Application of Quality Improvement Tools to a Perishables Food Distribution Center to Reduce Product Return and Improve Customer Satisfaction

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Abstract *— Product Return and Customer Satisfaction have a high impact on the financial, customer service and quality aspects of the food distribution and storage in the perishables food industry. A Lean Six Sigma approach was used to reduce the product return impact and improve the customer satisfaction overall. A significant improvement at the financial and operational aspects was revealed using more than one Quality Improvement tool, including statistical control measure and taking into account the FDA 21 CFR 101.10, USDA and PACA standards that regulates the industry. The implementation of recommendations had a positive outcome after only a week of the execution but needed to be controlled for a consistent change.*

Key Terms *— Customer Satisfaction, Lean, Product Return, Quality Improvement and Six Sigma.*

PROBLEM STATEMENT

The project was designed and developed in a company with more than 54 years in the market of perishables foods. The Quality Control Department had an average of 500 to 700 weekly cases of product returns from all its clients, in a three month period. The business impact of these product returns had a minimum impact of $8,000 to $19,000 weekly. The loss revenue was mostly due to sales gone astray and broken customer loyalty. These returns were triggered because of thirteen major product returns categories. Focusing on the top three high impact categories, would have a total benefit of more than $140,000, making for a 40% improvement and profitability in the first six months of improvement.

PROJECT DESCRIPTION

This project was intended to design and develop a quality improvement tool that measures the propensities of product return as a result of quality issues. The identification of these trends will allow to focus the efforts on the products that have a significant impact in the financial, customer service and quality aspects of the perishables food distribution center.

PROJECT OBJECTIVES

Design, develop and document all essential quality improvement tools that aid in making visible the trends of the product return, as well as, building a multidisciplinary team to take on the improvement strategies needed.

LITERATURE REVIEW

This section summarizes the most relevant topics that will be key for the understanding of this article.

Quality Improvement using Six Sigma

Implementing quality initiatives in any business leads to improvements in the performance of the organization through the generation of high quality products and services, and improve efficiency and competitiveness. Hence, the degree of implementation of quality practices is positively related to organizational performance, being the customer typically the key to justify the quality to any quality provider [1]. Yet, small to medium size enterprise appear to not be getting the benefits of such quality initiatives. The most common reason for not implementing Six Sigma is the unawareness of its usefulness. There is the perception that Six Sigma can be a heavily data -and training- oriented quality initiative and this makes it difficult for this enterprises to apply them. Meanwhile, the biggest outcome of applying quality initiatives in any organization is the so-called “change” in which the management and employee behavior supports the effectiveness of quality initiatives.

F. Nabhani et al showed that, according to the nature of the business, the culture interaction is a very important piece in respect of business strategy and relationships in a food distribution of small and medium enterprises and their customers [1]. Food distribution centers must align its quality with different cultures while at the same time a considerable barrage of food regulations must also be considered. The Food Safety Modernization Act (2011), the Perishables and Agricultural Act (PACA) and USDA Standards are some of the federal regulation agencies that oversee and influence the application of Six Sigma in the food distribution. As a consequence, human resources have been a big challenge for this kind of industry when matters of quality are considered, and, furthermore, quality systems are greatly affected by the organizational behavior. It is the organizational behavior characteristics that have the major influence on the quality improvement processes.

The culture understanding and commitment to quality are the major reasons to be less interested to change in the food distribution industry.

Statistical Thinking for Performance Improvement

There is strong empirical evidence that Statistical Quality Control (SQC) methods can be as beneficial to food organizations as they have been within other sector, provided that they are appropriate to the product/process context, and are understood and used in an appropriate way [2]. An understanding by managers of the statistical tools, as stated previously, is required. The methods are observed not to be successfully adopted, used or sustained where there is an absence of such requirement or where motivation is primarily defensive reaction to pressure rather than a desire to truly control and continually improve a process [3]. The motivation for this understanding will create willingness on the part of the management to invest time, efforts and resources to the endeavor; however for some organizations, compliance based and defensive motivation may result in only superficial use of the methods, and for others motivation may be entirely lacking due to the perceived irrelevance or complexity of the methods. Overcoming this requires the provision of information and management skills to create awareness of the methods, their effective use and integration and the benefits and costs likely to be involved.

METHODOLOGY

The Methodology to be used during this project was the DMAIC methodology. This methodology is defined in 5 phases as previously discussed in the literature review and consist on the define phase, the measure phase, the analyze phase the improve phase and the control phase.

During the Define phase a Critical to Quality (CTQ) diagram and a Voice of Customer (VoC) Matrix was developed to focus on the most critical areas in which the Quality Improvement tools need to focus and develop new strategies. This phase will conclude using a SIPOC Diagram to aid in the understanding of the process and to provide the key outputs to consider.

At the Measure phase the behavior of the product return, in its natural unmodified process, was pointed to establish a *Baseline*. Testing of this baseline was carried out for the next months in an effort to appreciate significant changes and its triggers. Pareto charts and graphs were used to establish the major offenders and bring attention to cost-effective measures of high impact products.

For the Analyze phase a list of primary findings was prepared in order to address the immediate factors that needed attention. Those factors do not necessarily involve a Six Sigma approach but instead Corrective and/or Preventive Actions that could improve the common cause while a more structured methodology was developed, if needed. A Cause and Effect (C&E) Diagram will be used to identify the Root Causes and establish priorities. The founding of a multi-disciplinary team was instituted given the complexity of factors involved in the product return customer satisfaction requirements.

The Improvement phase was expected at no more than six months from implementation of the corrective and preventive actions based on the C&E diagram and the execution of the needed Standard Operating Procedures (SOP). The team developed was in charge of designing the strategies using quality improvement tools, to resolve the issues identified. Other Lean Six Sigma tools, such as Visual Management, were used as part of the core of the improvement effort.

The Control Phase included recommendations on how to consistently sustain the improvement achieved, as well as, suggestions on next steps to achieve continuous improvement with the process introduced.

RESULTS

The following information covers the details of the DMAIC.

Define Phase

A Critical to Quality (CTQ) diagram and a Voice of Customer Matrix (VoC) was used to assess the necessary attributes in order of reducing product returns and acquire knowledge of customer requirements. The process, methods and personnel were the key elements to evaluate in order to obtain the Critical to Quality factors and reduce the product return. Refer to **Figure 1** CTQ diagram and **Table 1** for VoC Matrix.

A SIPOC diagram was used in order of develop a better understanding of the steps involving the Process; starting with the product ordering to the final distribution to clients. Identification of key outputs to meet customer requirements and quality compliance was established. Refer to **Figure 2** for Product Order and Distribution SIPOC diagram.

Measure

A Pareto Chart and graph was used to identify the 80:20 distributions of product returns within a three month period of data. The data showed that 13 different categories of products were the major offenders under the quality issues. These 13 products had an impact of $119,038.05 with a total of 4,756 cases of return products. The average amount of product return was between 500 and 700 cases weekly. Refer to **Table 2 and Table 3** Pareto Chart – Three (3) month period, **Figure 3** Pareto Graph- Cases Returned and **Figure 4** Pareto Graph – Cost of Product Return.

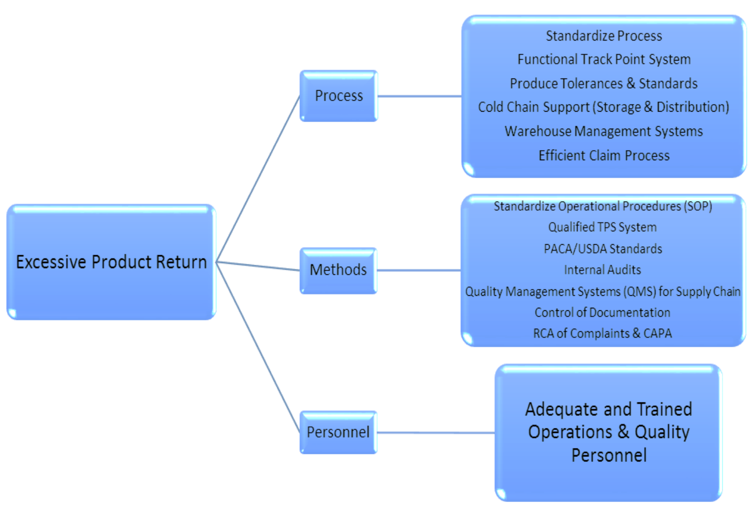

Figure 1
CTQ Diagram for Product Return & Customer Satisfaction

Table 1

VoC Matrix for Internal and External Customer Requirements

Voice Of the Customer Translation Matrix		
External Customer Comment	**Gathering More Understanding**	**Customer Requirement**
Wet boxes or product	Pallet Configuration	Appropiate pallet configuration based on product characteristics
Crushed boxes	Pallet Configuration	Appropiate pallet configuration based on product characteristics
Fluffy product	Quality/Condition	Specifications, better inspections
High temperatures during distribution	Out of range temperature	Appropiate temperature for the product being delivered
Rotten product (grapes)	Quality/Condition	Specifications, better inspections
Late deliveries	Logistics Operations	On time deliveries
Yellow brocoli	Quality/Condition	Specifications, better inspections
Ice on top of the boxes	Pallet Configuration	Appropiate pallet configuration based on product characteristics
Starchy products on the bottom	Pallet Configuration	Appropiate pallet configuration based on product characteristics
Sweet potato and plum on the bottom	Pallet Configuration	Appropiate pallet configuration based on product characteristics
Ripening of tomato	Quality/Condition	Specifications, better inspections
Tall pallets	Pallet Configuration	Appropiate pallet configuration based on product characteristics
Internal Customer Comment	**Gathering More Understanding**	**Customer Requirement**
They don't know what to do	There is no procedure on how to handle situations with external customers	Procedure development and Implementation
There is no communication	Quality Control Department doesn't maintain an open communication on product decisions	Communication on investigations and its results as well as Quality decisions are needed
They don't know what the procedure is, they are alone in quality matters	There is need of specific instructions of the QA/QC Department.	Procedure development and Implementation

Supplier	Input	Process	Output	Customer
Customer Service/Key Account	Product Order		Signed Invoice	Retail Client
Farms/Broker/Purchasing	Raw Material		PO Number	Transit/Quality/Finances
Farm/Distribution Center	Temperature Recorder		Temperature Report	Operations/Quality
CPE/Independent Carriers	Transportation		Product Delivery	Retail Client/Customer
Quality Personnel	Quality Release/Inspection		Product Release	Operations/Sales/Customer Service
Operations	Dispatch		Product Loading	Carriers/Retail Clients/Customer Service

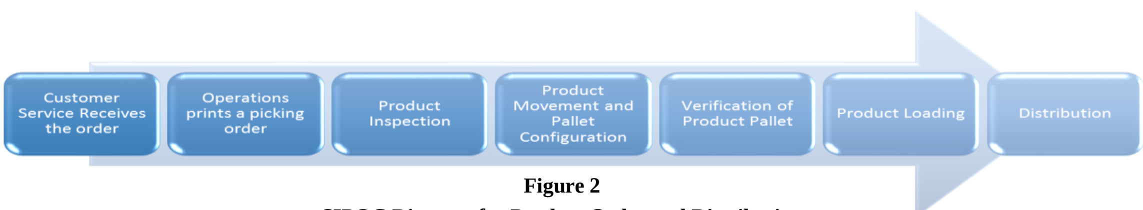

Figure 2

SIPOC Diagram for Product Order and Distribution

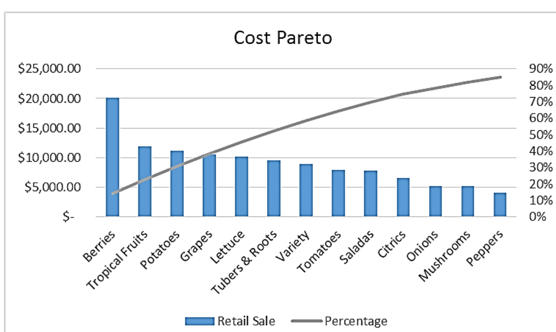

Figure 3

Pareto Graph of Product Return by Cost over a Three Month Period

Table 2
Pareto Chart of Baseline Cost Data over a Three Month Period

Costs Pareto			
Product	**Retail Sale**	**Acumulative Sale**	**Percentage**
Berries	$ 20,081.76	$ 20,081.76	14%
Tropical Fruits	$ 11,933.82	$ 32,015.58	23%
Potatoes	$ 11,097.38	$ 43,112.96	31%
Grapes	$ 10,479.78	$ 53,592.74	38%
Lettuce	$ 10,157.69	$ 63,750.43	45%
Tubers & Roots	$ 9,549.50	$ 73,299.93	52%
Variety	$ 8,965.71	$ 82,265.64	59%
Tomatoes	$ 7,928.28	$ 90,193.92	64%
Saladas	$ 7,768.50	$ 97,962.42	70%
Citrics	$ 6,547.60	$ 104,510.02	74%
Onions	$ 5,234.75	$ 109,744.77	78%
Mushrooms	$ 5,219.79	$ 114,964.56	82%
Peppers	$ 4,073.49	$ 119,038.05	85%
	$ 140,339.80		

Table 3
Pareto Chart of Baseline Data of Cases Returned over a Three Month Period

Cases Pareto			
Product	**Cases Qty**	**Acumulative Quantity**	**Percentage**
Potatoes	603	603	9%
Tropical Fruits	588	1191	18%
Berries	518	1709	26%
Salads	426	2135	32%
Grapes	390	2525	38%
Lettuce	389	2914	44%
Tomato	332	3246	49%
Variety	331	3577	54%
Tubers & Roots	324	3901	59%
Onions	250	4151	63%
Citrics	243	4394	66%
Mushrooms	182	4576	69%
Pepper	180	4756	72%
	6630		

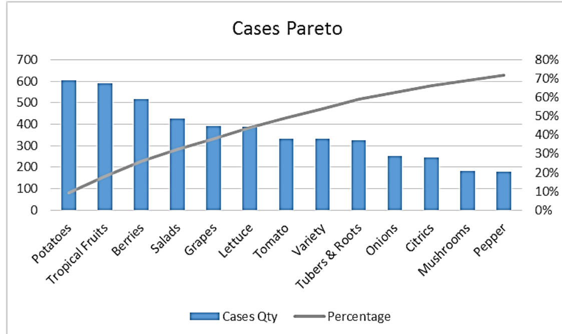

Figure 4
Pareto Graph of Product Return Cost over a Three Month Period

Analyze

During the Analyze phase of the methodology a group of primary findings led to the creation of a Cause and Effect Diagram with the purpose of identifying *Root Causes (RCA)*. The focus was on the established *Baseline* and costs involved. For those primary findings a Corrective and Preventive (CAPA) action list was develop in order to control those findings that did not need a Lean Six Sigma approach. Once the RCA's were identified, the creation of a team was the next step to improve them, as the CTQ and VoC previously showed. Refer to **Figure 5** C&E Diagram Results.

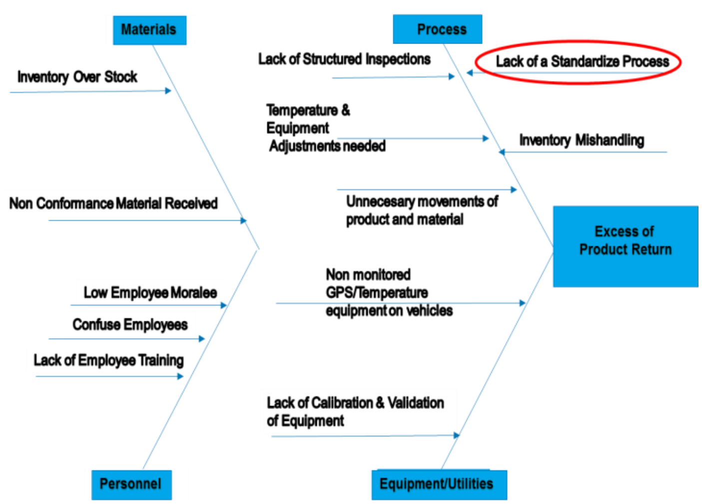

Figure 5
Cause & Effect (C&E) Diagram

Improve

A Continuous Improvement Committee (CIC) was built, in which all the required inputs and strategies could be developed and executed; each department involved in the product return had representation in the CIC. The Cause & Effect diagram showed that standardization of the process was needed. The action plan for improvement was: implement inventory control practices, decide on purchasing movements based on shelf life and product sensitivity, to evaluate the inspection process in the third shift (adding a quality inspector) and improving product handling during dispatch and loading processes, in compliance with product temperature requirements. During the development of the improvement tools, in the Define, Measure and Analyze processes the average of the product return increased up to 2,634 cases returned for quality reasons per week, in a 10 months period, at week 44 of the year. Refer to **Figure 7** Product Return Trend in 2014.

A 5's approach was implemented at the step of receiving product that was returned from the clients in order to facilitate the identification and proper destination of the product return. The space was identified and color coded by lanes, depending on the decision taken when a product return was received. This program helped to maintain product rotation and proper identification.

The product was placed on the lines with pre-established destinations: underprice sales cooler (*Lot Sales*), waste dumpsters, re-inspection lanes or regular sales cycles. Standard Operating Procedure (SOP) and training was developed to all personnel involved in the process of product return. Refer to **Figure 6** 5's Color Code Space Identification.

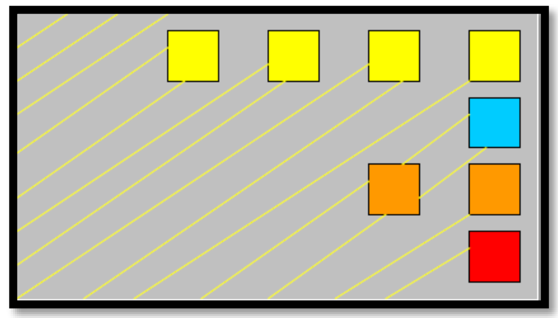

Figure 6
5'S Visual Management Color Coding for Product Returns and Proper Destinations

After five months, of introducing a quality inspector in the third shift, the information about the conditions of the product during dispatch was more accessible and decisions about removing products from pick-up locations were taken before any dispatch of products in poor quality conditions. By week 48, after a week of the implementation of purchasing and inventory control modifications, an improvement was shown, reducing the product returns to 326 cases weekly. Refer to **Figure 7** Product Trend 2014.

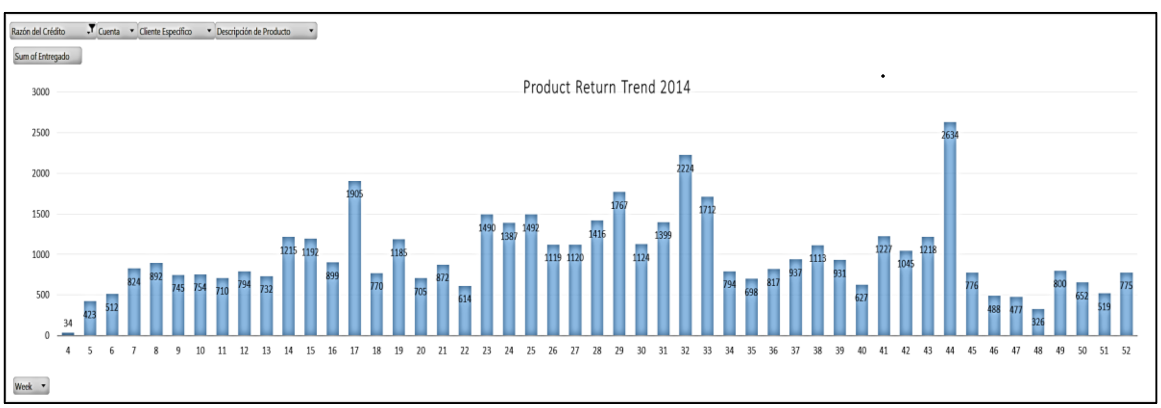

Figure 7
Product Return Trend 2014

Control Recommendations

As the **Figure 7** showed, the trend for 2014 year showed variation for more than one month. It is for that reason that the follow control measures are recommended:

- Implementation of a Warehouse Management Systems (WMS) for Inventory Control and product rotation assurance.
- Announce, distribute and enforce a product return policy and quality policy for all clients and employees in accordance with internal procedures established.
- Analysis of Quality Control and Operations processes and procedures for efficiency and productivity, using statistical tools for confirmation of observations.
- Evaluate all transportation and traffic routes for efficiency and temperature compliance.
- Quality, Sales and Customer Service visits to clients with increased return incidences.
- Create a Purchasing SOP based on shelf life of produce, sales forecast and possible risks taking into account product conditions reported.
- Standardization of Quality Control processes and development of a Quality Management System in accordance with internal customer needs.
- Cross-Training oriented environment in the operational and quality procedures or functions executed.

CONCLUSION

The DMAIC is a data-driven quality strategy used to improve processes. It works as an integral part of Six Sigma initiative, but in general can be implemented as a standalone quality improvement procedure or as part of other process improvement initiatives such as lean.

Critical to Quality aspects were identified and, relating with the Voice of the Customer they were the foundation for the measurement and implementation of improvements designs. The measures gave an impression of the actual situation of the business and established the trend that would reflect not only at the baseline but through the rest of the year measured. This was important since it marked the variation of the product behavior and the lack of control of the operational and quality processes. These measures lead to improve customer satisfaction and increase profitability by reducing waste, product return and costs related to poor quality.

It was imperative to focus on addressing the immediate operational ways to improve operational efficiency of the system as the Fishbone diagram exposed. Therefore, actions were taken to enhance the operational quality and recognizing root causes. Mishandling of the product and lack of controlling critical temperatures (cold chain support) for very sensitive perishables exhibited the first area to focus on, along with personnel training and quality awareness. The Continuous Improvement Committee created (CIC) gave the day-to-day, top management input from their collective wisdom and combined efforts using customer feedback, setting goals and considering the business strategy. The team developed new tactics during the DMAIC weekly discussion.

The evaluation of the existing process encouraged the planning of a new cooler structure and dispatch flow with the addition of a quality inspector, eliminating unnecessary movements and as a consequence preventing mishandling of the product. The statistical base and proper utilization of methodologies provided the CIC with the tools to improve the quality of both the product and the process.

The food industry has been characterized for being conservative and slow to change. Understanding the quality practices requires an understanding of how the consumer and the regulatory environment interact to affect the industry. The difficulties find were due to lack of experience, low level employee ability and unfamiliarity with improvement tools. The organizational behavior and organization makes it challenging to implement a systematic application of quality improvement tools. Despite the distinctive attributes of the food industry, significant improvements were made by the end of the year, reducing product return by more than 1,000 cases weekly and preventing losses of more than $340,000 in profit sales.

After completing the application of the selected quality improvement tools, it was obvious that no tool is effective without compromise or dedication of the team build and management support. With the commitment and active participation of the CIC, the return of products decreased and overall processes improved [3]. The multidisciplinary team efforts combined with top management support and Six Sigma tools were the key to a successful approach.

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