Blends Meat Stick Length Optimization

Hector Castro Lebron
Master of Engineering Management
Dr. Héctor J. Cruzado
Graduate School
Polytechnic University of Puerto Rico

Abstract *— Deli meat production is a continuous process which has more than one hundred variables that can affect the product. Through the implementation of Lean Six Sigma's Define, Measure, Analyze, Improve and Control methodology, helped understand the interaction of variables to optimize the length of blends deli meat stick and reduce meat rework. Particularly, the data collected benefit from the use of statistical process control tools to identify variation in the stuffing production line and predict the performance of the slice production line. As a metric of success, the results display how the slice production line improve the process capability index from 1.13 to the global baseline of 1.33 using three factors: temperature, time, and length in the stuffing production area. Finally, a new factor, "the position of the slide blade", that can be evaluated to gain more efficiency in the slice production lines was introduced,*

Key Terms *— deli meat slice production line, deli meat stick length, Lean Six Sigma methodology, process capability index*

INTRODUCTION

Deli meat companies are always looking for ways to improve their unique process to be competitive, to achieve or stay as consumer number one selection. Deli meat processing companies in the U.S, Midwest are no exception. The business unit two of a recognized meat processing company in the Midwest produces about 945,000 deli meat sticks per year of different stock keeping units (sku's) and uses specific program to increase efficiency. However, in recent years, the unit has seen an increase in meat rework and a decrease in stack unit per meat stick in all stock keeping units.

One of those stock keeping unit (sku) is blends deli meat 16 oz or known as sku 966. Blends deli meat represents 26 % of yearly production, 35% of overall meat rework and stack unit average loss of 1.5 units per stick. Through the implementation of Lean Six Sigma's Define, Measure, Analyze, Improve and Control methodology, helped understand the interaction of variables to optimize the length of blends deli meat stick and reduce meat rework.

LEAN SIX SIGMA METHODOLOGY

Lean Six Sigma is a methodology that can be used to assess a process and to reduce defects and improve quality [1]. Because of how is structured, different tools can be combined like statistics and on-the-floor observations. This section reviews each phase of the methodology and the tools used to optimize the length on blends deli meat stick.

Define Phase

In this phase, the problem to be solved is defined. For business unit two, the problem was meat rework and inconsistency in length. However, more information was required to identify and establish the scope and problem statement. Therefore, meetings were scheduled with the stockholders and process owners to discuss further the problem and establish a team. Historical data was collected to identify the behavior of the different sku's, directing the big offender as sku 966 (blends deli meat 16 oz). Figure 1 presents measurements of blends deli meat stick length and Figure 2 presents measurements of blends stick waste length.

The problem statement was defined as: Average stick length for SKU 966 (Blend Deli Meat 16 oz) is 70.29 inches which is converted to 34 stack units After meat stick is slice and pack, the average waste per stick is 4.25 inches send to rework.

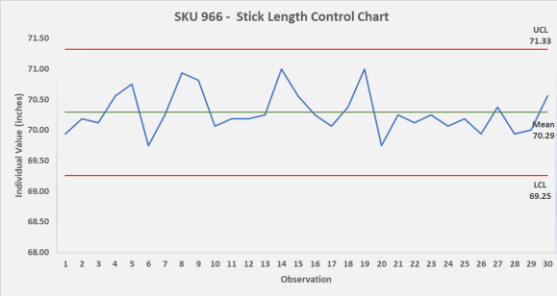

Figure 1
SKU 966 – Stick Length Control Chart

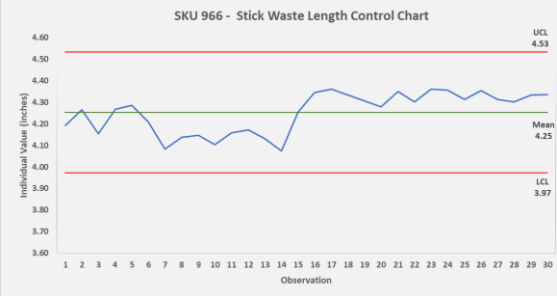

Figure 2
SKU 966 – Stick Waste Length Control Chart

Measure Phase

Deli meat production is a continuous process which has more than one hundred variables that can affect the product. In the measure phase, the data collection of all variables was considered. For data to be accurate, the measurement system was evaluated using Gage R&R analysis, as shown in Table 1. The total gage R&R percent was 10.49, meaning the measurement system is acceptable. An interesting data was the part-to-part indicated 89.51 percent, meaning the variability of the measurement is due to different parts (product). This confirmed one hypothesis that was furthered analyze.

Table 1
Gage R&R Variation Results

	Var	*%*	*Std Dev*	*%*
Total Gage R&R	1.258369	10.49%	1.121770	32.39%
- Repeatability	0.893251	7.45%	0.945119	27.29%
- Reproducibility	0.365118	3.04%	0.604250	17.45%
-- Operator	0.200877	1.67%	0.448194	12.94%
-- Op*Part	0.164241	1.37%	0.405266	11.70%
Part-to-Part	10.73729	89.51%	3.276781	94.61%
Total Variation	11.99566	100.00%	3.463476	100.00%

Two production lines (F1 and F4) are dedicated to process all blends deli meat sku's. Data collected does not reflects any noticeable difference between lines. F1 production line was taken as focus point. F1 process flow has fourteen stages; but the data-driven approach was from stuffing process area to slice lines area. Figure 3 shows in red the 5 stages related to stuffing and slice process.

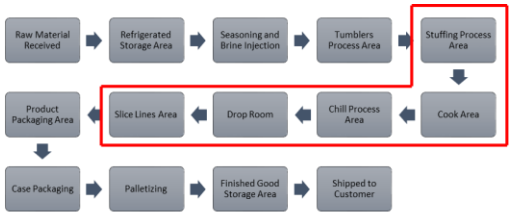

Figure 3
Data-driven five stage approach

Process capability analysis was performed for the 5 stages with the process capability index (cpk) calculated and compared with the global standard of 1.33 [2]. The noticeable variation was in the stuffing production line and the slice production line. Figure 4 and Figure 5 displays the variation analysis of this production lines. The stuffing production line had a cpk of .769 and slice production line had a cpk of 1.129 both below of the global standard of 1.33 for similar lines. As the stuffing production line begins the process for the data-driven flow approach and had a lower cpk, the adjustment made will affect the rest of the stages.

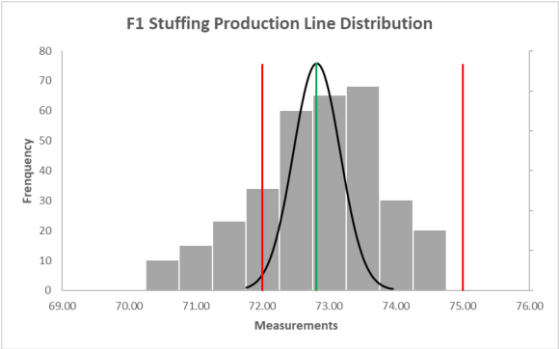

Figure 4
F1 Stuffing Production Line Process Capability

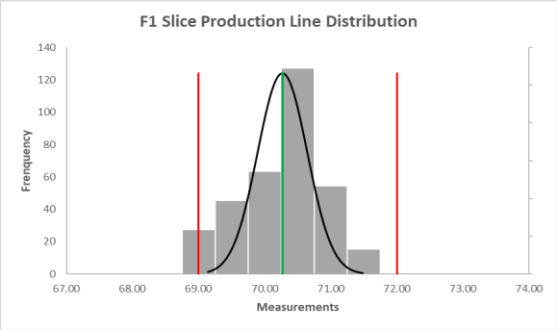

Figure 5
F1 Slice Production Line Process Capability

Analyze Phase

As the focus point arose to be the stuffing production line, a design of experiment was performed using the three major factors that affect the outcome of the stuffing line. Those factors are temperature, time, and length. The statistical approach was using a full factorial design; Figure 6 summarizes the full factorial experiment for the stuffing process area. The experiment indicated that all factors affect the product outcome on the slice area. However, the interaction between temperature and length from the stuffing process was the most noticeable.

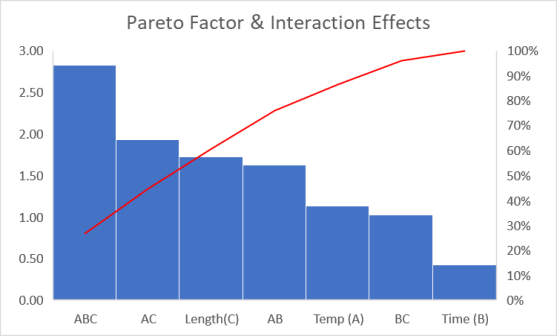

Figure 6
DOE Full Factorial Experiment Results

To minimize this interaction a detail review of the stuffing stick length was established. Figure 7 displays the length effects. The main observation was as the stuff stick length is higher the product slice stick shrinks percent is higher.

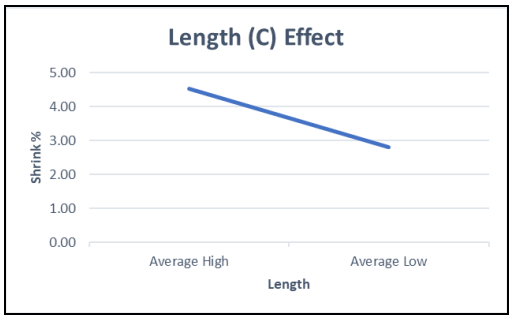

Figure 7
DOE Length Effect Results

As part of the stuff stick length effect analysis new settings were established, for a large production run of blends deli meat sku 966. Those settings were Time: 12 hours of cooking time, 32 F on meat mixture temperature and a set stuff stick length: 72.75 ±.5 inches.

Improve Phase

A large production run for sku 966 (blends deli meat 16 oz) was scheduled with the new settings. Figure 8 and Figure 9 displays the variation analysis with the new improvements in the production lines. The new data collected show an increase in the process capability index for the stuffing production line of 1.088. Furthermore, the stuff stick length was consistent in the range measurement of 72.25 to 73.25 inches. As the cpk increase in the stuffing production line, it consistently increases in the slice production line with a new cpk of 1.35 reaching the global standard goal. The blends deli meat stick length was consistent at 70.75 to 71.25 inches. Moreover, data show a decrease on meat rework from 35 % to 28 % overall blends meat.

The stack per stick unit still was inconsistent; in some batches, a whole stack was slice and in others was different. Because of this data a new factor was introduced the position of slice blade.

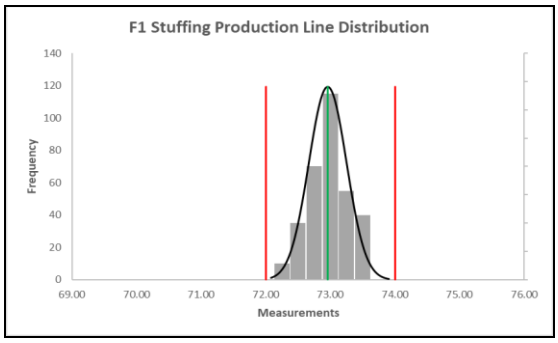

Figure 8
F1 Stuffing Production Line Process Capability – Improve

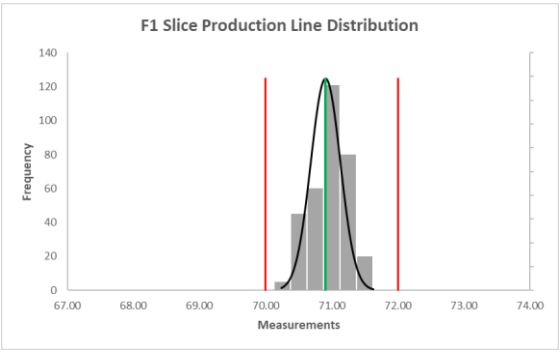

Figure 9
F1 Slice Production Line Process Capability – Improve

Control Phase

In the control phase the standard operation procedure was changed with the new settings and limits. A meeting and a walkthrough with the process owner was organized to show the new baseline identification and visual management in the stuffing production lines included in F1 and F4.

CONCLUSION

The data collected benefit from the use statistical process control tools to identify variation in the stuffing production line and predict the performance of the slice production line. As a metric of success, the results display how the slice production line improve the process capability index from 1.13 to the global baseline of 1.33 using three factors: temperature, time, and length in the stuffing production area. Moreover, the overall blends meat rework decreased by 7 %. Savings cost and reduction of meat rework given by the improvement are in final stage of revision from finance department. Finally, a new factor was introduced: “the position of the slide blade”. It can be evaluated to gain more efficiency in the slice production lines

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[2] Toldrá, F (2010). Handbook of Meat Processing, Wiley-Blackwell Publishing