Suppliers Information Exchange Process Optimization

Rafael O. Sánchez-Thompson
Master of Engineering in Manufacturing Engineering
Advisor: Carlos González, PhD.
Industrial and Systems Engineering Department
Polytechnic University of Puerto Rico

Abstract **—** *The emphasis of this research project is to reduce the processing time for supplier's requests for change and/or information (RC/I), a tool utilized to request information and/or change in response to technical or contractual issues encountered before or during the manufacturing process, for requesting Process Plan approvals, or for Counterfeit Material Prevention/Detection. The Six Sigma Initiative provides us with two key methodologies: DMAIC and DMADV. For this research project, we utilize the DMAIC methodology. It consists of five steps: Define, Measure, Analyze, Improve, and Control. DMAIC is a data-driven quality approach with the purpose of improving a process or processes. In this case the RCI tool has been established and we are seeking to reduce the requests processing time. Reducing the suppliers' request time is critical due to the direct correlation with the production and manufacturing phase of an aerospace system.*

Key Terms — *DMAIC, Manufacturing, RCI, Suppliers.*

INTRODUCTION

In the mid 1990s the Aerospace Industry went through a historic evolution that impacted their typical "modus operandi." Large aerospace companies decided that "in house" manufacturing was not cost-effective and initiated an outsourcing phenomenon. Nowadays outsourcing has become more than just a way to get inexpensive components and parts. In order to offload some of the investigation expenses and development, U.S. firms are entering into joint partnerships with state-subsidized firms in other nations. Currently, the industry depends on their suppliers' performance. They are even investing in the suppliers' quality systems to ensure a quality product. The industry has being forced to change the customer-supplier relationship with the intent of removing any communication constraint and identify misalignment in their processes.

This project will focus on developing an improvement for the suppliers' communication exchange processing time.

PROBLEM STATEMENT

For years the aerospace industry has relied on suppliers to provide quality products for the system assembly line. Historically, paper format has been the communication platform among engineering, suppliers, and assembly line for any request for change or information. Paper format refers to communication via email, letter, and/or phone call. Depending on the magnitude of the program, this format could create traceability issues especially when referring to engineering specs, design changes, software, material, manufacturing processes, etc. Suppliers' manufacturing engineers deal with this issue on a daily basis. To deal with this issue, the industry has established a tool to interact with customers, suppliers, engineers, and assembly line.

RESEARCH DESCRIPTION

This research is about how to enhance the information exchange process and how to reduce the turnaround time for suppliers' engineering inquiries. The communication between all entities is directly related to the daily operations of a system design, development, assembly, and sustainability.

Research Objectives

The general objective of this research is to enhance communication between all the entities involved in the life cycle of this system. The specific objective is to reduce requests for change and/or information processing time by 30% by January 2019.

Research Contributions

This research targets the reduction of waste in the inquiries processing phase. Reducing the processing time will allow us to focus in properly filtering the inquiries, enhancing the quality of this product. By focusing in proper filtering, we reduce the inquiries amount, since they are dispositioned prior to being submitted through the complete approval cycle. Operational cost is positively impacted. The information exchange is crucial when manufacturing processes are involved. By lowering the processing time we minimize or eliminate the "work stoppage" condition at the manufacturing floor, creating and promoting an efficient quality oriented environment.

Literature Review

In order to investigate the issues surrounding suppliers-buyers communication, we selected a subgroup of literature to address these questions:

- What channels of communication are utilized in the buyer-supplier information exchange?
- How does communication impact suppliers' performance?
- How does technology uncertainty influence buyer-supplier communication and relationship?

Communication is defined as the process by which information is sent from one place or person to another; it is also defined as the exchange of information. It is imperative to mention that an inefficient communication between buyer and supplier will directly impact the organization's budget and performance goals. In this literature analysis, we will focus on the importance of the buyer-supplier relationship and how it can impact suppliers' performance.

What Channels of Communication are utilized in the Buyer-Supplier Information Exchange?

In a 1987 research, five channels of communication were identified: face-to-face, memos, email, voicemail, and telephone [1]. The channels were measured using a media richness scale. Media richness was based on feedback capacity, medium, source, and language. The findings indicated the media richness decreasing in the following order: face-to-face, telephone, voicemail, email, and written memos. Nowadays, with technology, four computer-mediated communications channels have been defined as video conferencing, email, web-based tools, and face-to-face, since it has been universally characterized as such. The research revealed that a channel with higher media richness is likely to lead to greater levels of knowledge exchange between buyer and supplier. Face-to-face was the highest, followed by video conferencing, email, and web-based tools.

How does Communication Impact Suppliers' Performance?

It is generally believed that frequent communications between buyers and suppliers enables suppliers to make improvements linked to specific relationship goals and so to enhance their performance. In a study, it was discovered that communication frequency was completely related to supplier performance when both the supplier and the buyer agreed on the technology uncertainty issue [2, p. 1]. The study revealed that the communication could negatively impact the supplier performance if the buyer observed a greater technology uncertainty than their suppliers. The Communication Increase between buyers and suppliers will positively impact the supplier performance when both entities agree on the significant/critical technology uncertainty.

How does Technology Uncertainty Influence Buyer-Supplier Communication and Relationship?

Usually, the expectation is that suppliers have a greater technical understanding of technological developments in their industry [2, p. 12]. However, it is imperative to mention that the buyers' understanding may also play an important role. Historically, if the supplier perceives a large level of technology uncertainty with regards to the product to be delivered, they will communicate with their buyers to avoid a negative impact on performance. If the buyer doesn't concur that a high level of technology uncertainty exists, it is highly uncertain whether increased communication will be positively impacting the supplier's performance. The buyer-supplier relationship will be mainly impacted by the lack of definitions and the lack of technical knowledge.

SIX SIGMA: DMAIC METHODOLOGY

DMAIC is a data-driven method used to improve processes. It is a key tool of the Six Sigma methodology, but it can be implemented as a standalone improvement method or as part of other process initiatives like Lean. DMAIC stands for define, measure, analyze, and control. These five steps signify an improvement cycle that is intended to be repeated frequently in an effort to identify best practices and move closer to perfect processes [3]. The DMAIC methodology acronym defines the steps' order of execution and the importance of performing all the steps (Figure 1).

- Define: This is the definition stage were the team will define the problem to be solved, the stakeholders, including the customer, and the goal to be obtained. The process will be mapped to better understand the stakeholders' responsibilities.
- Measure: In this phase, the team will develop a data collection plan. The data will be collected utilizing the existing communication tool format to avoid data repeatability.
- Analyze: In this phase, the team analyzes the data collected and brainstorms potential root causes. It aims to generate multiple hypotheses as to why the issues occur and then work to validate or invalidate their hypotheses. Subsequently, this will provide a better understanding of the root cause(s), identifying opportunities for improvement and the differences between current performance and goal performance.
- Improve: In this phase, the team will brainstorm and implement possible solutions to the previously identified root cause. It is important to collect the data post implementation to ensure that we have a measurable improvement.
- Control: In this phase, the team will establish a monitoring plan intended to keep measuring the updated process' success. It is imperative to focus on preventive actions to impede recurrence of the issue.

Figure 1
DMAIC

PROJECT METHODOLOGY

This project intends to achieve an enhanced communication exchange processing time. Since organization is crucial, we will use a systematic approach via the DMAIC methodology, which will provide the necessary tools to organize, investigate, correct, and control this issue.

In the Define phase, the team will develop a project charter aimed at clarifying the process issue being addressed, the motive for addressing it, and what "accomplishment/success" looks like for the team. Basically, the project charter outlines the process improvement project for the team, the leadership, and, in some instances, the customer.

Since this process is already established, the team will use the automated software to collect the data. A process flowchart will be created to identify the locations where the data will be collected.

The Analyze, Improvement, and Control steps' tools will be selected during the project processes development. Each step's tool will be driven by the previous step's output.

RESULTS AND DISCUSSION

In this section, all the phases will be discussed in order to provide an overview of the results and tools utilized to achieve the desire project goal.

Define

The project charter was created to determine/establish the problem statement, the project's goal, and the metrics that will be defined (Table 1).

Table 1
Project Charter

Project Charter
Problem Statement
Suppliers request changes and/or information, impacting production line due to prolonged processing time
Goal Statement
To reduce the processing time of requests for changes and/or information by 30% by January 2019
Metrics
Processing Time = Days

In addition to the project charter, a process flowchart was developed for visibility and mapping purposes. A process flowchart is a graphical illustration of a business process through a flowchart [4]. It is used as a means of getting a top-down understanding of how a process works, what steps it consists of, what events change results, and so on. The process flowchart provides multiple benefits when utilized correctly. For example, Visual Clarity is basically the tool's ability to visualize multiple progresses and their sequence into a document or an output. The process flowchart tool is capable of creating a visual representation of the stakeholders and their involvement on each step (Figure 2).

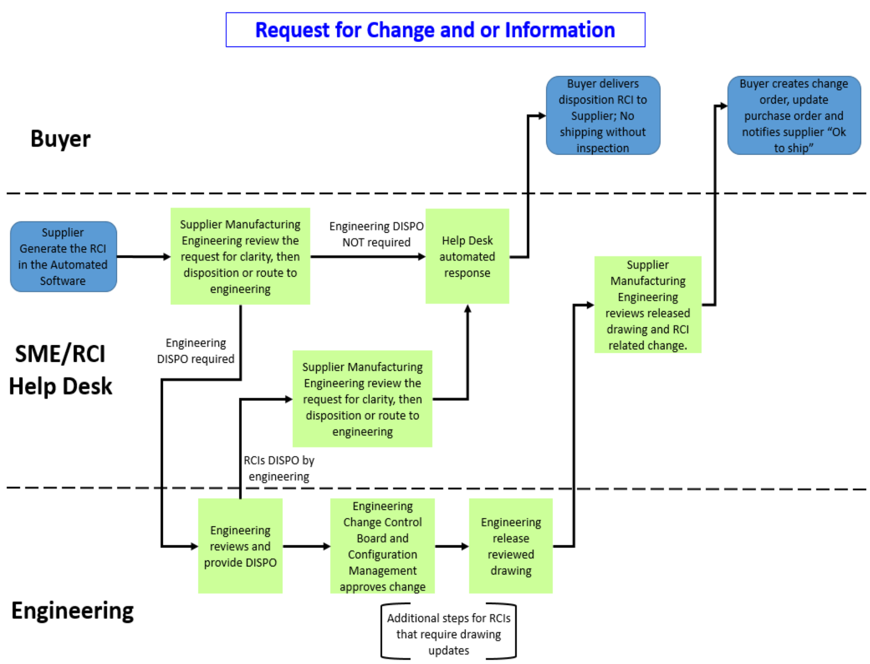


Figure 2
Process Flowchart

The team decided to utilize this tool because of the tool ability to visually represent progresses. As stated in the previous paragraph, the process flowchart tool facilitated us the stakeholders' involvement on each step of the task execution. The team was able to immediately familiarize with the process and understand what to do when performing the task/operation. This information allow us to evaluate each step from multiple stakeholders' perspective.

Measure

For the measure phase, the team decided to use the established software report feature to collect the data. This will minimized data formatting and repeatability issues. The software automated reporting feature provides the data in an excel format (Table 2).

For consistency purposes, an operational definition chart was developed to avoid confusion on the dates, codes, etc. (Table 3). The reason why the team decided to create an operational definition chart is that the detailed description of each measurement is intended to ensure that each measurement is interpreted the same way by different team members. Since this project was a quality initiative from the team and there was no requirements or expectations from the customer, the team assume that the improvement goal was the customer requirements. The request for change and or information process current state was considered our operational baseline.

Table 3
Operational Definitions

Measure	Operational Definition
SIN#	Software identification number; assigned automatically by the system when the request is logged in
Dwg/Doc Number	Drawing and or document number
Open Date	Starting point of the measurement
Closed Date	Stop point of the measurement
Req DIW	Requests days in work
Supplier Name	Suplpier name
Need Date	Need date provided by the requestor, supplier due date for returning dispositioned RC/I
Disposition Code	Approval, clarification or reject code assigned by supplier manufacturing engineering team
Reason Code	Code assigned by engineering to identify the type of issue to be addressed. The code directly relates to the entity responsible for the disposition.

The drawing information and suppliers name have been modified to avoid violating the company non-disclosure agreement and proprietary information policy.

Table 2
RC/I Trend

SIN#	Dwg/Doc Number	Open Date	Closed Date	Req DIW	Supplier Name	Need Date	Disposition Code	Reason Code
1001	XXXXXX0000	13-Sep-16	21-Sep-16	6	Supplier 01	14-Sep-16	R	M2A
1002	XXXXXX0001	11-Aug-15	25-Aug-15	9	Supplier 02	2-Sep-15	A	M5
1003	XXXXXX0002	20-Oct-15	27-Oct-15	4	Supplier 03	11-Nov-15	C	E3A
1004	XXXXXX0003	11-Feb-15	16-Feb-15	2	Supplier 04	5-Mar-15	A	P1A
1005	XXXXXX0004	11-Feb-15	16-Feb-15	2	Supplier 05	5-Mar-15	A	M2A
1006	XXXXXX0005	11-Feb-15	6-Apr-15	34	Supplier 06	1-Apr-15	C	M2A
1007	XXXXXX0006	11-Feb-15	2-Mar-15	11	Supplier 07	5-Mar-15	A	G1
1008	XXXXXX0007	25-Feb-15	23-Mar-15	16	Supplier 08	19-Mar-15	R	M2A
1009	XXXXXX0008	4-Mar-15	5-Mar-15	1	Supplier 09	25-Mar-15	A	T4B
1010	XXXXXX0009	4-Mar-15	5-Mar-15	1	Supplier 10	25-Mar-15	A	M2B
1011	XXXXXX0010	4-Mar-15	5-Mar-15	1	Supplier 11	25-Mar-15	A	M2B
1012	XXXXXX0011	4-Mar-15	9-Mar-15	3	Supplier 12	6-Mar-15	A	G3
1013	XXXXXX0012	11-Feb-15	16-Feb-15	2	Supplier 13	5-Mar-15	A	E6A
1014	XXXXXX0013	11-Feb-15	16-Feb-15	2	Supplier 14	12-Feb-15	C	A1
1015	XXXXXX0014	12-Jan-15	15-Jan-15	3	Supplier 15	14-Jan-15	A	G3
1016	XXXXXX0015	11-Feb-15	23-Feb-15	7	Supplier 16	5-Mar-15	A	T6
1017	XXXXXX0016	11-Feb-15	23-Feb-15	7	Supplier 17	5-Mar-15	A	M1
1018	XXXXXX0017	11-Feb-15	9-Mar-15	16	Supplier 18	12-Feb-15	A	E4A
1019	XXXXXX0018	5-Mar-15	31-Mar-15	16	Supplier 19	6-Mar-15	A	M2B
1020	XXXXXX0019	25-Feb-15	6-Apr-15	25	Supplier 20	19-Mar-15	C	M2B
1021	XXXXXX0020	4-Mar-15	9-Mar-15	3	Supplier 21	25-Mar-15	A	M2B
1022	XXXXXX0021	5-Mar-15	5-Mar-15	0	Supplier 22	6-Mar-15	A	M5
1023	XXXXXX0022	5-Mar-15	17-Mar-15	7	Supplier 23	26-Mar-15	A	T2

Analyze

The average turnaround time to obtain a request for change and/or information is 44 days. For the Analyze phase, a Pareto chart was created to show the quantity of requests submitted between January 1, 2015 and June 18, 2018 (Figure 3).

During those dates, the top-five requestors were Suppliers 1, 2, 3, 4, and 5. Since our goal was to reduce processing time by 30%, our investigation was focused on those suppliers that caused 30% of RCIs submitted. We are aware that the Pareto chart uses the 80/20 rule to narrow the focus of process improvement to 20%. However, the team decided to go with 30%. Figure 3 contains a visual representation of the 30% marker; any supplier under that mark was subject to investigation as part of our process improvement project.

With the observations acquired from the previous Pareto chart, the team proceeded to investigate each individual supplier. The automated software data collection feature provided us with the ability to segregate the data per supplier, reason code, date submitted, date required, etc. We concentrated on analyzing the data in the reason code category. Why the reason code category and not the date? Simply because in order for us to understand the issue, we needed to evaluate the process from all perspectives, starting with our internal interface. The reason code identifies the type of issue the supplier is dealing with. The code also communicates that the supplier needs a change or additional information on how to fix the issue. The five suppliers' data analysis revealed that the top contributor in the reason code category was M2B. The M2B code is defined as a Manufacturing Request from the supplier (Figure 4). The reason code library contains 76 codes. The remaining reason codes in Figure 4 are comprised of 72 codes.

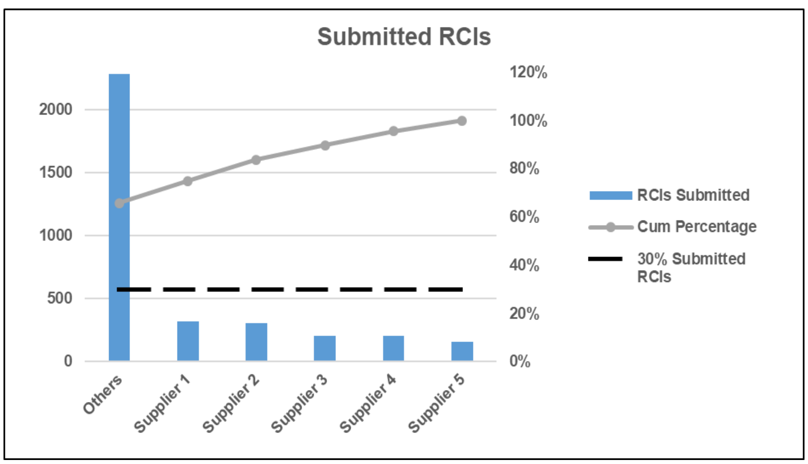
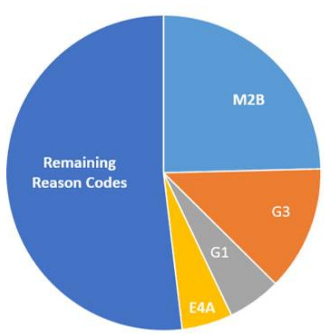


Figure 3
Submitted RCIs



Reason Code	Percentage of RCIs
M2B: Mfg Request	24.592
G3: Mfg Instructions, Change Requested	12.835
G1: Mfg Instructions Required	5.4478
E4A: Specification Issues	5.2324
Remaining RCs	51.893

Figure 4
Reason Codes

In order to understand why the Manufacturing Request (M2B) reason code was the top contributor, the team developed a fishbone, or cause and effect, diagram to identify the possible drivers of this issue.

From the fishbone diagram (Figure 5) it was determined that users utilized the M2B reason code for multiple/different issues to which the system has dedicated reason codes. It is imperative to mention that the fishbone diagram identified a "no-correlation" condition between all the contributors. Due to the incorrect reason code assigned to the RCI, the team spent more time reassigning/rerouting the requests to the adequate entity, driving the increase of processing time. Once the correct entity was notified about the supplier request, the processing time was not affected. The team concluded that the Manufacturing Request Code's category definition does not provide a proper description of the true reason as to why the supplier initiated the RCI. If we provide a proper definition of the reason code, then the users will be able to assign the correct one. The team also discovered during this research that there were unnecessary codes in the reason codes library. For example, from the 76 existing codes, 15 codes had not been used in the past three years and six were used once in the past three years. Most of this lack of usage is directly related to manufacturing processes. The aerospace industry's constant evolution is impacting the codes. The data also revealed that the suppliers and sub-tiers, also known as sub-suppliers, submitted 69% of the total RCIs.

Improve

The improvement phase of the DMAIC process focuses on finding a solution based on the problem exposed in the first three phases. The Improvement phase requires three things: 1) brainstorming (by project owners and members whose intent is to develop a solution that will address the main problem), 2) testing (done by the process owners to ensure positive results, and 3) assessment (done by the process owners to assess the outcome of the executed solutions). These three things will assist in choosing the most effective setting. However, the company's resources, policies, and procedures will play a key role in the implementation of the solution. Because this is a manufacturing process, in the Improvement phase, we should focus on the Seven Deadly Wastes, also known as 7 Mudas or 7 Wastes of Lean Manufacturing. The 7 Mudas are transport, inventory, motion, waiting, over-processing, overproduction, and defects. The principle is identifying the wastes that we want to remove. The simplest way to define waste is as "something that adds no value" to either your process and/or organization. In this case the team was able to expose an issue that was creating at least two types of Mudas or wastes: waiting and over-processing.

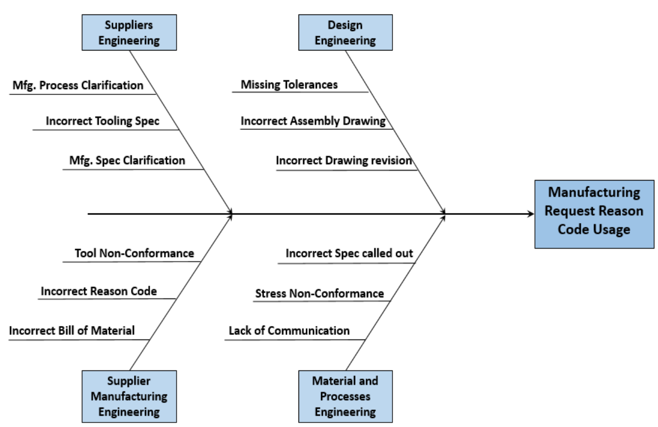


Figure 5
Fishbone or Cause-and-Effect Diagram

In order to remove the wastes from our process the team needs to identify a solution and in order for the team to identify a solution the team developed an Impact Effort Matrix. An Impact Effort Matrix is a grid that helps you evaluate solutions for their relative impact given the effort required. It provides a quick way to filter out solutions that might not be worth the effort. Typically, the best solutions are in the upper right quadrant, easy to implement but with substantial impact however, the solutions are directly related to the company resources.

Table 6
Impact Effort Matrix

	Hard	Easy
High Impact	Develop an automated software feature that will screen the form to collect the request data via key word selection and assign the code automatically	Specifically define the M2B code via company process architecture, conduct a yearly refresh training and discuss the issue before submitting the formal request
Low Impact	Communicate to all suppliers and sub-suppliers the investigation findings via paper format (email, IM, etc.)	Reduce the number of existing requests for change and or information reason codes

Based on the Impact Effort Matrix results, the team can determined that the best solution for our problem is to specifically define the M2B code via company process architecture, conduct a yearly refresh training and discuss the issue before submitting the formal request. During the improvement phase we also determined that we need to revise/review our training package to ensure a clear understanding on the reason code to use. The Request for Change and or Information is the platform established to communicate between the suppliers, sub-suppliers, suppliers manufacturing engineers, material & processes engineers, design engineers, contract administrators, configuration management, procurement and property management. Anticipation/projection are keys when it comes to manufacturing operations. Instead of waiting for the Requests for Change and Information to be submitted, we should discuss the situation with our suppliers. In some instances a conversation will result in a supplier internal solution and there's no need to submit the formal request. Respectful communication in the work place always promote a healthy working environment without mentioning that you also develop a trustworthy relationship with your suppliers and company entities.

Control

The Request for Change and or Information procedure was assessed and updated to ensure processing time reduction. In addition we developed an automated monitoring system that communicates to the stakeholders the current and past due requests for change and or information. Recently, a new tendency was exposed were the quantity of the requests for change and or information increased due to a work transfer. In other words when a supplier transfer his current statement of work to another supplier, the number of requests for change and or information will grow. To mitigate such behavior, we deployed supplier manufacturing engineers to their facilities to accelerate the process and ensure a smooth transition. The project implementation positively impacted the new tendency since the training material and requirements were recently updated.

CONCLUSION

The Requests for Change and or Information Process has been enhanced/improved throughout the last four months. As mentioned in the Analyze section, the average requests for change and or information processing time was 44 days and we were able to reduce the average processing time to 27 days an equivalent to a 39% improvement in processing time. The improvement was achieved utilizing the DMAIC Methodology.

Our established goal of reducing the processing time by 30% was accomplished within the first two months of implemented. In addition to accomplishing the established goal, another opportunities for improvements were identified for example the standardization of the supplier work transfer activities.

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