Process Improvement of Equipment Support Project Requests

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Abstract *— A project request package moves through five different departments: Pre-Induction, Engineering Design, Planning, Material and Execution. The project request package is constantly returned to a previous department for rework. Engineering design drawings are the most recurring returns, therefore improvement efforts of this project were focused on how to set guidelines for the engineering design department to provide complete, comprehensive and quality drawings the first time. A Drawing Checklist was designed by a team made up of engineers, planners, schedulers and craft shop supervisors that will ensure quality drawings with accurate measurements and materials.*

Key Terms *— DMAIC, Guidelines, Quality, Recurrence.*

Introduction

Background

The project takes place in Robins Air Force Base Georgia, an Air Logistics Complex. The base provides depot maintenance support to C-130, C-5, C-17, F-15 and Special Operation Forces (SOF) aircraft. The Maintenance Support Organization receives Equipment Support Project Request from four other organizations on base that sustain the weapons system and the warfighter. The Project Requests can range from installing new equipment, relocating equipment, equipment upgrade/updates or enhancements, providing utilities for equipment (like compressed air, power, water), preparing equipment staging areas, manufacturing dollies or stands to fit equipment and more. A high-level view of the Project Request Process is shown in Figure 1. The process has five different Phases: Pre-Induction, Engineering Design, Planning, Material and Execution. The process is designed to move in a linear form, visiting each department once.

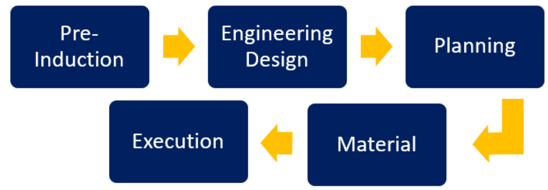

Figure 1
Project Request Process

Motivation to study

The Air Force encourages any opportunity of improvement that will enhance warfighter capabilities. An Equipment Support Project Team meets every week to discuss new projects, updates and constraints on current projects that support the warfighter. Occasionally, the term “sent back” is used to explain when a project request package is incomplete and returns to a previous department for rework.

Project Objective

The objective of this project is to make an equipment support project request run smoothly through the process with no rework required.

Literature Review

Process Improvement

The DMAIC methodology has been used extensively in many industries to improve processes. For example, an Ohio State USPS Facility used the DMAIC methodology to identify root causes and implement Standard Operating Procedures to reduce late deliveries by 6.7% and save $15,000 a year [1].

Production support or modification of a product require engineers to understand the importance of what each step in the process means, how to clearly differentiate them and how to correctly apply them, given that steps are necessary, costly and time consuming [2]. Observations, time study, work sampling, estimation and historical data can be used to calculate required manpower when assessing workload in any change of a process [3].

Customer Orientation

The Voice of Customer (VOC) can provide vital insight to an organization, of how a product or service is doing and providing competitive advantage. Gaining VOC can, be time consuming, expensive and not necessarily customer friendly [4]. A customer-focused organization should consider customer satisfaction, customer loyalty and customer value [5].

METHODOLOGY

The selected methodology for the project is DMAIC, which is short for Define, Measure, Analyze, Improve and Control. The Define phase seeks to define the process and identify the scope and goals for the project. The Measure phase is used to create a deep understanding of the process by collecting all available and necessary data. The Analyze phase is used to analyze data collected and identify the root cause of the issues. The Improve phase considers potential solutions and selects one that best optimizes the process. The Control phase is used to monitor the improvement that was selected and create metrics that support the improved process.

Define

The schedule for this project is aligned with the duration of a 12-week course of "Engineering Management Project". The methodology was adjusted to fit the 12-week period and was completed as follow: Define Phase, August 10 through August 24, Measure Phase, August 25 through September 7, Analyze Phase, September 8 through September 21, Improve Phase, September 22 through October 3 and Control Phase, October 4 through October 10.

The problem statement was established as follows: The Equipment Support Project Packages move forward and backward during its design, planning, material and execution phase causing rework and delays, not meeting customer deadlines.

To better understand the process, a Project Request Process Flowchart is broken down into a cross-functional flowchart that shows in detail how the project request package moves between departments and the customer.

The Project Request Process Flowchart is shown in Figure 2, which illustrates how all departments have multiple functions, participation and responsibilities within process. The customer initiates the process, when the customer submits a project request package. The Project Engineer Supervisor (PES) receives the package, reviews the documents, and determines if the package is complete, clear and understandable. If the documents do not meet criteria, the package is returned to the customer, if it meets criteria, the PES consults the planners to acknowledge the project is indeed executable. If not, the project request package is returned to the customer, otherwise the project request package enters the "Pre-Induction Phase", where Safety, Bioenvironmental, Environmental and the Fire Department review the project request package and agree that meets parameters. The PES puts the package in the Engineering Design Queue and assigns a design engineer. The design engineer receives the project request package and contacts the customers for any clarification as well as to conduct a site visit. This allows the design engineer to create drawings according to the request. When the design engineer is complete, he provides the drawings to a fellow engineer for review and then to the PES. The PES also reviews the package and takes it to the Planning Office.

The planning office receives the project request package with the drawings. They use the drawings to identify the required crafts (Millwright, Electrician, Pipe Shop, Carpenter, Mechanics, Electronics, Machinist, Welding Shop and Paint Shop) and plan hours of work per craft. They also generate a Bill of Materials (BOM) and draw a general critical path for the execution office. The planning office then creates an individual work package per craft that includes material, drawings and planned hours. Once complete, the project request package moves to the Material Office, where they determine if material is

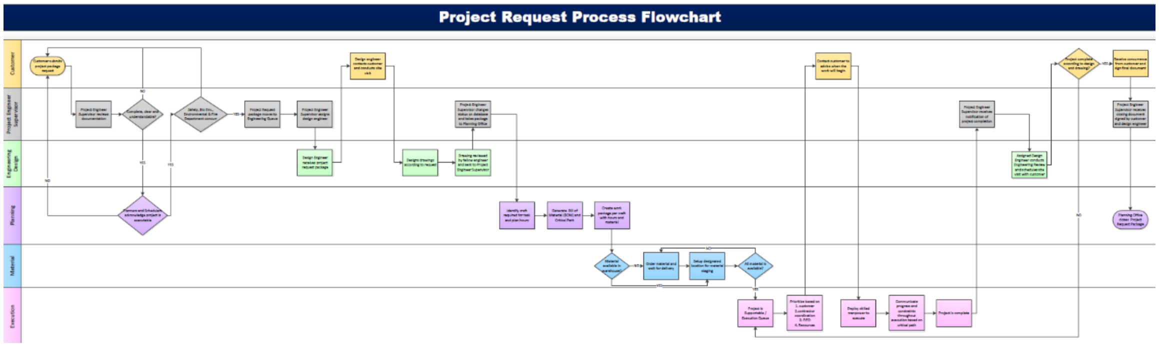

Figure 2

Project Request Process Flowchart

available in the warehouse. If it is not, they order the material and wait for delivery, if it is available; they setup a designated location to stage the material. Once all material is available, the project request package becomes supportable and goes into the Execution Queue.

The execution supervisor prioritizes the projects in Queue based on customer input, contractor coordination, FIFO and resources (manpower). Then contact the customer to advise when the work is scheduled to begin. The skilled manpower are deployed to execute based on the critical path outlined by the Planning Office. The execution office communicates progress and constraints throughout the phase based on the critical path and complete the project. The PES receives notification of project completion, notifies the design engineer who conducts an Engineering Review and schedules a final site visit with the customer. The customer determines if the project was complete according to design and drawing, if not, it returns to Execution (or any other department, if required), if the customer answers "Yes", then the customer concurs with signature of a final document. This document is sent to the PES, who in turn forwards the document to the Planning office, who officially closes the Project Request Package. Measure

Measure

This project used historical data available in a database used to collect and store project information. A sample of 100 projects was pulled from the database on August 26, 2020 for all closed projects. Ninety-four (94) projects had a complete set of data. Twenty (20) projects detailed when the package moved back in the process.

Table 1 shows a breakdown of each project and how many times it re-visited a department. Three main reasons where identified in the database as constraints during the process and are shown in Table 1 below: Issues with Engineering Drawings (Green), Facility/ Equipment Availability (Red) and Customer Change Scope (Yellow). In occasions, one or more constraints are found within the same project.

Table 1

Project Request Process Breakdown

#	Eng. Design	Planning	Material	Execution
1	XX	XX	X	X
2	XX	X	X	X
3	XX	XX	X	XX
4	XXXX	XXXX	X	XX
5	XX	XX	X	X
6	XX	XX	X	XX
7	XXX	X	XXXXX	X
8	XXX	XXX	XXXX	X
9	XX	X	X	XX
10	X	X	XX	X
11	XX	XX	XX	X
12	XX	X	X	X
13	XX	XX	X	X
14	XXX	XXX	X	XX
15	X	X	XX	X
16	XX	XX	X	XX
17	X	X	XXX	X
18	XX	XX	X	XX
19	XX	X	XXX	X
20	XXX	XXX	X	X
Engineering Drawing		Facility/Equip.		Change Scope

Analyze

A Pareto Chart was used to identify which of the areas is where the problem is most recurring. Figure 3 shows that Project Request packages returned to Engineering Design are the most recurring with twenty-three (23) returns. This means that twenty project request packages went through engineering and nearly all of them had to return to the Engineering Design, and in occasions, returned more than once. Followed by project request packages returned to the Material Office with seventeen (17) returns, then the Planning Office has fourteen (14) returns and lastly the Execution office with seven (7) returns.

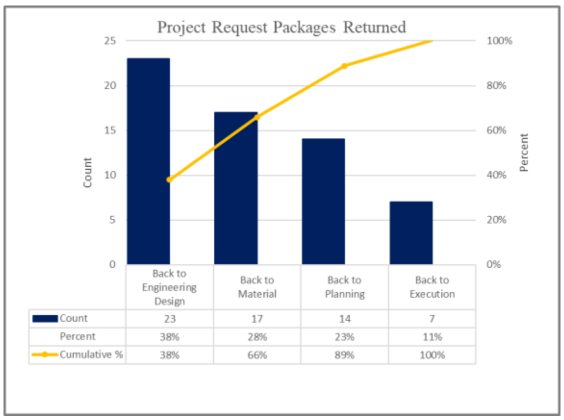

Figure 3

Project Request Packages Returned

The Cause-and-Effect Diagram, otherwise known as the Fishbone, helps to identify root causes of issues. In this case, the issue is why project request packages are returned to a previous department, as shown in Figure 4. The categories are the departments itself: Engineering, Planning, Material and Execution. Engineering, shows the less root causes, given a project request package is early in its process. The root causes are "Project Letter is not clear or detailed enough, paperwork from customer is not complete or the base request is rejected. Root causes identified from the Planning office are "Customer changes scope, Facility Availability, Drawings not accurate, which further breaks down into "wrong details in drawings, lack of specifications and no measurements". Root causes identified by the Material office is that "Material specified by engineering is obsolete, material is no longer produced/manufactured, the Vendor/Country of purchase is not authorized, the material has incorrect classification (IT purchase of computerized equipment), and Insufficient Information. Root causes identified by the Execution office are "Drawings do not match location requirements, scope creep, failure to comply with Base requirements, Material incorrect/incomplete, Facility/equipment not available."

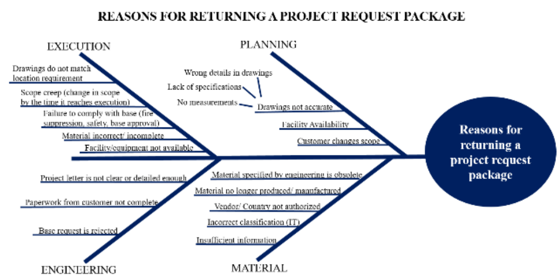

Figure 4

Cause-and-Effect Diagram Reasons for returning a project request package

Improve

Based on high and root causes identified, the focus on improvement for this project was on the engineering design drawings. Given engineering design drawings are early on the process, quality engineering design drawings, will drive complete and accurate bill of materials, which would assist the Material office in ordering the right and correct materials the first time. This will provide the execution office with all of the required information, material and schedule to conduct their task effectively.

The proposal to control the quality of the drawings is to introduce a checklist for design engineers that would standardize the product or drawings. Currently design engineers do not have a set of guidelines on how to provide design drawings. The checklist would minimize inconsistencies between design engineers, increase accuracy of measurements and materials as will provide complete, comprehensive quality drawings for the rest of the departments. Even though each design engineer has their own style, when doing a design drawing, they will have a set of guidelines that will result in complete and comprehensive drawings.

A Lean Event takes place, made up of two mechanical design engineers, two electrical design engineers, one representative from the planning office, one representative from the scheduling office, one representative from the execution office and the lean program manager. The product of the lean event is the Drawing Checklist, a complete comprehensive list with input from all the departments of what details they need in a drawing. The Drawing Checklist will serve as a guide for the Design engineers to do quality drawings for the benefit of the organization.

Control

The proposed control plan is embedded within the Drawing Checklist, where the design engineer signs and dates the document. Then the design engineer provides the equipment support project request package to the PES, who confirms the checklist is signed and dated prior to delivering the package to the Planning office. The lean program manager set up a calendar event for Friday October 8, 2021, to pull closed project data from the database. This data will be analyzed to see how many projects have returned to a previous department and filter out the projects that have returned due to engineering drawings.

CONCLUSION

The Robins Air Force Base in Georgia is a depot maintenance facility that operates 24 hours a day, seven days of the week and three hundred and sixty-five days of the year. The Nations Defense does not sleep. Identifying improvement opportunities in any process will benefit and aid the warfighter.

This project delineates a problem of rework and delays within a Project Request process within the base. The process itself is complex and involves many entities from different departments. Information collected from an internal database, interviews and sessions of brainstorming showed how all the steps within the process are interconnected. The use of the DMAIC methodology pointed out that the beginning of the process was already lacking quality. Therefore, the lack of quality in the engineering design drawings directly impacted the planning office performance, the material office purchase and staging of material and execution.

The results of the study in the Analyze phase, motivated management to support the proposal of a drawing checklist. The Drawing Checklist will serve as a guideline for all design engineers to provide complete comprehensive drawings, with less inconsistencies between design engineers. A complete set of drawings would allow all other department entities with sufficient information to reduce or eliminate rework and delays in the project.

Additional improvement opportunities for future research identified in the project would include the process of the planners while drafting the Bill of Materials and potentially standardize common use components like air drops and electrical switches. In order to successfully further research the development of the Bill of Materials, the engineering design drawings must be flawless. The standardization of common use components will require the collaboration and support of all departments identified in this study.

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