Heat Trace Control Improvements at Appleton Group Houston Facility

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Abstract *— Heat Trace products delivery time at Appleton manufacturing company located in Houston Texas has become a problem since a year ago. The causes of this problem are components and mounting pan lead times, as well as assembly time. In an effort to decrease time, components and mounting pans were analyzed in regards to days. Also, employee assembly time was studied in regards to products configuration and days. It was found that by creating pre-drilled mounting pans, employee time can be reduced from 2 to 3 days. Also, assembly time can decrease by having the components that have high lead times and will be installed on the mounting pans, stock in Houston facility. The facility can even go beyond in their improvements by purchasing a machine to do the pre-drilled mounting pans, instead of buying these once outside. Also standardizations for combo products can be developed in the future. These will retain and increase new customers.*

Key Terms *— Assembly Innovation, Base plate Evolution, Components Standardization, Manufacturing Improvements.*

INTRODUCTION

Appleton Group is a manufacturing company which offers electrical equipment's used in explosion proof castings for ordinary and hazard location of commercial and industrial business. The company provides safety to field operators with their quality product, which is one of a kind. Heat Trace issues emerged by multiples feedbacks the company has been receiving lately in regards to not meeting delivery dates, resulting in disappointed customers.

Motivation on this topic emerges, because the author works directly with these products and wants to improve their reputations. The main goal of this project is to reduce assembly time of specific heat trace products, to keep customer satisfied; while meeting delivery dates. This will be accomplished by performing assembly time study; identification of product demand, components and mounting pan lead time; and drawings creation.

The focus of this project is the Heat Trace control improvements at Appleton Group Houston Facility by a method implemented; which reduced manufacturing assembly time.

HEAT TRACE PRODUCTS

The development and first steps of cable traces such as self-regulating and mineral cable for a small range of applications was created; following by the simple thermostat component for temperature control. The combination of these two developments as a unit was innovated later on with a system capable of controlling network connectivity. Heat trace controllers were formally launched by the 1990's as a complete unit.

Heat Trace Applications

Heat trace products have been in the market for a while in different applications in commercial and industrial organizations. Their main focus is to maintained or supply excessive heat to pipes to avoid any type of freeze to fluids flowing thru the pipes. Their products aren't limited to refinery only; they can be used in roofs and gutter to melt snow, in driveways and walkways to melt freezing water, and even in drinking fountains to maintain water flowing. The applications for heat trace products in industrial organizations are the following:

- **Industrial Pipe Tracing:** Industrial pipe tracing application offers customers a wide range of necessary heating cable products to

fully fit customers demand, no matter the classification area or temperature.

- **Viscosity Maintenance:** Viscosity maintenance application offers customers a heating fit to maintain their products inside pipes in a viscosity characteristic. Customers can pick from a "one-size-fit" or "right fit" option. The first option will be a fit that can be used by customer for any type of application, and vice versa to the second option used for specific application; depending on customers' selection.
- **Roof and Gutter De-icing:** Roof and gutter de-icing application offers customers heating cables that can be "cut-to-length" for installation on top of roofs or inside gutter to prevent the ice formation, on or inside these ones. This application is important, since it prevents the roof from collapsing because of the snow accumulation. This application is important, because it prevents the roof from being in tension caused by the pressure of snow.
- **Vessel and Tank Heating:** Vessel and tanking heating application offers heating to tanks and vessel in a unique way by using heating panels or "foundation heating". This application is used for specific application known as process temperature.
- **Hot Water Temperature Maintenance:** Hot water temperature maintenance application offers continual heating to water flowing inside pipes. This application is mostly used in commercial industries rather than residential or industrial.

Heat Trace Manufacturing Facility

Appleton Group is a manufacturing company, which offers electrical equipments used in explosion proof castings for ordinary and hazard location of commercial and industrial business. The company provides safety to field operators with their quality product, which is one of a kind. Houston facility offers standard and special (customized) products to customers, orders need to move smoothly and in a fast pace throughout the process once they touch production.

Appleton Products Base Plate Standardization

It was found in 2005 that outgoing orders in Appleton Group were not flowing as fast as incoming ones. Specific products were evaluated in relation to their process. The findings were that it took more time for the machining department to drill holes for different standard products as well as special ones. In the case of these targeted products, components from different brands were installed on baseplate, based on the catalog (part) number requested in the orders. To solve this issue, the standardization technique was performed. Standard baseplates were created for each targeted product with all the possible holes to fit components from different brands in the same baseplate. A generic standard baseplate was created for specific product because their enclosure size changes per product. This baseplate was used in standard and special orders to accelerate the process of assembly.

Heat Trace Migration

Heat trace control system migration from Tulsa Oklahoma facility to Houston facility was done in 2010. They were merging the facilities because the organization was trying to consolidate and restructure its brands to specific manufacturing locations. Also, the migration was conducted because all the manufacturing machinery is located at Houston Facility. Therefore heat trace mounting pans products were not targeted like the Appleton ones, in 2005. The following products were migrated to Houston facility:

- **Monitoring System:** System that continually monitors the status of both series and parallel styles of electric heat tracing cable, called CM1.
- **Circuit Management Panel:** PLC Based Control and Monitoring, called CM3.
- **Power Management Panel:** Designed to provide continuous supply voltage to all circuits, called DP. Another item under this topic is the AP, which is designed to turn the

entire panel on or off with a single control device.

PROCEDURE OF ANALYSIS

The scope of the analysis is to implement different types of methods with the main goal of gathering and identifying the necessary information to accomplish the time reduction in the heat trace products, in regards to CM1's and CM3's.

Employee Interview

The interview method was conducted to the assembly employee of heat trace area in regards to specific assembly time of the enclosures. The purpose was to identify the amount of time it takes the employee on assembling the products.

Product Segregation

The product segregation method was conducted to items sold from 10/1/11 thru 10/1/14 to segregate and identify the products demand for each enclosure.

Standardization Creation

Standardization method was conducted to enclosures mounting pans. This task was performed by the Engineering Department to reduce assembly time.

Lead Time Identification

Lead time identification method was conducted to determine, which components from the products takes the longest to arrive once planning department order these once.

RESULTS

Under the following topic, results from the techniques previously mentioned are discussed more in depth. Table and graphs are used to represent the data collected for more clear understanding.

Assembly Time

Based on the interview conducted to the employees of heat trace area, information such as layout time, wiring time and total time in regards to days was collected. As shown in Table 1, assembly time for products CM1, CM3, AP and DP is tabulated. The first column shows all the controller products per configuration, following by the layout time in the second column. In this column the amount of time the employee takes to layout all the components on the mounting pan and mark their locating to finish by drilling and tapping these ones is collected.

Table 1
Heat Trace Product Assembly

Heat Trace Product Assembly Time			
Products (configurations)	*Layout Time (days)*	*Wiring Time (days)*	*Total Time (days)*
CM1-12	2.00	2.00	4.00
CM1-24	2.50	2.50	5.00
CM1-32	2.50	3.00	5.50
CM3-8	3.00	3.00	6.00
CM3-16	3.00	3.50	6.50
CM3-24	3.00	4.00	7.00
CM3-32	3.00	4.50	7.50
AP-12	1.00	1.50	2.50
AP-30	1.00	1.50	2.50
AP-42	1.00	1.50	2.50
DP-12	1.00	1.00	2.00
DP-30	1.00	1.00	2.00
DP-42	1.00	1.00	2.00

The third column shows the time it takes the employee to connect all components, followed by the total assembly time in the last column. The AP and DP enclosures aren't considered critical products, since their total time isn't greater than 3 days. This project is emphasized specifically in CM1 and CM3 enclosures, since their total assembly time is in the range of 4 thru 7.50 days. An important key of this table is the increase of assembly time in regards to products configuration.

The reader may wonder why the design time in CM3 product is the same in comparison to CM1's. The reason is, because no matter the configuration, the employee has to drill all the mounting location holes for the components. This is done so customers can expand their configuration without the need of drilling the mounting pans in the field.

Products Demand

The product demand technique was used to identify the amount of product sold per system from 2011 thru 2014, in regards to the Monitoring System,

Circuit Management Panel and Power Management Panel. As shown in Figure 1, the products demand for AP, DP, CM1 and CM3 configurations; sold from January (2011-2014) are tabulated. The first column shows the AP product, which was one of the best sellers with a total of 70 units, followed by the CM1 in column 3 with 62. The next product in line with a decent demand amount is the CM3 in column 4 with 37, followed by the DP with 9 units in column 2. Even though the AP was one of the best sellers, this project will focus only on CM1 and CM3 products.

Identification of Components Lead Time

As in product demand, information from the organization data base was used for the identification of components lead time. As shown in Figure 2, lead time for the components used on the mounting pans are tabulated in regards to days. The first three columns in red show the lead time of the CM1 components, followed by the CM3 components presented as dark red. The column in green represents the component which both CM1 and CM3 have in common. All the components shown in Figure 2 are represented as alphabetic letters to keep organization confidentiality.

Mounting Pans Lead Time per Products

As in product demand and components lead time, information from the organization data base was used for the identification of mounting pans lead time. As shown in Figure 3, lead time for the mounting pans of the CM1 and CM3 products are tabulated in regards to days. The CM3 mounting pan is the latest to arrive with a 21 day lead time. The CM1-24, 32 & 48 circuits have a lead time of 15 days. The CM1 -8 &12 circuits have a lead time of 7 days.

Mounting Pans Standards

Mounting pans standards is one of the most important steps in this project, to reduce assembly time of heat trace area. The author was assigned the creation of construction drawings for the configurations of CM1 and CM3 pre-drilled mounting pans in AutoCAD. Once all drawings were accomplished, these were submitted to planning department for their purchase. The effectiveness of these mounting pans were tested for drawing accuracy and assembler feedback, as follows:

- **Drawing Accuracy:** Drawing accuracy was tested once standard pre-drilled mounting pans arrived to the facility. The test was conducted by installing components from a test unit used by engineering department on the pre-drilled mounting pan. The findings were that 97% of the pre-drilled holes were accurate, with a margin error of 0.25" (in some specific holes.
- **Assembler Feedback:** The assembler feedback to the Engineering Department was to eliminate some holes that were accurate, but at the same time difficult to drill, once the components were installed. There are some sensors cards that need to be installed on top of plastic rail tracks and screwed to the mounting pan. The issues here is that holes already pre-drilled to hold the plastic tracks on place were accurate, but when the mounting track was installed to the mounting pan, it covered the holes which were already pre-drilled and assigned for the sensor cards. This forces the assembler to guess where the pre-drilling of the mounting pan is, to proceed and drill the plastic rail track and match the one in the mounting pan. Based on the employee feedback, these specific holes were deleted from the pre-drilled mounting pan for easy installation. Drawings were modified immediately for 100% accuracy and a second purchase was submitted for the pre-drilled mounting pans.

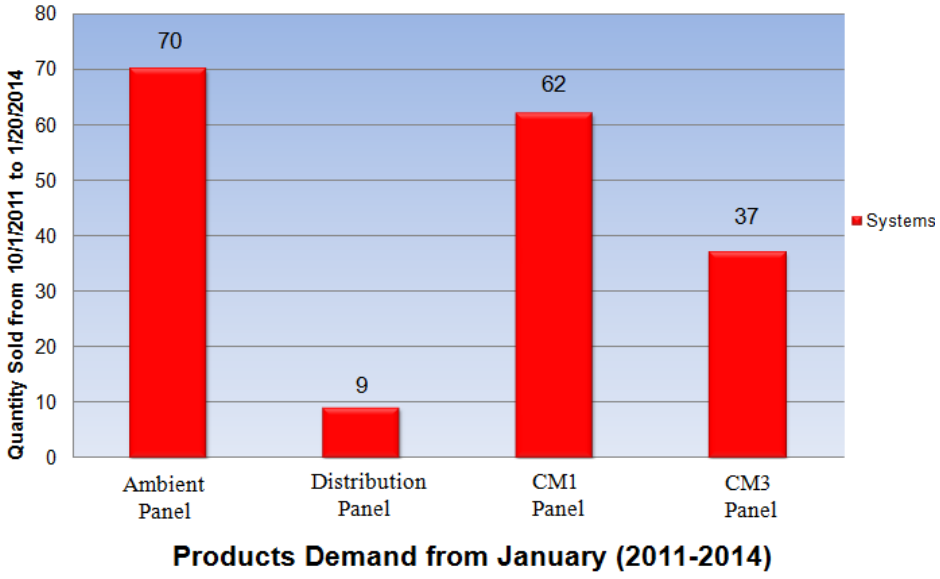

Figure 1
Product Demand from January (2011-2014)

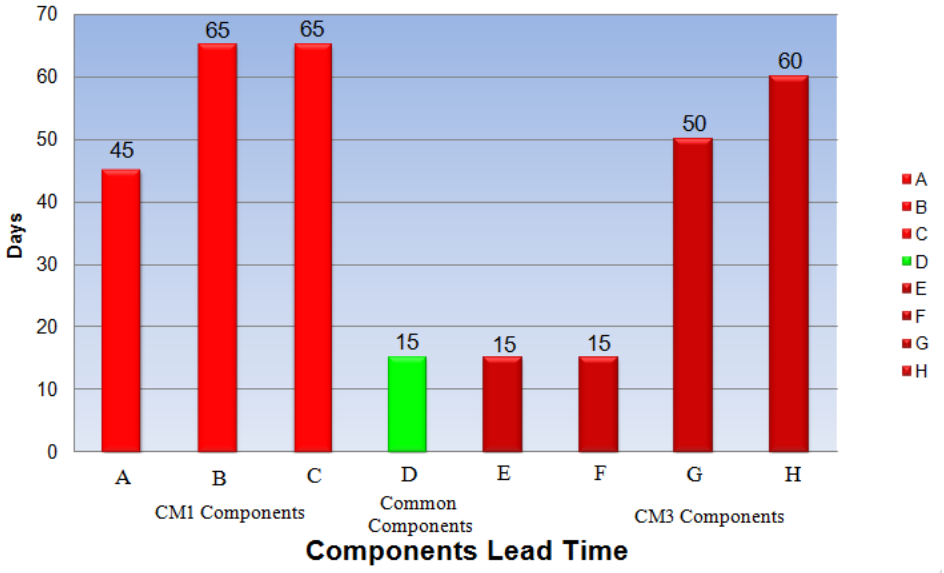

Figure 2
Components Lead Time

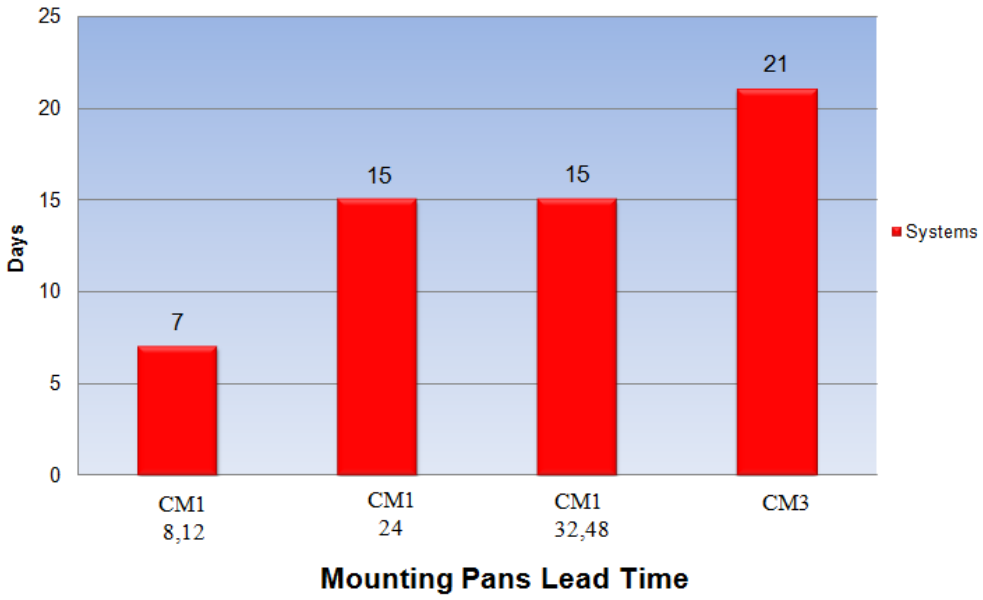

Figure 3
Mounting Pans Lead Time

CONCLUSION

As discussed at the beginning of this project, multiple objectives were established and one by one these once were accomplished. The assembly time study was accomplished by performing an interview to the assembly employee, followed by identification of product demand gathered from the organization data base. The third and fourth objectives of components and mounting pans lead time was executed in the same way as the products demand, by gathering information from the organization data base. Finally, the drawing creation in regards to the mounting pan standardization was accomplished by drawings creations in AutoCAD. Headers and Footers are not allowed in the document.

The findings of this project are that, if components that have high lead time and are used in demand product can be stocked for fast availability, the assembly time can be reduced. Also, by ordering standardized pre-drilled mounting pan, assembly time can be reduced from 2 to 3 days.

The actions that need to be taken in the future will be to find a way on how to standardize the combo enclosures products. The combo enclosures are a combination of a CM3-DP, CM3-AP, CM1-DP or CM1-DP. This task is a challenging one, since all the combo enclosures are built to customer request. Also, based on the data collected from components demand, planning department can perform a price study to determine if is cost effective to stock components or analyze alternate distributors. Another alternative that can be looked at is the investment of a new machine that can performed the drill and tap to the mounting pans, instead of buying these once outside.