Automation of Guidewire Packaging Lines at ABBOTT Laboratories Vascular Division

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Abstract *— With the increasing demand for guidewires worldwide, Abbott decided to make changes in the manufacturing line in order to meet these demands. In an evaluation of the manufacturing process, they considered that the area that needed the most improvement was the packaging lines. Therefore, the assignment was to make the packaging lines faster. Various alternatives for each module were evaluated in order to give the company more choices to match their specific needs, including different machinery layouts and various changes in their process in order to make it faster and more effective. All the options were analyzed and the one which suited the company the most was putting two labelers, one for the box and one for the pouch. It was also decided to eliminate the printed instructions from inside the packaging and indicate on the label that the instructions could be found on the company's website. A tab used to identify the guidewire was also eliminated and instead use a color code on the dispenser matching the color of the product label.*

Key Terms *— Automation, Guidewires, Instructions, Tabs.*

INTRODUCTION

Abbott Vascular PR, located in Barceloneta, is a medical device company dedicated to the manufacturing of guidewires. Within the guidewire manufacturing areas, there are 3 main non automated packaging operations. Abbott Vascular PR is interested in considering an automated process to reduce labor cost and improve productivity and efficiency. This will provide more production of the guidewires which are in constant growing demand every day.

PROJECT OBJECTIVES

-Propose options for automated packaging process that fit Abbott Vascular needs.
-Perform calculations of Benefits and Return of Investment.
-Design a strategy for the deployment or implementation of automation processes.

CURRENT SITUATION

The current situation is illustrated as Figure 1 and the manufacturing area where this activities are perform is illustrated as Figure 2.

It is shown that after the guidewire is fabricated and put into its protective plastic coil as show in Figure 3, a tab as Figure 4 with the number of the wire is inserted on a clip on the plastic coil. Then the guidewire is put in a bag as Figure 5. To the bag are attached a label as Figure 6, with the product name and in the backside the instructions as Figure 7, of the product. Next, the bag passes through a machine with a conveyor belt that seals the top of the bag thermally. Then the guidewire package has 4 barcodes that are scanned that include the information of the number of the wire, number of the package, the number of the instructions and tab number. After 5 guidewire s are scanned, they are put in a box as Figure 8. This box also has a label with two barcodes. The barcodes is used to count the box and it also contains the number of the box. Then a piece of tape is used to

seal the box and put into a cart. When an accumulation of *x* boxes is reached, it is transported and packaged into the final box in another area. [1]-[3]

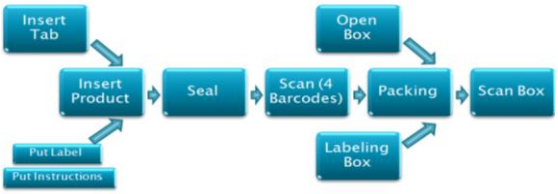

Figure 1
Block Diagram of process step

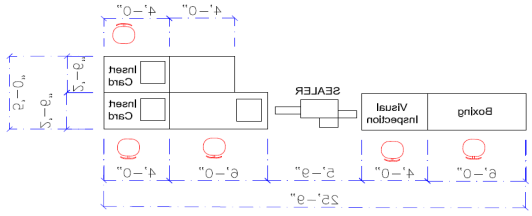

Figure 2
Actual Layout

Packaging Process Parts

Figure 3
Guidewire in dispenser

Figure 4
ID Tab

Figure 5
Pouch

Figure 6
Product Label

Figure 7
Instructions

Figure 8
Box

Time Study

To measure or to define a progress, it was require setting a present situation to compare. Each step of the process was evaluated and was measure in the time consuming. After summering and the time, the steps were given the percent of time of the complete packaging process. The results of this analysis are represented in Table 1 and Figure 9.

Table 1

Time Study for the Packaging Process

Step	Task Component	% of the Process
1	Fit the guidewire tab to the dispenser	12
2	Label pouch with guidewire information	10
3	Label pouch with guidewire instructions	21
4	Put the guidewire inside the pouch	12
5	Put the product into the sealer machine	5
6	Seal the pouch	12
7	Quality visual inspection	12
8	Labeling product box	3
9	Scan barcodes (5 units)	7
10	Put 5 units in the box and close it	6

Pre-design Alternatives

Illustrated in Figure 9, is the bar graph of the Table 1, it is demonstrated the steps that take the most time in the process, and these are the step 3. Label the pouch with the guidewire instructions and the step 1. Fit the guidewire tab to the dispenser. By focusing in these two (2) steps, the improvement of the process can be 33% of the total time of the packaging process.

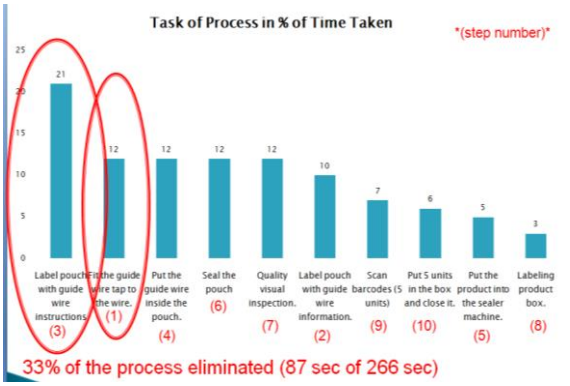

Figure 9
Task of process in % of time taken

ALTERNATIVE SOLUTIONS

It was proposed to first divide the automation into two modules as shown in Figure 10. Then to change the way the two steps are done, therefore saving time in the process. These steps are the ones which take the most time in the process: putting the instructions on the pouch and putting the tab on the guidewire.

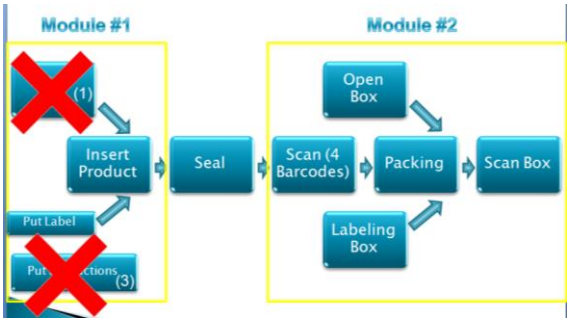

Figure 10
Process divided into modules

Module #1 Alternatives

Instructions Alternatives

The step of attaching the Product Instruction is the most time consuming step since currently every pouch require an Instruction. The Instructions have a cost $0.85 each. In a short term improvement, it is proposed that the Instruction should be attach to the box. This method will use only one instruction instead of five. Also this step is done manually and is suggested to add a labeler machine to work this step. By applying this suggestion, the packaging process time will reduce 17-19% and the scrap produce by this step will reduce 10-20%; expecting a saving $1.3 million. This change was not continue since sometimes the guidewire are sold separately.

Another alternative with the Product Instruction, as a long term, is to remove the Instructions from the pouches and adding them to the web page of the company. The web page address of the Instruction will be printed in to the label of the product. By applying this suggestion, the packaging process time will reduce 21% and the scrap produce by this step will reduce 10-20%; expecting a saving $1.5 million in instructions and around $30,000 in labor cost. This change will require having FDA approval.

Overall the implementation of this strategy will be for 3 manufacturing lines. The expected benefits are 1.5 to 4 million saving per year and a $30 to $200 thousands saving in labor cost. The investment will require a drafter to process the documentation and the return of investment will be in less than 1 month (after implementation).

Tab Alternatives

The step of attaching the ID Tab is the second most time consuming step since currently every guidewire require a Tab. The ID Tab have a cost $0.10 each. It was proposed that the ID Tab should be eliminated since its purpose is for the Doctor to recognize which guidewire but during surgery the Doctor does not use a variety of these guidewires. By applying this suggestion, the packaging process time will reduce 12% and expecting a saving $130-140 thousands.

Another alternative with the ID Tab, to use a color code in the dispenser coil which matches its label color to properly identify the Abbott product without the need of the paper tab having an more ecofriendly option. An example of the color coding of guidewire is shown in Figures 11 and 12. [4]

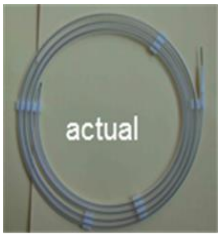

Figure 11
Actual dispenser

Figure 12
Green dispenser color code

Overall the implementation of this strategy will impacted 3 manufacturing lines. The expected benefits are 130 to 450 thousands saving per year and a $15 to $60 thousands saving in labor cost. The investment will require FDA approval and a drafter to process the documentation. The return of investment will be in less than 2.4 month (after implementation).

Labeler Alternative

As the current situation, the labels that are attached to the pouches are manually placed. This step is a great area of improvement since a manual process is slow and can produce more a greater quantity of rework or scrap. Also in the current situation the label placement has to be pre-work, creating an inventory in the manufacturing line. This inventory requires space and operators have to produce this inventory prior to the work shift. Therefore, a reduction in wasted labels, increase label placement accuracy and labor saving time in operations.

Automating this process will demand a labeler machine. Acquiring a labeler machine will have an initial investment, a consideration of energy consumption and maintenance costs. A labeler machine works by rotating two shafts at the same speed in opposite directions with the label paper passing through some other shafts to keep it stretched. One shaft feeds the label and the other collects the scrap from the roll. The label is then attached to the product when it passes under the applicator. The applicator of the labeler machine comes in four (4) different methods. An example of the labeler machine is shown in Figure 13 and examples of the applicators are shown in figures 14-17.

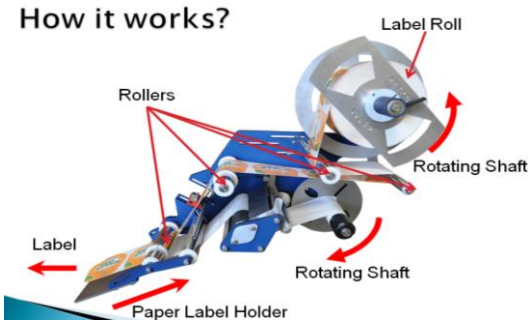

Figure 13
Automatic Labeler, How it Works.

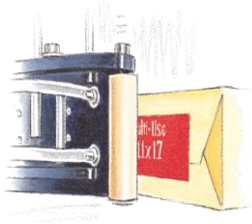

Figure 14
Roller (Roll-on)

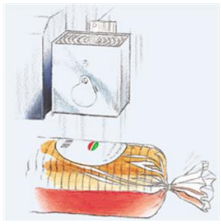

Figure 15
Air pressure (vacuum) applicator

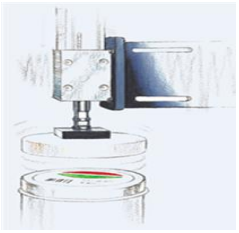

Figure 16
Tamp

Figure 17
Wipe (brush) applicator

The applicator that will be more effective to apply the labels to the pouches is the Roller, as per Figure 14. This applicator can a label vertically and horizontally with a high precision of 1/16 tolerance. It typically applies to irregular and/or fragile products, packaged goods, cases, and cartons; it can place up to 25 labels per minute. This type of application requires a conveyor with suction belt to retain pouch in its place.

In the search for a Labeler machine, the Paragon Labelers Company was contacted. The company was notified of the requirements of the process and the alternatives preferred. Paragon Labelers Company supplies a model that can meet the requirement of the process. An example of the labeler machine is shown in Figure 18. [5]

Figure 18
Pouch Labeler

The product information that Paragon Labelers provided is that the system includes a PLS-420 plus label applicator will utilize a Zebra 173PAX4 right hand print engine with Maple Systems Touch Screen Display. It complies with the vacuum conveyor and the roll-on applicator module. It has a product detection sensor; this will assist the process when feeding the labeler machine. However the labeler machine model provided requires electrical 110/120 VAC, 20A power and pneumatic 80 psi, 33 air connection utilities: [5]

Module #2 Alternatives

The alternatives for the Module #2 will consist in automation the box labeling and the box opening. The box labeling will be another labeler machine similar to the pouches but dedicated to the boxes. Paragon Labelers was also consulted for the box labeler and the machine propose was a model with minor changes, as shown in Figure 19.

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Figure 19
Box Labeler

In the search for a Case Erector machine, the Pearson Packaging System company was contacted. The company was notified of the requirements of the process and the alternatives preferred. Pearson Packaging System company suggested a model that can meet the requirement of the process. Automation this step of the packaging process will reduce labor cost, avoid wasted boxes and increase productivity of the manufacturing line. Acquiring a case erector machine will have an initial investment, a consideration of energy consumption and maintenance costs.

The best alternative suggested for our process since opens the box with the help of a metal bar and opens the boxes vertically. Implementing the case erector machine will be a fast tool-less set up. The guidewire can be drop into the box and can perform up to 10 cases per minute. An example of the Case Erector machine is shown in Figure 20.

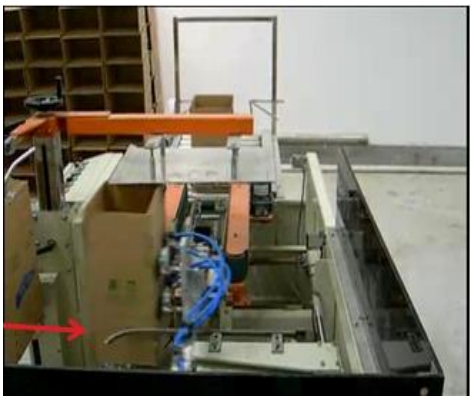

Figure 20
Case erector

Label Inspection

Another step of the packaging process that can be optimized is the barcode scanning inspection. The optical character recognition device checks the legibility of the label to ensure proper reading and minimize label waste. The device has a high speed capacity and an omni directional reading capacity. This device will reduce inspection time significantly and they are easy to step up. It will require some programing, maintenance and calibration. An example of the optical device is shown in Figure 21.

Figure 21
Optical Reader

Conveyor Belts Alternatives

Part of the automation process, the new equipment has to be connected to pass the product form one station to the other. The conveyor can transfer the product. The Dynacon Company was contacted and proposes solutions for the project. The company suggested three (3) utilizations for the conveyors. The first option is to use a photo eye that will count (5) guidewire and then stop the conveyor. When the operator wants to restart the conveyor, he steps on a footswitch. The other option is to have a footswitch that will start and stop the conveyor. The operator will count (5) products and step on the footswitch to stop the conveyor. When he wants to restart the conveyor he, again, steps on the footswitch. The last option is to use a palm button that will start and stop the conveyor. The operator will count (5) products and push the palm button to stop the conveyor. When he wants to restart the conveyor he will pull the palm button back out. [6]

Dynacon Company provided the conveyor information and specifications. The conveyor has a motor drive 8065 S Std variable speed ext 58 fpm, a belt surface 7104 24" wide by 10 feet long and it has leg support castered 36" inches. An example of the optical device is shown in Figure 22. [6]

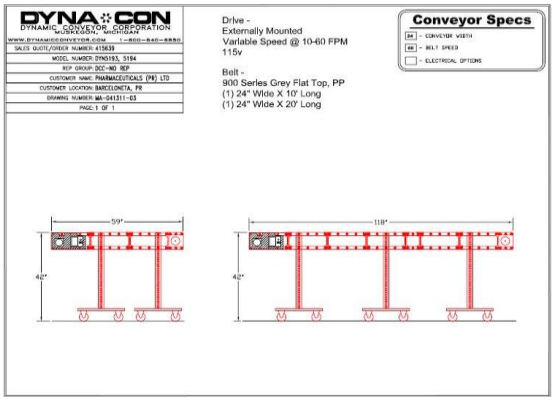

Figure 22
Conveyor Belts

COST ANALYSIS

The cost analysis was focus in the short term proposes and some of the suggestions will be postponing it as long term arraignments. This project generates significant cost avoidance. It will reduce five (5) head count, avoiding around $400,000 in annual salary. The expected return of investment is 7.1 months after implementation. The details of the cost analysis are as shown in Table 2.

Table 2
Total Investment Costs

Investment	Cost
Pouch Labeler	$43,375.00
Pouch Labeler Spare parts	$820.00
Pouch Labeler Training & Installation	$5,125.00
Box Labeler	$43,490.00
Box Labeler Spare parts	$820.00
Box Labeler Training	$5,125.00
Stationary Scanners (3)	$1,050.00
Conveyor	$2,500.00
Conveyor Sensors (1)	$1,500.00
SubTotal	$104,000.00
Validation Cost (15% of subtotal)	$15,600.00
Total	$120,000.00

PROPOSED LAYOUTS

Adding all the equipment suggested for this project produces the concern about the layout of the manufacturing line. Many layout where propose for the equipment, the Figures 23 and 24 are the preferred layouts, the final decision will be taken after the equipment is onsite.

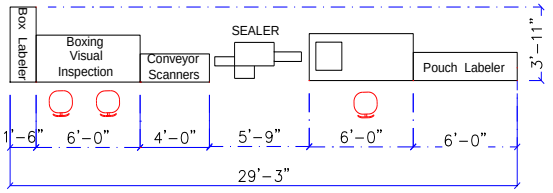

Figure 23
Linear Layout #1

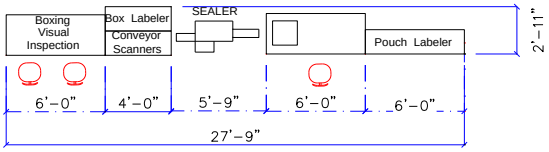

Figure 24
Linear Layout #2

CONCLUSIONS AND RECOMMENDATION

After a careful analysis of the various alternatives found, the one which fitted best the needs of ABBOTT Vascular guidewire packaging lines is to modify two processes, these being how the instructions are placed on the product and eliminating the tab. Now the product label is going to have the website for the consumer to go online and retrieve the instructions for the product therefore eliminating waste and saving time. It was propose to change the tab for identifying the Abbott product by instead using a color code in the wire dispenser, also eliminating waste and saving time during the process. The other major changes is to make the labeling of the pouch automatic making it faster and more precise the placement of the labels eliminating greatly the need to waste pouches which labels are not properly placed. Also automate the labeling of the box with another labeler also saving time in the process.

A research of different equipment and manufacturers and have come with some basic quotes on the equipment which is going to be used on this project. The prices have been reasonable on the budget and on the expectative of the company. After making the return of investment calculations, the investment is estimated to be $120,000.00 dollars and would be making a profit in 7.1 months after implementation.

It was decided not to implement module 2, the case erector because the time it was saving was minimal and the cost of the machinery was too much, it would have bring more problems that it solved.

Some other recommendations for the company is to install the Optical Character recognition scanners which save on inspection time and reduce the wasted labels problems and re-work. Also in the future it is better to take the packaging lines out of the clean room environment. The benefits for this will be to: unite all the packaging lines into one, reducing the space needed for packaging. Another benefit is that they will be able to change the packaging box to a cheaper one without the clean room treatment. There will be more space for accommodating product outside of the building. The transportation from there to the truck will be an easier one. And finally there will be less clutter inside of clean room, making more space for people to move or to put more people in the manufacture of the guidewire.

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