Cost Reduction by Improving the Engineering and Operation Design Department

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Abstract *— This research paper focused on how reducing the lower expenses instead of one of the largest expenses provide the most cost reduction in Bechtel Plan Machinery, Inc. (BMPI). The fundamental objectives of this research is the improvement of the use of the resource BPMI specifically in the area of Engineering and Operation Design Department to have the maximum cost reduction. Different techniques were applied to investigate the sources of cost. As a result of the investigation and the major findings, some cost reduction recommendations and business plan were provided, which are predicted to aid in the improvement and monitoring of the right use of resources of this department.*

Key Terms *—Design Phase, Improvement, Up-front Cost, Use of Resource.*

INTRODUCTION

Bechtel Plan Machinery, Inc. (BPMI) is responsible of supporting the US fleet and its sailors. BPMI works with many partners to deliver and maintain safe, reliable, cost-effective products to ensure the long-term viability of Naval Nuclear Propulsion. BPMI is a Bechtel-owned division under contract with the Navy. Bechtel is a global engineering-construction organization providing premier services to develop, engineer, build, operate, and manage customer projects and facilities worldwide. Bechtel is one of the most respected engineering, construction & project management companies. Bechtel is built upon time-tested values of excellence and integrity **Error! Reference source not found.**.

Every fiscal year, each branch is required to develop an annual assessment of Cost Reduction Metrics (CRM) based on continuous improvement of ongoing products, services, and processes. This is intended to document actual cost improvement against the desired cost improvement. Each branch is expected to complete the CRM at the end of the fiscal year. In the 2013 CRM, BPMI did not meet their desired cost improvement. This information was documented in the 2013 CRM. The intent of this CRM is to drive the identification of problems earlier in the process and to use this indicator to improve or reduce the cost of ongoing products. As part of the effort to identify the problem(s), BPMI provided an overall programmatic cost reduction associated with each department, as shown in Figure 1, that indicate a less saving than previous years. A more detailed tracking of costs, during an internal audit in each department identified the design (Engineering and Operation Design) department as the most crucial department with less cost saving. Therefore, this project will focus on the early detection of how to reduce cost using process improvement during the design phase.

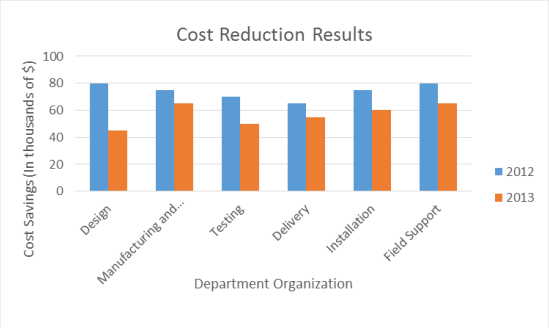

Figure 1
Fishbone Diagram of Cause and Effect

General Objective

The general objective of this research is to identify the phase(s) and the major factor(s) of the Engineering and Operation Design (E-OD) department that contribute to cost increase in BPMI. This will aid to clearly identify which improvements could provide the best cost reduction for ongoing goods.

The following specific objectives should also take into consideration as part of the continuing resolution to reduce costs during the design phase.

- Decrease the amount of physical prototypes.
- Decrease the percentage of rework, rejection parts, or non-conforming products.
- Optimize the use of standardized parts and reusable items.

LITERATURE REVIEW

The cost reduction in a company can be achieved in different ways or stages (departments). However, decisions made during the design stages have the major determinants of the new product cost, instead of achieving cost reductions during the manufacture of the product and rendering of services [2]. Dr. Lefcovich [3] states that the decisions made during the design development are the dominant influence on production costs, and once these decisions are made, the cost of design changes can be huge. This is because decisions about the production process and the technology investment required to support production are made long before the product are actually produced [4]. Therefore, the efforts to reduce costs after the design phase are unlikely to be successful or significant when the upfront costs are committed or locked in as part of the technology and process decisions made during the contract agreement.

Dr. Anderson [5] conducted several studies on how to develop manufactured products right the first time at low-cost and high-quality. In the studies, Dr. Anderson found that Design for Manufacturability and Concurrent Engineering in mind during the design phase are proven design methodologies that work for any size company and shall save time and money by not having to "re-invent the wheel". Cost reduction from the beginning of the design phase involve many challenges, however there are many tools like 3D CAD (computer-aided design) software, as Eauclaire-Kopier [6] mentioned, that can provide a way to cut testing cost and production times of the components before it goes to manufacturing. The following research should replicate similar results as these references.

METHODOLOGY

The methodology presented in this research, and showed in Figure 2, uses the Project Management Methodology (PMM) that help in the process for managing the project. The PMM is a technique to tell the team what has to be accomplished, how it should be completed, in which order and by when [7].

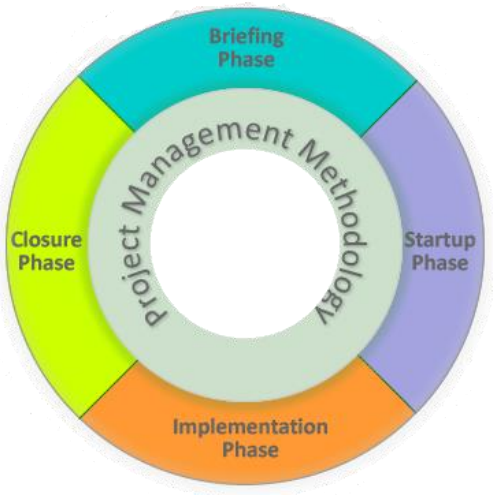

Figure 2
Project Management Methodology Steps

Supplementary method was also executed to discover all of the things that could cause the problem before jumping to a conclusion. This method used is called Cause and Effect Diagram, also often called a "Fishbone" diagram. This approach will ensure that the problem can be solved entirely, rather than just solving some of the symptoms of the problem.

SOURCES OF DATA

There are two sources of data were obtained from the BPMI data base. Both data were used in this research paper with the purpose of finding a faultless solution that aid with the solution to reduce cost.

Primary Data – The 2013 CRM that is summarized in terms of dollars, the results of cost reduction initiatives initiated in the fiscal year, process improvements resulting in internal man-power savings and percent of milestones completed on time.

Secondary Data – Survey with questionnaires question that were used to receive feedback from managers and employees in order to get a better answer about what type of causes are influencing the problem and what alternatives could be used to reduce cost. The survey measured with rating scale from 1 to 5 where one was strongly disagree.

Limitation of the Study

This research paper may be limited due to limited unclassified information and data that can be given out by BPMI or provided by the author.

ANALYSIS

Briefing Phase – Initiation

During the first step of the PMM, as shown in Figure 2, the research project starts with the initiation that focused on the analysis of the problem to be resolved or the desirable outcome. At this stage was determined the work plan, scope and deliverables, requirements and redefinition of measurable objectives, resources needed, milestone plan and timeline as well as the timeline to receive the 2013 CRM data and 2013 individual employee survey. It's very important to spend time at this stage, since the omission of key requirements could cause rework.

Startup Phase – Planning and Design

During the second step, more levels of details was created. At this phase, the Gantt chart was created and selection of the point of contact and stakeholders in the different department was established. Communication of the work plan and authorization request to use the 2013 CRM and survey was sent.

Implementation Phase – Executing

At this phase the authorization of the data was received and the Fishbone diagram was populated with the information. The problem or effect is displayed at the head or mouth of the fish. Possible contributing causes are listed on the smaller "bones" under various cause categories. This diagram was used during the methodology to help in brainstorming and mind mapping to identify possible causes of a problem and in sorting ideas into useful categories [8].

After the result obtained from the Fishbone diagram, a plan distribution and pilot solution were held in place. Draft of the procurement of 3D software and test of deliverables against the initial design were sent to stakeholder review.

Closure Phase – Monitoring and Controlling

The monitoring and controlling process were created for managing and tracking the progress of the solution and improvement. This Monitoring and controlling helps to quickly identify problems or error, so a corrective action can take place.

A formal close out of the methodology is presented once the objectives are achieved.

RESULTS

The analysis result of the data in Figure 3 shows that the main problem of the increase in cost is caused by three areas in the design phase in the E-OD department. These three main problems are the following:

- The cost of rework throughout the process of improvement
- The amount of non-conforming part
- The increase in cost of custom part in each ongoing goods.

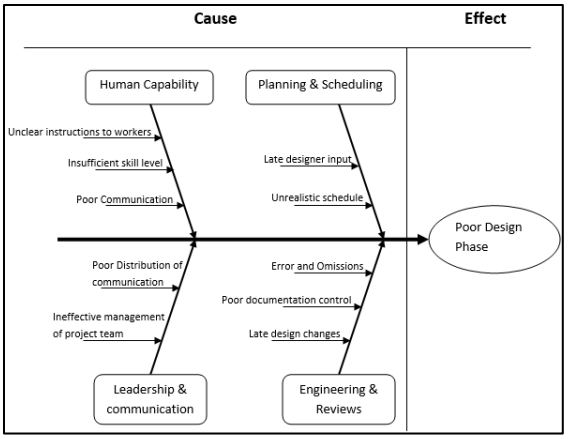

Figure 3
Fishbone Diagram of Cause and Effect

DISCUSSION AND RECOMMENDATION

The amount cost reduction during the fiscal 2013 has decreased 66% in comparison with the previous fiscal year, as shown in Figure 4. This decrease in cost reduction is based on the three areas identified during the Implementation Phase and are explained in detail below.

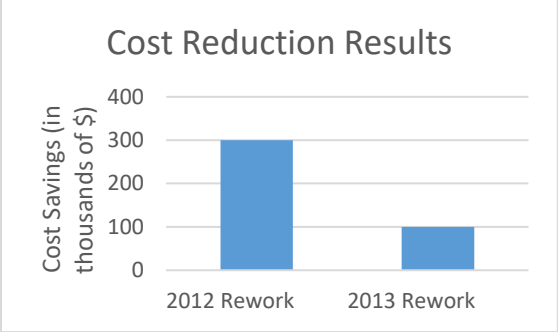

Figure 4
Cost Reduction Results between 2012 and 2013 of BPMI

Problem 1 – Cost of Rework

The lack of quality of technical work and absence of a clear work plan and misses of key functional requirement will have a significance rework cost at the end of the process, when technical changes are more costly. Rework affects time and increases work that produce a high cost, as shown in Table 1. This salary paid during rework do not add value or revenue to the product.

Recommendation: The implementation of an Up-front Plan and periodic revision of the upfront plan and schedule (Gantt chart) will allow the engineer to receive peer review, management review, prime contractor review and customer review, which will provide comments and catch any problems or concern early in the process before the engineer start the planning stage.

Table 1
Man-hours applied per year

Week Ending	Rework Hours (Cumulative)	Cost of Rework (Cumulative)
8/1	1528	$45,840.00
8/8	1711	$51,330.00
8/15	1966	$58,980.00
8/22	2149	$64,470.00
8/29	2229	$66,870.00
9/5	2435	$73,050.00
9/12	2691	$80,730.00
9/19	2875	$86,250.00
9/26	3032	$90,960.00
10/3	3157	$94,710.00

Problem 2 – Scrap and Waste of Material

Physical Prototype during the design process do not add value to the end product. Once the physical plastic prototype is shown to the customers or managers, they do not have any other applications. Moreover, when something goes wrong with the plastic prototype it becomes scrap. The scrap leads to material costs and loss of time, making parts that will not bring in revenue, and waste will cause interruptions, price change, and impact on the schedule.

Recommendation: Use of 3D software during the customers or stakeholder presentation is a good way to show end product without the need to create a physical prototype. This can provide a way to cut testing cost and production times of the components during the design development and before it goes to manufacturing.

Problem 3 – Custom Parts

Custom parts in the design phase of products are well used because they meet the requirements for the application to be used without adding cost or

changing the design. However, the parts cannot be easily reused and the process of manufacturing takes time and costs more.

Recommendation: Use of standard components makes easier the management of inventories and helps facilitate the analysis of the part and limit the risk of completing the project on time.

CONCLUSION

The research has provided sufficient information and proof to predict that a pilot program using the recommendations above will reduce the cost of improvement of ongoing products and increase in cost savings.

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