Assessment of Material Availability Support (AMAS)

Jendry Melo Pérez
Master in Engineering Management
Dr. Héctor J. Cruzado
Department of Civil & Environmental Engineering and Land Surveying
Polytechnic University of Puerto Rico

Abstract *— Supply Change Management (SCM) processes are critical to meet customer requirements and construction schedule. SCM is responsible for procuring all the necessary material to support construction activities. The main purpose of the project was to increase the material availability position. The project was completed at a shipyard in the United States that builds warships. The methodology used to achieve the objective is DMAIC (Define, Measure, Analyze, Improve, Control). Multiple simulation model scenarios were evaluated to determinate the best solution. The recommended solution was a phased approach with multiple changes. It showed to be a cost-effective way to increase the material availably support position.*

Key Terms *— DMAIC, Material Availability, Process Improvement, Simulation Model, Supply Chain Management.*

INTRODUCTION

In the shipbuilding industry, Supply Chain Management (SCM) processes are critical to meet customer requirements and construction schedule. The study subject for this project is a shipyard in the United States that builds warships for the Navy. The shipbuilding construction processes require thousands of piece parts to be combined together based on schedule. At a high level, SCM is responsible for procuring all the necessary material to support construction activities. Currently, there are delays in the production areas due to material not being available when needed. A delay in production will cause an increase in cost and risk to the expected completion date.

The main purpose of the project is to address the material availability issue. The goal is to increase material availability up to 95% by evaluating the processes within SCM. The material lifecycle process is based on 5 main steps: material requirements, procurement processes, vendor lead times, receiving, and distribution. Each one of these steps contribute to the material availability support position.

The methodology used for this project is a Lean Six Sigma tool called DMAIC. A specific procedure is used for each phase of this approach.

LITERATURE REVIEW

DMAIC is the problem-solving tool behind Lean Six Sigma. "DMAIC is a data-driven, customer-focused, structured problem-solving framework" [1]. DMAIC is composes of five phases: Define, Measure, Analyze, Improve and Control.

- D (Define)
  - Project Chapter
  - SIPOC (Supplier, Input, Process, Output, Customer)
  - Gannt Chart
- M (Measure)
  - Process Flow
  - SME (Subject Matter Expert) interviews
  - Time Study
- A (Analyze)
  - Pareto Chart
  - Root Cause Analysis
  - PFMEA (Process Failure Mode and Effect Analysis)
- I (Improve)
  - Simulation Model
- C (Control)
  - Implementation Plan
  - Control Chart

"Using a sequential and flexible problem-solving methodology such as Lean Six Sigma's

DMAIC for current process will ensure success" [2].

Nowadays, a predictive supply chain performance management model is more favorable than a reactive approach. These models have proven to provide very accurate Key Performance Index projections and valuable insights into newly emerging trends, opportunities, and problems [3]. Management could use that information to make more effective decisions.

As part of the Improve Phase, a Simulation Model will be used to test multiple scenarios and predict the SCM support position. The model will also provide SCM with resources capable of adapting to the future business environment. Procurement lead time will also be evaluated because it is an important aspect of the ordering process. Normally, lead times are assumed to be constant in inventory decision models, but ignoring lead time variability could have a devasting effect on customer service [4].

METHOD

Through Subject Matter Expert (SME) interviews, the team identified "pain points" throughout the process and separated them into two major groups: those that affect material availability, and those that do not. Also, the "pain points" were mapped out to the corresponding process step to provide a better understanding of where are the main problems are.

An evaluation to determine the current major offenders and the drivers was completed. The evaluation was accomplished through a Pareto Chart and a Root Cause Analysis. The Pareto Chart showed the non-support position by material type and frequency. The Root Cause Analysis provided the causes of the problems and the corrective actions to resolve them.

The team mapped the overall process flow, as shown in Figure 1. In addition, the team developed process flows with cycle time and headcount for each process area of SCM. The cycle time and headcount were calculated based on time and motion studies. Also, a Process Failure Mode and Effect Analysis (PFMEA) was developed for each process step using a reverse waste walk approach. Based on the PFMEA evaluation, there were scenarios identified to be incorporated in the simulation model.

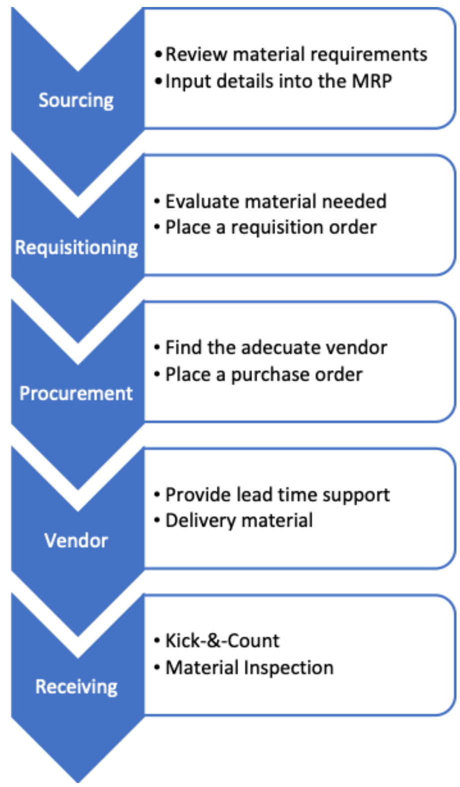

Figure 1
SCM High Level Process Flow

Simulation models are digital imitations of business systems. A simulation model can be built to imitates a business system as it currently exists today, or it can be built as a prototype of a future business to predict its performance in the real world. In this case, the team built a current state model, and will make changes to that baseline to predict the material support position over the time.

RESULTS AND DISCUSSION

The team considered more than five scenarios to evaluate three main outputs; material availability support position, workforce utilization, and lead-time. The scenarios include variables such as vendor lead time, ordering quantity and frequency, material requirement release, workforce volume, among others.

After running the initial scenarios, the team developed additional scenarios by mixing multiple scenarios together to analyze how improvement could be compounded onto one another. By analyzing the changes in the metrics from the initial scenarios of the current state, the team was able to determine which combination of scenarios would create the biggest positive impact.

When analyzing all of the scenario's outputs, Scenario B had the greatest positive impact on the material availability support position metric, increasing from the current state by 6%. Scenario B includes an increase in the window for material request and new formula to calculate vendor lead time estimation.

Instead of solely using the scenario output metrics, the team calculated an estimated savings for getting material when scheduled. By improving the overall material availability support position, the cost due to schedule delays will be reduced. When evaluating possible improvements and solutions, the team began estimating potential costs of implementation.

Upon completion of all scenarios, the team gathered all cost and savings data into one table to easily compare the possible improvements impact from an economical perspective.

The team suggested various methods and metrics such as control charts to assist with measuring and monitoring future efforts by SCM and to increase the material availability support position.

CONCLUSIONS

Over the course of the project, many factors involving SCM processes were evaluated and analyzed over the DMAIC phases. Consistent and timely communication between departments will greatly help overall awareness of SCM and prevent them from wrong ordering. The team gathered quantitative and qualitative data on the processes in each area by data mining, studying process flows, performing PFMEA sessions, and building simulations to model the current state and potential improvements.

Due to many potential implementation factors for the different scenarios, particularly the ones that would involve different departments, the team suggests rolling out improvements in phases. The first two phases can be completed under SCM without involvement of other departments or manpower changes. The phases are as follows:

- Phase 1: The easiest and faster change that SCM could implement and would also have the highest cost savings due to late material.
- Phase 2: Other improvements that SCM can perform without any other entities, but will likely take more time and effort to implement.
- Phase 3: Requires other departments to change their process.
- Phase 4: Requires organization changes.

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