Manufacturing Processes Documentation Improvement and Standardization for New Generation Blade Product

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Abstract *— The new product introduction process is the heart of every company that manufactures products. Its effectiveness will play a critical role to gain competitive advantage. There is a need to reduce the quantity of assembly and packaging defects during proto builds for a new generation blade product. It was demonstrated that in order to achieve this, standards methods are required to ensure products are assembled, tested, and packed around the world in the same manner. These processes need to be the best in class to guarantee high quality and that wastes are eliminated to attain the expected revenue. For this, the product preparation process was used to create the standard methods. The objective was achieved once the methods were implemented and used during the proto builds in the different worldwide manufacturing sites. This resulted in the required reduction of the assembly and packaging defects.*

Key Terms *— new product introduction, product preparation process, proto builds, standard manufacturing methods.*

INTRODUCTION

The new product introduction (NPI) process for a new generation blade product is used as the means to meet the project scope and purpose. The project purpose is to create the manufacturing process methods that will become the standards for all worldwide manufacturing sites to implement. Thus, improving and standardizing the manufacturing processes documentation for the new blade product.

During the NPI process, two proto builds are completed: the Site Pilot and the Manufacturing Verification Build (MVB), prior to release the product to market. The manufacturing methods created will be used by the different manufacturing sites to execute these builds.

Objective

The objective of this project is to reduce the quantity of assembly and packaging defects during proto builds.

BACKGROUND

In today's competitive market, the new product introduction process or strategy a company has can be determinant on their market share gain. The faster new products are introduced to market, the better its competitive advantage. Developing profitable, timely, high-quality products is more important today than ever before [1]. In order to do this, the NPI process needs to be as effective as it is efficient; and in companies where their manufacturing is done worldwide, they need to guarantee that the products are done in the best way possible with the highest quality, no matter the location where they are being manufactured. This motivates them to pursue more cost-effective and time-efficient methods and technologies [2].

A new generation blade product is to be launched on June 2018. This is to be manufactured in different sites between three regions: Americas, Europe, and Asia Pacific, and this include internal manufacturing and Original Design Manufactures (ODMs). The current process is for each site to create their own methods and there is no sharing of best practices among them. There is a crucial need for standard methods that will provide the instructions to assemble, test, and pack the products with the best processes, eliminating waste and inefficiencies. Historical data of previous generation's blade products shows that several issues seen in sustaining lifecycle can be prevented

if standard documentation is provided and followed.

The main goal of this project is to create the methods that will become the standards for all sites to implement and absorb, but to do so in a way that all regions can participate in their creation. The main tool to be used to enable this is the 3P: Product Preparation Process. This program emphasizes teamwork to find the best way to promote good product flow, high volume and excellent quality [3]. It focuses and attempts to optimize the collective design of the actual product and the production operation that will produce the product, with strong input from and consideration of the people who will interface with it from all the many different functional areas [4]. This will ensure a faster agreement and absorption process. During the 3P event, several tools and techniques are programed to be used, being one of them the Failure Mode Effect Analysis (FMEA). This is a very powerful tool to guarantee that issues are addressed using the methods created. The FMEA enhances identification of the most critical and most probable errors in the product or in the process [5]. Once this goal is achieved, the assembly and packaging defects are expected to be minimized during the product lifecycle.

METHODOLOGY

In order to achieve the project objective, the following methodology was used. It can be summarized as three main tasks: the methods creation, their implementation, and the assembly and packaging defects analysis and comparison.

Methods Creation

The main tool used for methods creation was the 3P. The starting point was to compare and document the differences between the previous generation blade product and the new generation. Using the manufacturing methods of the previous generation blade product from Americas as the baseline, the first drafts of the methods were created. Once these were completed, they were shared with the seven worldwide manufacturing sites prior to the 3P event. The sites provided their feedback which was incorporated on the methods, and the 3P event pre-work was completed. The pre-work consisted of completing several exercises which included documenting the process of assembling and teardown of the product. These were later on validated and updated during the 3P event.

Product Preparation Process

The 3P event consisted of a group of Subject Matter Experts (SME) from different teams (Engineering, Supply Chain, Procurement, Research & Development, and Diagnostics) and representatives from the three regions. They came together in a single location for a week to conduct a series of activities to learn and share knowledge of the new product. Among the activities completed in the event were the assembly and teardown of the product using mechanical samples, selection of the best alternative for several processes, and an FMEA exercise, among a few others. For the FMEA, the main concerns were scored based on severity, occurrence and detection; actions were recommended and the analysis was again performed taking them into consideration. To conclude the exercise a new score was obtained, which was lower than the previous one, and the recommendations were then added to the methods.

The main purpose of the event was to better understand the product and the processes that are followed in the regions for the assembly, test, and packaging in order to select the best. The exercises completed during the 3P were crucial to proactively identify issues and their solutions. The results were then added to the drafts of the methods, and these were shared once again with the seven sites for feedback gathering. Figure 1 displays a summary of the main tools used in the 3P event. For more details, Figures 2 and 3 provide examples of mock-ups and the selection of the best alternative. The creation of mock-ups is an exercise where simple materials are used to emulate what is used in manufacturing. For example, post-it as parts used

on the assembling of the product, or using foam and carton to carve the assembling tools or even emulate a manufacturing workstation or material.

Figure 1
3P Main Tools Used

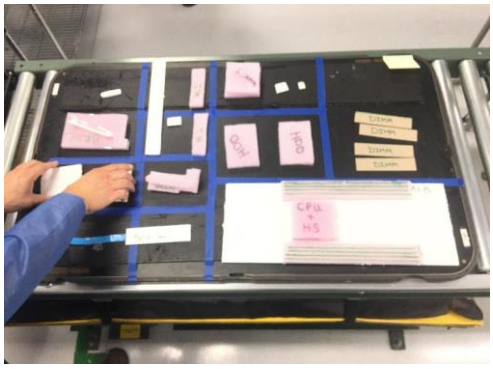

Figure 2
Mock-up Example

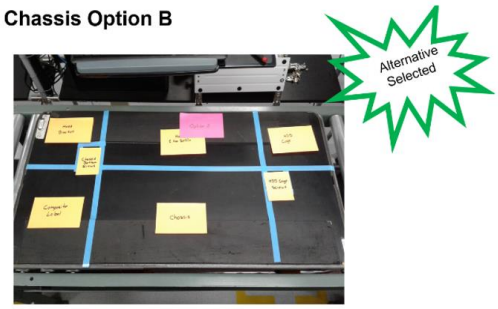

Figure 3
Selection of Best Alternative Example

Prior to the first proto build, the Site Pilot, all sites provided their official methods sign-off. This indicated that they agreed to use the methods during their proto builds and to provide feedback as the product was processed on the different stages.

In the end, the methods created and signed-off by all the sites were the following:

- Assembly Method
- Teardown Method
- Packaging Method
- Test Procedure
- Test Infrastructure
- Test Handling
- Trouble Shooting Guide

Methods Implementation

Once the methods were created, the next step was to proceed with their implementation and absorption in the manufacturing sites. The main tasks that were completed during this stage were the following:

- Sites were required to use the methods and provide their feedback for Site Pilot and MVB.
- Methods were updated to address defects found during the builds and shared with sites.
- A methods audit was performed in the lead site with very good results. It was demonstrated the methods were used.
- Absorption was completed on the methods shared by all sites.

The absorption was formally provided by each of the seven sites. They agreed to use the methods as the standards to train their personnel. This included to translate them to their local language and made them available in their production lines. Continuous gathering feedback cycles were executed to guarantee a smooth implementation and absorption of the methods.

Assembly and Packaging Defects Analysis and Comparison

To finalize, after each of the proto builds the assembly and packaging defects were analyzed and compared. The results are presented and discussed in the following “Results” section.

RESULTS

The results achieved for the reduction of assembly and packaging defects in Site Pilot and

MVB proto builds, for the new generation blade product, are summarized in this section.

Site Pilot Build Results

For Site Pilot builds, the assembly and packaging defects quantities were compared with the ones seen on the previous generation Site Pilot for the blade product. Figures 4-6 display the results achieved. Both assembly and packaging defects were reduced: assembly defects by 8 and packaging defects by 3. This resulted in a combined reduction of 11 less defects when compared to the previous generation Site Pilot.

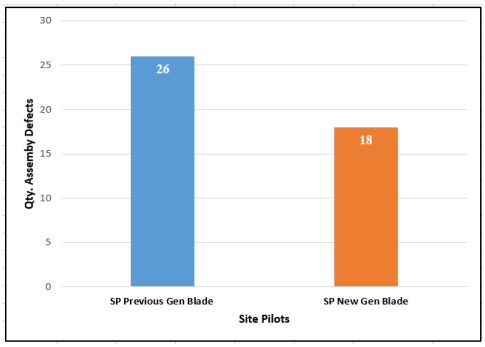

Figure 4
Site Pilots Assembly Defects

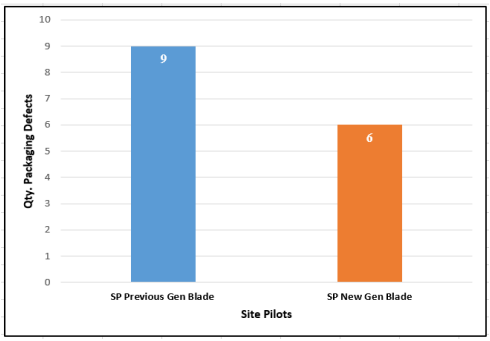

Figure 5
Site Pilots Packaging Defects

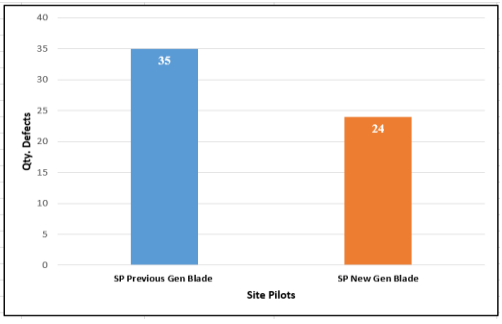

Figure 6
Site Pilots Asembly and Packaging Defects

MVB Results

After MVB was completed, the defects for assembly and packaging were tabulated and compared; but this time, to the Site Pilot previously completed. Figures 7-9 demonstrate that these defects were reduced even more. In this case, assembly defects were reduced by 13 and packaging defects by 4. Once these were combined, resulted in a reduction of 17 defects when compared to Site Pilot for the new generation blade product.

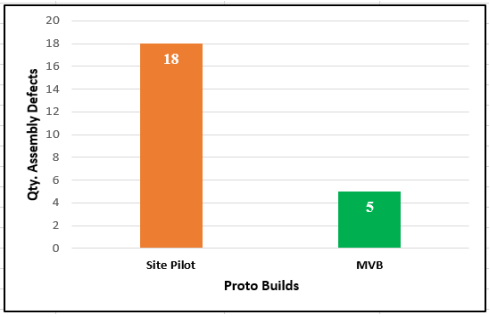

Figure 7
Assembly Defects Proto Builds for New Gen Blade Product

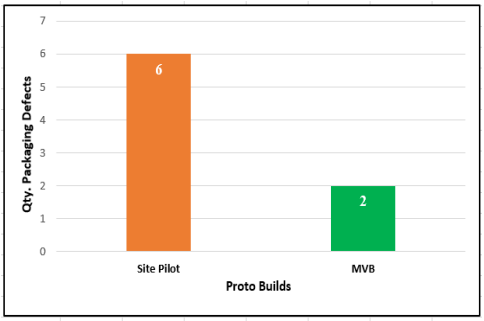

Figure 8
Packaging Defects Proto Builds for New Gen Blade Product

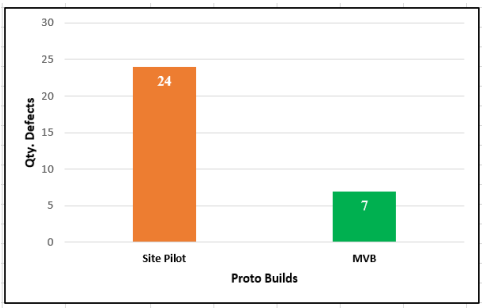

Figure 9
Assembly and Packaging Defects Proto Build for New Gen Blade Product

To summarize, Table 1 presents the percentage reduction achieved for Site Pilot and MVB. These were calculated based on the 80 total units processed on each of the proto builds.

Table 1
Summary of % Reduction for Assembly and Packaging Defects for New Gen Blade Product

Proto Builds	Assembly % Reduction	Packaging % Reduction	Assembly and Packaging Combined % Reduction
Site Pilot	10.0%	3.8%	13.8%
MVB	16.3%	5.0%	21.3%

The results attained in both proto builds, Site Pilot and MVB, were a total success. It was unknown at the beginning of the project by how much the defects could be reduced. This was the first time the methods were created and this reduction was attempted. The results achieved provide great confidence that this can be reached and implemented in other products.

CONCLUSION

The project objective was successfully accomplished. The assembly and packaging defects quantities were reduced for this new generation blade product. The creation and implementation of the methods as the standards to be followed by all manufacturing sites proved to be determinant to accomplish this. The 3P process played a crucial role to achieve the defect reductions in the best way possible. The methodology used was a very powerful learning experience. It was demonstrated that the work done to anticipate issues is extremely beneficial. Furthermore, the overall feedback received from the manufacturing sites was excellent; they were very satisfied with the methods. Their implementation and absorption was achieved easier since sites were able to participate in their creation and in the decision making process. The project proved to be a total success.

For the future, the 3P process for methods creation will be added as a requirement to be followed for every major new product launch. The assembly and packaging defects reduction obtained on this product is expected to be met on other products as methods are implemented. In addition, it will be required that the sustaining engineering team continue to update and modify accordingly these methods as new issues are seen during the lifecycle of the products.

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