Improving Critical Parts Inventory for Fast Field Service Response

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Abstract *— This study's focus is the evaluation of critical spare parts inventory for a service business organization to ensure adequate customer support. The study is carried out at a local provider for laboratory and process equipment, which are deemed critical to most of its customers' operations. This paper also reflects how the use of Six-Sigma tools can help improve decision-making and establish a systematic effort to manage and improve the organization's critical spare parts management. Considering that spare parts criticality depends on independent customers and operational needs, the study focused on utilizing data gathered from the organization's Enterprise Resource Management (ERP) system and service log platform. This approach allowed the team to properly identify the most common repairs done compared to the organization's install base. As a result, the aim of the organization is to define the necessary spare parts required for the service organization to improve service response, reduce employee overtime, minimize customer downtime while increasing customer satisfaction. As the organization applies these findings and the recommendations provide by the team executing the study, further evaluation will be required in order to identify long-term limitations and continue improving the process.*

Key Terms *— Critical, spare parts, inventory, Six-Sigma, PDCA*

INTRODUCTION

One of the most recurrent issues in today's competitive manufacturing world is how to manage critical systems and equipment properly. Critical systems and equipment are those that, if by any means, cease to operate correctly, could impact or impair any business operation. Minimizing downtime while maintaining production efficiency and effectiveness is considered one of the top priorities of these businesses. Hence management of critical spare parts is crucial for both manufacturers and suppliers.

The following study was conducted at MD Solutions, a process and laboratory equipment provider serving the pharmaceutical, medical device, and other regulated industries in the Puerto Rico market. The organization is considered a key supplier of critical systems utilized by many of its customer's operations. For this reason, reducing downtime and ensuring a quick response is critical to the field service organization.

In the last couple of years, the organization has confronted several issues due to its increasing large install base of different instruments and equipment. Some of these challenges include adequate management of critical spares parts for properly managing customer service requests to ensure the first-time-fix approach and reduce customer downtime.

At the same time, as OEM's (original equipment manufacturer) has moved toward maintaining a lower inventory of parts, this has resulted in other challenges such as service delays, customer discontent, increased overtime for technicians in order to accommodate pending services due to lack of parts.

This project aims to assist the organization in identifying how to properly manage its spare parts inventory to ensure first-time fix service to reduce downtime of customer critical equipment.

METHODOLOGY

For this study, the methodology involved uses a Six-Sigma tool known as the Plan, Do, Check (Study), Act (PDCA) cycle, or commonly known as the Deming Cycle or Shewhart Cycle" [1]. "Six Sigma is a tool first introduced in the mid-1980s by an American engineer working for Motorola. This discipline provides a quantitative approach to properly measure, analyze, improve, and control any process. This has been a widely used concept by many organizations in the last few decades, intending to increase process and business quality and overall performance while reducing waste and other process variations. Hence, reducing operation costs and maximizing profits" [2].

To carry out the study, a team was organized to define the steps and review the process on a bi-weekly meeting scheduled by the organization's management. The study started with an initial assessment to properly understand the reality of the organization's inventory management. It was defined that the study was to be conducted using historical data to properly evaluate total repairs performed by the organization in the last three years, compared to the total installed base. Statistical analysis would be conducted to identify those systems with the most service repair calls based on the data collected. The PDCA cycle used was defined as follows:

- Plan: Identify the opportunity and define the study's objectives & goals.
- Do: Gather the study data. In this stage of the study, the team proposed gathering data to conduct the study. As part of the project activities, historical data from the organization's ERP system and its service logs platform were gathered.
- Study: Analyzed the data gathered and define the systems that require attention. During this step, the use of a statistical tool such as histograms and Pareto analysis is applied. A histogram is a graphical representation use to organize data in groups. This study allowed the team to define the concentration of install base units. On the other hand, the Pareto analysis is a tool used for decision making and assessing the impact of the most frequent problems or issues found. In the study, this allowed identifying which instruments from the organizations installed based are most likely to fail based on the data gathered.
- Act: After the study stage and the evaluation of the data, the findings are presented to the organization management and a series of recommendations. Additional to the finding gaps may be identified for future studies or improvement projects.

RESULTS AND DISCUSSION

During the "Do" phase of the study, the team gathered the required data. This was collected from the organization's ERP system as well as the organization's service logs platform. The data was then populated on an excel spreadsheet and analyzed. The data gathered was divided by equipment and instrument populations to establish the study's baseline based on the organization's install base. The results were analyzed and evaluated by the team, determining next steps, and finalizing their report to the organization management. As part of the data gathered, a total of 40 different instruments and equipment were identified. From those 40 systems, a total of 15 were cataloged as critical. These are defined based on the design and nature of the systems, given these systems are considered critical to the overall manufacturing operation of the organization's customers. These labels are assigned as part of the organization's ERP and service asset management system.

Figure 1 shows a histogram representing the organization's current install base for instruments and other equipment. The data is defined as per total units from large to small.

Once the team identified the most critical systems, the next step was to determine if there was a correlation between X instruments or equipment with the number of failures and repairs reported on

the service logs from the service asset management system. During the study, the team confronted some challenges, including that not all repairs are cataloged the same, resulting in a challenge with pinpointing specific parts required for these services. Nonetheless, this allowed the team to identify another area of opportunity that may be addressed for future studies.

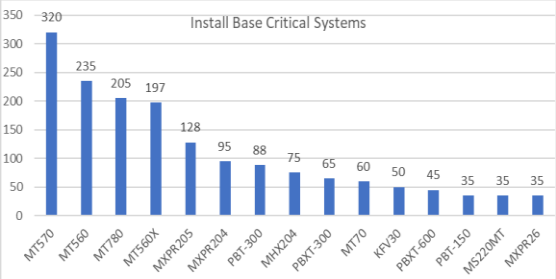

Figure 1
Histogram Critical Systems Install base

Analyzing the service logs against the designated critical system, the team was able to identify the most common failures and the number of repairs for these critical systems. Figure 2 shows a Pareto chart representing the organization's total repairs in the last 3 years. Based on these findings using statistical analysis, the team defined where the organization's efforts should be focused properly. The chart provides a good summary of the population of instruments and equipment with the most service repair calls. This data will allow for the next steps towards addressing the necessary spare parts inventory to ensure customer uptime and support.

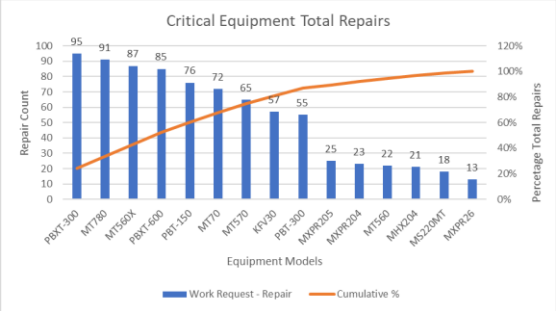

Figure 2
Pareto Chart Concentration of Repairs for Critical Equipment

Following the data gathering and analysis, the team determined that the systems that required the most attention are: PBXT-300, MT780, MT560X, PBXT-600, PBT-150, MT70, MT570, and KFV30. Further discussion with management presented that from these units, four of them represented a large portion of the annual service income of the organization. As part of the study, the most common spare parts for these repairs where defined.

In collaboration with the areas, management, and service, it was determined that three service kits would be kept in stock locally for each of the systems defined. These kits will have all the necessary spare parts to ensure adequate field response and ensure a first-time fix. Once the service is completed and the technician's work order is closed, the parts used are invoiced by the system and automatically will set an alert for placing an order to the supplier to replenish the part. This process will allow the service kit to be replenished quickly, minimizing delivery delays, and consequently guaranteeing a quick turnaround to customer service needs.

Following the discussion with the organization's management, the team also recommended that further cost analysis be conducted and a more comprehensive evaluation of customer contracts. This will allow the organization to continuously monitor and better manage their spare parts inventory level while reducing unnecessary costs. “As these factor are critical in efficient inventory management, it is important to have a detailed analysis of all conditions that affect the logistics of spare parts in order to make the right decision and apply the adequate inventory management policy” [3]. Further use of six sigma tools will provide a clearer picture for the organization and continue identifying other areas of opportunity to improve their operation.

CONCLUSION

The management of critical spare parts is an important task that can have severe repercussions

on any operation if not properly managed. From the study conducted, the team gained substantial insight into the operation of the organization under study. Implementing Six Sigma tools as part of a business strategy can provide significant improvements to ensure the organization's efficiency and effectiveness.

The study's main objective was to identify those critical systems the organization provides and support properly. The problem arose as the organization service business area started facing delays in service, increased labor costs, and customer complaints due to the lack of visibility of spare parts. Based on the study, a classification of define critical equipment was adopted to differentiate between the most common system that required intervention by the organization. Hence, establishing the required level of spare parts to improve service response to those customer systems with a higher failure rate that result in operational downtime.

At the end of the study, the organization defined the best strategy to mitigate their current situation. Allowing the use of spare part kits facilitates an avid rotation of spare parts and triggering inventory replenishment points, reducing the low level of inventory. Further detailed analysis is encouraged to evaluate all conditions that may affect proper management of spare parts and respond to customer needs and the incurred cost for the organization. Efficient inventory management allows the achievement of competitive advantage and adds value to the organization's customers.

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