

Investigation of Process Optimization for Small and Medium Enterprises in the Aviation Maintenance Repair and Overhaul

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Abstract

This research is conducted as part of a two-year research funded by Stichting Innovatie Alliantie the Aviation Research programme of the Amsterdam University of Applied Science started a project called “Onderhoud je marktpositie” or “Maintaining your competitive edge”. The entire two-year research consists of four phases (1/2 year each) in which this research is the starting point (Phase 1). The entire project focuses on the improvement of Small and Medium Enterprise (SME) in the aviation Maintenance Repair and Overhaul (MRO) processes. To know if the SME MROs have experienced an improvement at the end of the project, the current situation of process improvement of the participating companies has to be researched. This baseline measurement is conducted through qualitative semi-structured interviews and observations. Also data is collected from the participating companies in the form of documents and system print outs of applied process improvement methods. This data is then transcribed and compared to the studied literature. At last the data is subjected to multiple hypotheses and the companies are compared to each other and benchmarks to determine their performance. This research is done in close collaboration and with the same background and objectives as the performance management research, and therefore partially has the same background and objectives.

Nomenclature

6σ	= Six Sigma
MRO	= Maintenance Repair and Overhaul
SME	= Small and Medium Enterprise
TOC	= Theory of Constraints
TQM	= Total Quality Management

I. Introduction

This research investigates the current situation of Small and Medium Enterprises (SMEs) in the Aviation Maintenance Repair and Overhaul (MRO) environment regarding process optimization.

The maintenance on aircraft and its related component represents approximately 70% of the total turnover in the Dutch aviation cluster (Brinkhorst, 2006, Januari). Around 50% of the MRO companies can be defined as small or medium enterprises¹ (Van der Hoeven, 2009). These MRO SMEs can be divided in companies that maintain the airframe and companies that maintain certain aircraft components. Maintenance organizations that maintain the airframe can be

¹ According to European Commission guidelines <http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/sme-definition/>

subdivided in companies that perform heavy or base maintenance tasks, and companies that perform the line maintenance tasks. Due to the economic crisis since 2008 these SME MROs are having difficulties maintaining their competitive edge, customers are more demanding in terms of: costs, reliability and lead-time. Though initial investigation of the Amsterdam University of Applied Science two reasons can be identified why the SMEs are experiencing difficulties implementing existing process improvement initiatives (Boersma, de Vries, & Wennink, 2011):

- SMEs have limited knowledge of- or resources for state of the art process improvement developed elsewhere;
- The unpredictable characteristics of maintenance, small volumes and high variation of products and services.

Several SMEs in the aviation maintenance repair and overhaul have therefor collaborated with the Aviation Research Program of the Amsterdam University of Applied Science in this two year research initiative. The main goal for this project is to provide a toolbox for SME MROs to independently improve their processes and performance.

The main question for the two year project is stated: *What are the possibilities for MRO SMEs, with their specific situation, to improve and consolidate their performances?*

To answer this question the project has been divided into four phases of half a year each. The first phase will mainly consist of two separate researches providing an insight of where the participating companies are currently standing with regard to performance measurement and process improvement. These researches are being carried out simultaneously and in close collaboration with each other. The results of this phase will also be the starting point for the next phases. This research paper will focus on process improvement.

A. Statement of the problem

Maintenance, Repair and Overhaul SMEs state that they have little to no knowledge on how to improve their processes and often lack the manpower and resources to do so. Initial investigation concluded that current process optimization philosophies such as LEAN and 6-Sigma cannot be implemented directly (Boersma, Vries, & Wennink, Lean at JetSupport, 2011). Therefore, new knowledge has to be developed to be able to help these MRO SME's solve their problems.

B. Framework

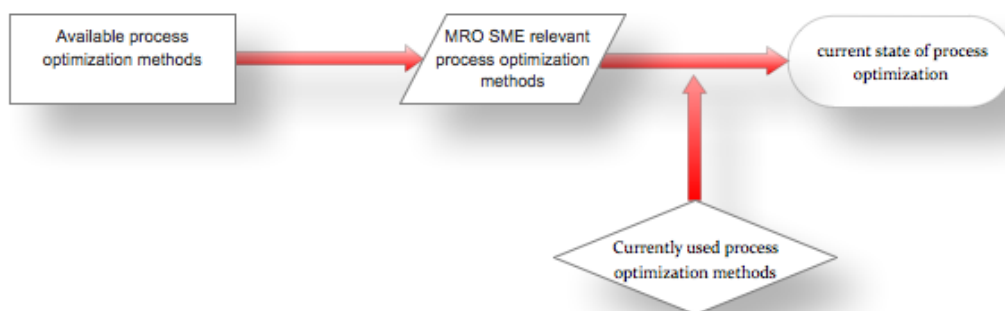


Figure 1: research framework

The research framework as shown in Figure 1 consists of four variables. The main objective and dependent variable is to identify the current state of the process optimization of the participating companies. The independent variable and starting point for this research framework is the currently available state of the art knowledge of process optimization. To filter out the non-applicable optimization methods for MRO SMEs the available methods will be screened with the MRO SME characteristics. This has the result that only the relevant process optimization methods which can be used in the MRO SMEs are left (intervening variable). The third variable is the process optimization methods that are currently used within the participating companies (moderating variable).

C. Research question

Using the research framework, the problem statement can be used to form the main question to answer the dependent variable: *What is the current state of the participating companies with regard to process optimization en coordination?*

To answer the main question and other variables of the research framework three sub questions need to be answered:

1. What are the available process optimization methods for MRO SMEs? (Independent and intervening variable)
2. In what way does coordination and process improvement takes place in the participating companies and on behalf of which performance indicators? (Moderating variable)
3. Which characteristics do the participating companies have in common, and which are different? Which common characteristics differ from SMEs outside the MRO environment and can a unique profile be made for these particular MROs? (Intervening variable)

D. Theoretical background

In a literature study success stories of proven process optimization methods in the maintenance, repair and overhaul environment were used to determine the most common process optimization philosophies.

Success reached	Optimization philosophy	Literature Source
Decrease in lead time of Delta TechOps maintenances process	Lean + TOC	(Mcauliffe, 2007)
Reduction of El Al's maintenance process lead time, reduction of stock and increased workspace	Lean	(Verma & et-all, 2004)
Fokker reduces administrative waste and stock	Lean	(Peterson, 2010)
RAF reduces C5 galaxy maintenance lead time from 339 to 220 days	Lean	(MRO Yearbook, 2011)
FedEx reduces lead time of the	Lean	(Bartholomew, xx)

C-check		
General Electric achieves \$700 million documented improvements	6 σ	(Henderson & Evans, 2000)
Asian MRO reduces lead time 747 modification from 92 to 45 days	6 σ	(Ho & et-all, 2008)
Marine corps Albania reduces maintenance on MK48 vehicles from 167 to 58 days. Also the repair costs were reduced with 25%	TOC + Critical path	(Srinivasan, 2004)
TQM has a significant positive impact on customer satisfaction, employee satisfaction and operational effectiveness compared to non TQM airlines	Total Quality Management	(Adediran & Adediran, 2008)
TQM has reduced total operating cost by 20 to 30 per cent by decreasing employee overtime, raw materials, industrial chemicals used and penalty payments to customers	Total Quality Management	(Goh & Fang-Seng, 1996)

The optimization philosophies that have been proven most successful are: Lean, 6-Sigma, Theory of Constraints (TOC) and Total Quality Management (TQM). Because there are multiple philosophies about process optimization it is essential that a wide view is kept on the different process optimization tools. To keep this wide view, the different underlying steps of each philosophy are further investigated.

	Define the problem	Current situation	Root cause	Goal	Implementation	Securing success
Lean	Identify value	Map the value stream		Create Flow	Establish pull	Seek perfection
6σ	Define	Measure	Analyse		Improve	Control
TOC	Identify		Exploit		Evolve	Find the next constrain
TQM	Identify the problem		Find the root cause	Generate solution	Plan and improve	Measure and standardise

During the elaboration of the four main process optimization philosophies it became clear that certain steps of different philosophies are identical and some steps overlap each other. All the different philosophies have in common that first a problem will be defined, then the current situation of the process is further investigated, the root cause of the problem is analyzed using the problem definition and the current situation, and after the root cause the goal of the improvement is set after which the problem is taken out of the process during with an implementation of a certain improvement. And at last the achieved success will be secured.

II. Method

To achieve the main objective for the first phase, data is gathered on site at the participating companies during a one week visit.

A. Research

The project team observed and noted findings per department they experience using a findings list. Another part of the qualitative research was performed by semi-structured interviews with five different levels in the organization: Higher management (representative of the organization and its stakeholders), middle management (representative of the process between higher management and the work floor), quality manager (representative of all the companies processes), customer support/sales (representative of the customer) and the Work floor (representative of the hands-on process). These levels have been chosen so that an overall view of the company can be made. The interviews were held using an interview guideline and recorded for further analysis. Besides the semi-structured qualitative interviews data was collected from the different departments. The collected data consist of available charts and forms used by the different departments for process optimization. Also a quantitative literature study is performed to answer the first sub question “What are the available process optimization methods for MRO SMEs?” and to construct the SME MRO filter.

B. Data analysis

Collected data from the research, especially the interviews is transcribed and sorted together with the findings and collected forms and documents into the earlier described optimization steps found in the literature study: defining the problem, current situation, finding the root cause, set a goal, implement a solution and secure the success. This data is compared to the data from the literature study to find the current performance of the participating MRO SME's. The findings, such as available process optimization methods and their purpose, will be used during the next phase of this project.

III. Results

Now that all the data of the participating companies is collected and transcribed, the next step is to analyze the current state of process improvement through a hypothesis test. This is currently the focus of this research. The gathered data will be tested with multiple hypotheses:

- Within the company there is a structural way of:

- Defining a problem
- Analyzing the current situation
- Finding the root cause
- Defining the goal
- Implementing the improvement
- Securing the success

- Within the company there is a systematic way to:

- Defining a problem
- Analyze the current situation
- Find the root cause
- Define the goal
- Implement the improvement
- Secure the success

A. Further research

The last step of this phase will be to compare the companies to each other and benchmarks, so that they can not only determine their own performance, but also see where they stand in the industry. They will also be benchmarked against companies that are at first thought completely different, but which show particular similarities, such as a hospital which has similar unpredictability.

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