is company's proprietary information.

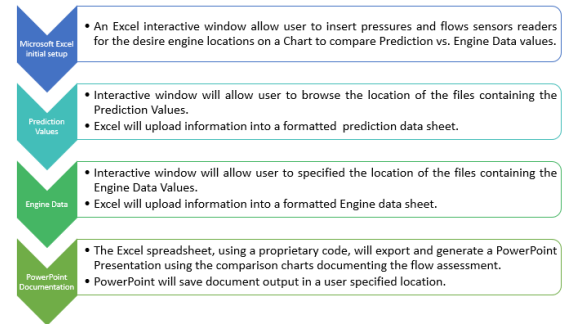
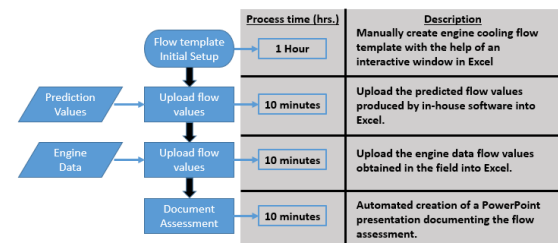


Figure 2

Automation Process Diagram

The automation of the flow assessment documentation resulted in a process improvement with new execution times and the description of each step the is shown in Figure 3, The total execution time for four engine assessment with improved process was reduced to 6 hours per day, utilizing a manpower of 1 FTE and total cost of \$372.00 per day.



Note: Process times are for a single engine flow assessment. Four engine flow assessment are documented per day, utilizing a manpower of 1 Full Time Employees (FTE's), at a rate of \$62 per hour.

Figure 3

Improve Flow Assessment Documentation Process

The improved process achieved a reduction of the execution time of 81%, a reduction of the execution cost by 90% and a reduction of the manpower of 81%. This was accomplished on a period of 10 weeks as required by the high management of the company. Table 1 shows the key milestones and the completed schedule for the execution of this project.

Table 1
Project Milestones and Schedule

Key Milestones	Start	Complete	Actual Dates	
			Start	Complete
Project Startup and Objective Definition	04/09/18	4/13/2018	04/09/18	4/13/2018
Proposal	04/16/18	4/20/2018	04/16/18	4/20/2018
Flow Assessment Process Diagram	04/23/18	4/27/2018	04/23/18	4/26/2018
Process Improvement Ideas	04/30/18	05/04/18	04/30/18	5/4/2018
Development and Implementation of Automation Tool	05/07/18	5/11/2018	05/07/18	5/11/2018
Flow Assessment Improved Process Diagram	05/14/18	5/18/2018	05/14/18	5/18/2018
Cost and Benefit Analysis	05/21/18	5/25/2018	05/21/18	5/25/2018
Objective Verification	05/28/18	6/1/2018	05/28/18	6/1/2018
Final Report	06/04/18	6/8/2018	06/04/18	6/8/2018
Poster Creation and Delivery	06/11/18	6/15/2018	06/11/18	6/15/2018

CONCLUSION

The utilization of the Company X Quality Operational System ACE and the implementation of the defined process improvement methodology, produced results that surpassed the defined objectives. The objectives defined at the beginning of the project were: automation of the cooling flow assessment documentation process within a period of 10 weeks, reduction of the execution time by 50%, execution cost by 80% and manpower by 75%. This process improvement was achieved within the proposed 10 weeks, with a reduction of the execution time of 81%, a reduction of the execution cost by 90% and a reduction of the manpower of 81%. These results confirmed that the objective of the projects were accomplished.

The feedback from the users will be required to continue with the improvement of the engine cooling flow assessment documentation automation and for the final implementation of the new process within the department.

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