

Lean Six Sigma Implementation in a Small Business Warehouse Inventory Management Redesign

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Abstract

This design project is based on the suggestion to implement Lean Six Sigma concepts, with proper inventory management, in a small business: a local grocery store. This business has served Puerto Rico since 2017, just after Hurricane Maria. Despite being a successful business, there is always room for improvement. That is why inventory management in the warehouse was redesigned. To get there, the five-step DMADV methodology was implemented. After defining the project, the process cycle time and its operational cost were measured. Then, how both were affecting the warehouse inventory management and how they could be reduced was analyzed. In the design phase, the inventory management was redesigned, which provided customer specifications to reduce time and costs. Lastly, to verify the redesign, a prototype was created and presented to the customer.

Key Terms - DMADV, grocery store, inventory management, Lean Six Sigma

Problem Statement

The small business considered in this study is a local grocery store that has successfully served the community for about 4 years. Its owner has always been emphatic on providing quality service to its consumers.

The customer expressed that a proper inventory management process was not in place, specifically in the warehouse. This must start from the moment items are ordered, received from a supplier, stored, and/or placed for sale. Additionally, this is a topic of utmost importance in business terms, since it affects it financially.

Methodology

The methodology selected was Design for Six Sigma (DFSS), or DMADV, which is an acronym for Define, Measure, Analyze, Design, and Verify. It is implemented in Six Sigma projects that aim to design or redesign a new process, product, or service. Table 1 summarizes the methodology by steps, including the tools that will be implemented. Also, a Gant Chart was added every two weeks to estimate the amount of time developing the project would take.

Table 1: Project Timeline

DMADV [7]		Tools	Gant Chart	
			March	April
Define	Determine the project goals and customer requirements (external and internal).	Project Charter VOC		
Measure	Assess customer needs and specifications.	SIPOC Pareto Chart		
Analyze	Examine process options to meet customer requirements.	Brainstorming FMEA		
Design	Develop the process to meet customer requirements.	Process Redesign		
Verify	Check the design to ensure that it is meeting customer requirements.	Control Measures		

Results and Discussion

DEFINE PHASE

Table 2: Project Charter

Project Description	Lean Six Sigma Implementation in a Small Business Warehouse Inventory Management Redesign	
Start and Completion Date	March 2022 – April 2022	
Goals	To implement a proper inventory management. To reduce cycle time and operational costs.	
Benefits	Customer	A quality process to perform proper inventory management while reducing costs.
	Financial	Operational cost reductions.
	Internal Productivity	Redesign of the current process.
Phase Milestones	Define	March 2022
	Consider Lean Tools	Multiple tools
		Dates are set by main DMADV phases
	Measure	March 2022
	Analyze	March 2022
	Design	April 2022
Verify	April 2022	
Team Support	Grocery store owner	
Team Members	Graduate student; grocery store employees	

MEASURE PHASE

Table 3: SIPOC Chart

Suppliers	Inputs	Process	Outputs	Customers
Grocery store employees 50 suppliers	Goods Computer Checklist Pen and pad Organizational skills Customer service		Appropriate inventory management	Grocery store owner

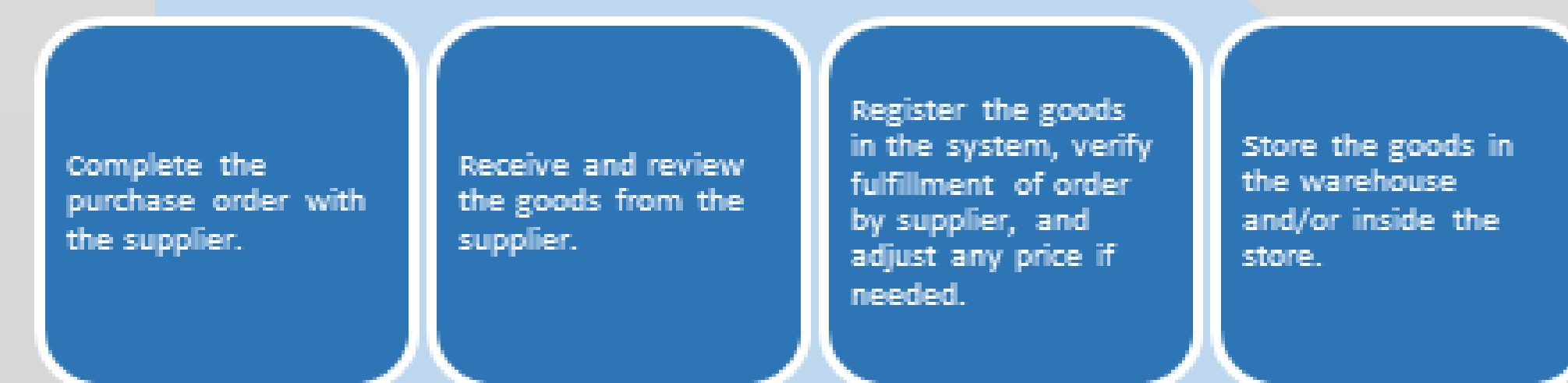


Figure 1: Current Grocery Store Inventory Management Process

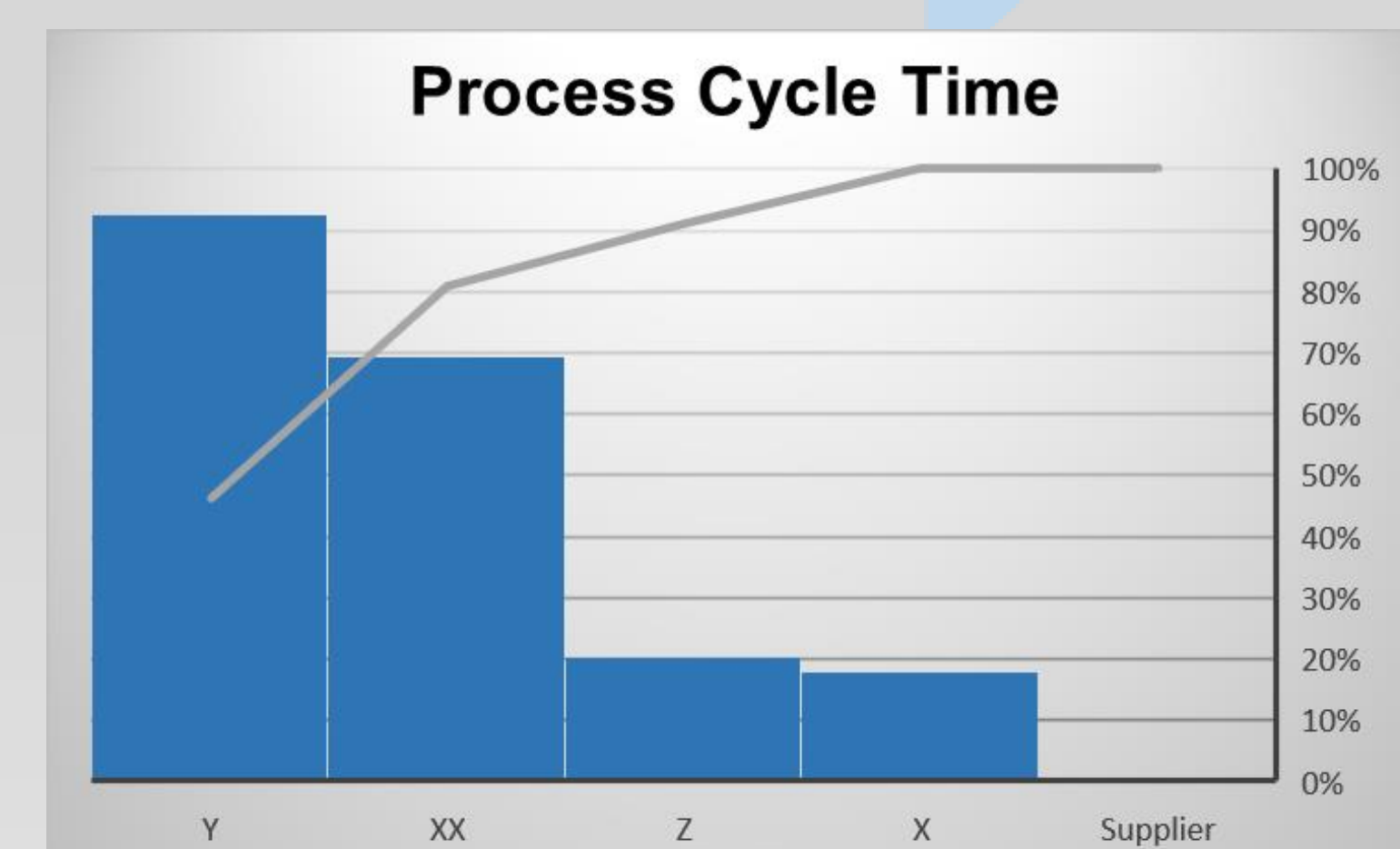


Figure 2: Pareto Chart - Purchase Order (PO) Management Cycle Time per Supplier

ANALYZE PHASE

After the brainstorming, customer requirements were re-analyzed and based on the FMEA results; see table 4. It was determined that the last step of the process was the one causing more issues to the grocery store's inventory management and the one that would be redesigned for the moment.

Table 4: Failure Mode and Effects Analysis (FMEA)

Process & Step	Potential Failure Mode	Potential Effect(s) of Failure	SEV	Potential Cause(s)	OCC	Current Process Controls	DET	RPN
Complete the purchase order with the supplier.	The supplier is not available. The supplier does not have all the products needed.	The order cannot be completed. Product demand cannot be fulfilled.	5	High product demand. Order was not created in advance.	3	Order in advance. Contacting an alternate supplier.	3	45
Receive and review the goods from the supplier.	The supplier arrives at a rush hour, while the employee is busy with customers and cannot attend it quickly. Incomplete purchase order.	Annoyed supplier. Dissatisfied customer.	4	Not having a fixed schedule for deliveries. Supplier did not check the order before delivering it and/or did not inform of product(s) unavailability in advance.	2	Notify suppliers that deliveries will be accepted after 1:00 p.m..	2	16
Register the goods in the system, verify fulfillment of order by supplier, and adjust any price if needed.	Data entry error. Downtime due to employee busyness.	Wrong reports. Loss of money.	6	Lack of concentration, desire to speed up the step and/or lack of training. Multiple tasks pending and/or high customer traffic in store.	2	Based on the supplier's delivery trend, project day and time it will deliver the products and get ready for it.	3	36
Store the goods in the warehouse and/or inside the store.	Lack of space to store the products. Downtime to store goods if employee is busy.	Excess of products. Loss of money.	7	More products than normal were ordered. Multiple tasks pending and/or store high customer traffic.	3	Make purchase orders based on demand and space. Based on the supplier's delivery trend, project day and time it will deliver the products and get ready for it.	4	84

DESIGN PHASE

As part of redesigning the inventory management process, it was considered that the firsts steps that needed to be dealt with were related to the current storage processes in the warehouse; see figure 3.

Therefore, the following was planned:

- Implement a 5S.
- Use the pallets with the longest side alongside the hallway. This increments hallway space.
- Increase storage space (wall-mounted shelves and regular shelves) and reorganize existing space. All heavy products will go in the lower shelves and the lighter ones in the upper shelves.
- Add a shelf in the receiving area for items to be returned to suppliers due to non-conformity or wrong delivered items.
- Add visual management tools (floor safety marking tape and labels) and a fire extinguisher along with a properly identifiable sign for safety purposes. Label codification should be by color, based on family grouping. Also, refer to figure 4 for the label code to identify the bay; it should be identified as follows:

- Bay 01: Yellow (wall mounted shelves)
- Bay 02: Red (pallets)
- Bay 03: Green (PVC/Wooden shelves)
- Bay 04: Orange (metal shelves)
- Bay 05: Blue (pallets)
- Only metal, wood, and/or PVC shelves have more than one level. The levels should start incrementing from the bottom, starting with number 1. The pallets and shelves should be identified from left to right, starting with number 1.
- Implement a common locator system, a combination system due to space availability, and use an inventory control system (LIFO/FIFO), including a physical control (family grouping).

VERIFY PHASE

A Lean Six Sigma briefing was offered to the customer and employees, in which the meaning and purposes of it was explained. Also, we explained how its tools can assist in employing its methodology, how they sustain a lean business and how they should be implemented.

Furthermore, the prototype that was developed, based on the design phase, in an online design program (Floor Planner) was presented. Figure 4 shows the dimensions, how to place the pallets, the shelves, and other elements as described in the previous phase. Also, through the implementation of the 5S, the client will maintain checklists to keep the warehouse properly organized. In turn, visual aids will keep employees alert to maintain proper storage and sustain the inventory control and common locator systems.

However, the customer decided to remodel the grocery store before proceeding to complete the proposed redesign within the warehouse.

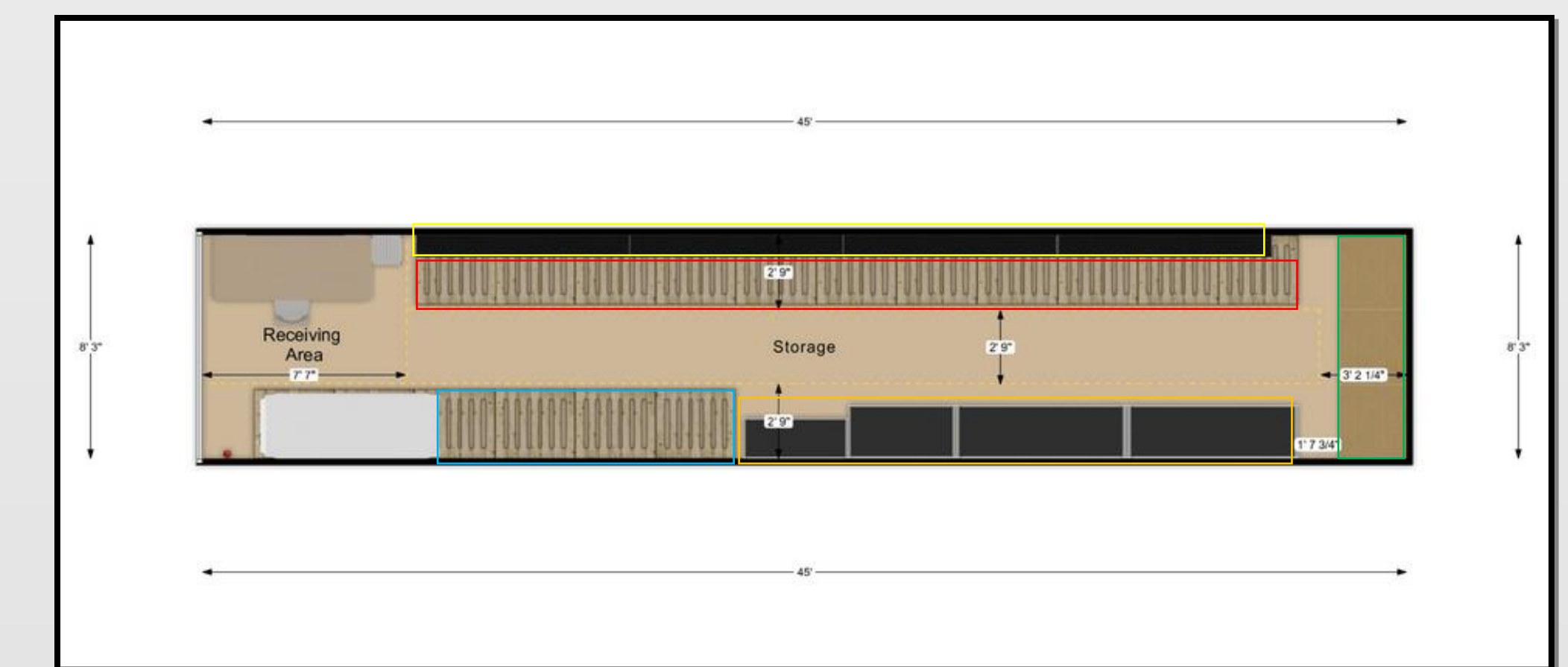


Figure 4: Warehouse Interior, Top View

Conclusion

By redesigning the inventory management of the warehouse through the implementation of the DMADV methodology, it is expected that customer requirements are met. The cycle time should be reduced to an average 69 minutes per purchase order, and this in turn will reduce the operational costs by 20% (\$8.07) or even less. Also, one of the client's requirements was to not lose products and/or sales due to poor inventory management, which should be met with the sustainability of the inventory control and common locator systems, and the continued implementation of the 5S. This in turn reduces waste, such as transportation, processing, inventory and motion, fulfilling Lean Six Sigma concepts.

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