Pull System for material replenishment in Sunshine Meds

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Abstract

This project evaluates the material replenishment for manufacturing lines in Sunshine Meds Company who prepares medical devices kits in a manufacturing cleaning room. Opportunities were found looking into the material handles replenishment process like a waste of time and waiting time in stations while raw materials are supplied. The problem statement is the following: due to a lack of organization, there is a high time consumption to complete a replenishment cycle, excess inventory on the manufacturing floor, and no signals to replenish material, causing a lack of material handler flexibility to serve different manufacturing lines. Designing a Kanban system as a part of the replenishment process using two types of signals, a bin system and an inventory level system solve the higher volume of raw material in the clean room while improve the Firs in first out (FIFO) of material consumption.

Introduction

This project intends to create a visual replenishment system and to ensure proper inventory levels on the manufacturing floor; based on demand while keeping the fewer inventories possible without affecting line productivity. The system must be designed flexibly so that one material handler can serve different lines or sites on the manufacturing floor. The desired states are to reduce the time consumed to supply materials and optimize replenishing the manufacturing line stations. The metrics used to carry out the analysis are the distance traveled by the Material handler, the space the material occupies within the cleaning room, the inventory, and the time they spend performing the task.

Background

The material replenishment dynamic includes having a supermarket (mini-warehouse) inside the clean manufacturing room to supply the line stations. The excess material creates poor organization, which leads to complex material handling. In this industry, the product is a medical device containing raw material with a shelf life and expiration date. The pull system project will be implemented on the manufacturing floor, directly impacting the materials handlers responsible for replenishing manufacturing line stations. Various wasted can be identify in the process like waiting time, transportation waste while moving picklist to warehouse, waste of motion, inventory waste and overprocessing. All these activities have the same common factor; none add value to the process; they only consume time, money, energy, and workforce availability. This ended up resulting in adding costs, more work steps or rework, lowering productivity and product quality.

Problem

Due to the excess of inventory the FIFO methodology cannot be guaranteed, and raw materials are at risk of being out of date by the time that is going to be consumed in the manufacturing line stations. This problem affects daily activities because manufacturing lines must be filled daily during the stocking process of raw materials.

Methodology

To maintain an adequate stock level, an inventory quantity study of raw materials must be done, considering more than one day to know the daily inflow of materials entering manufacturing. A storage organization, labeling process, and replenishment procedure must be performed to meet this objective. Using the measuring step of the DMAIC tool, various activities are planned to be used, like a time study to identify the amount of time needed to complete the process and the waste in it. Inventory of the mini-warehouse will be studied as product demand. The actual state will be studied for the analysis step using DMAIC to propose solutions to its deficits. Lead times, operators' feedback, space utilization, material handler work activities, and the number of materials in lines will be considered as is in the actual state.

Using the SIPOC tool, see Figure 1.0, it was possible to identify the critical elements of the process. As a supplier, we have the material handler, planners and buyers, and warehouse employees; these are the ones who supply what will be used in the process.

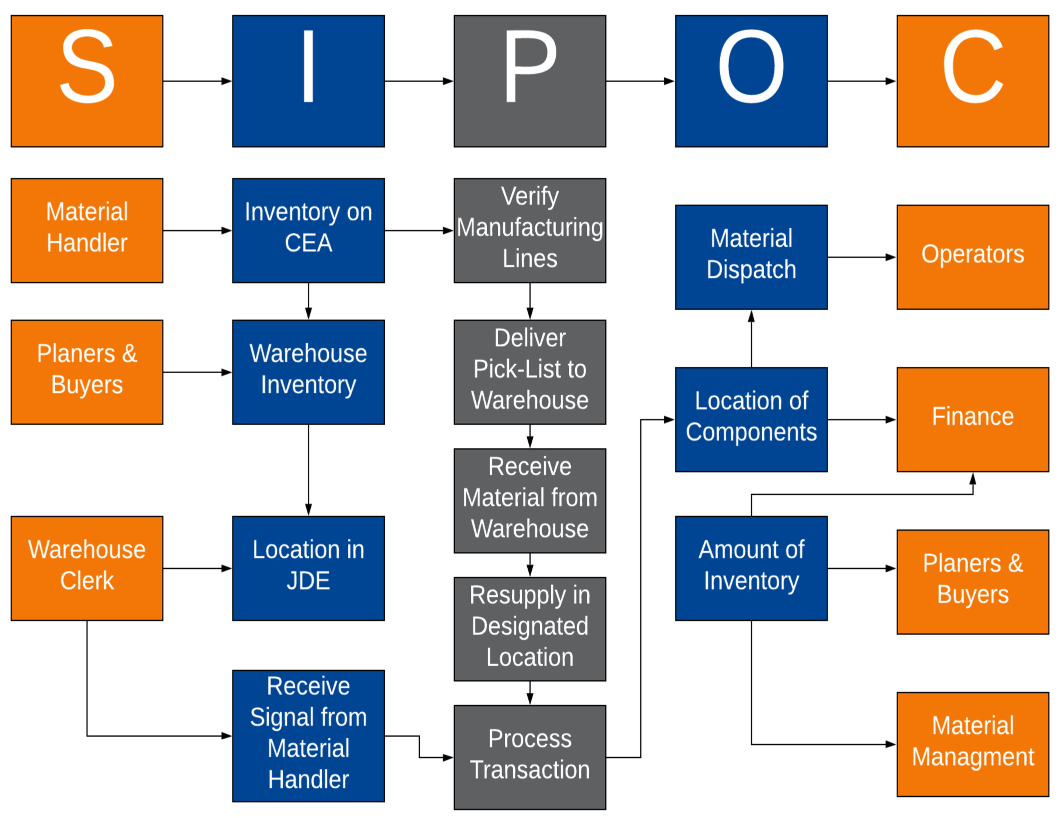

Figure 1.0
SIPOC diagram

As the material handler is responsible for the material distribution and inventory, we can focus on his work activities which consist of the following steps; initially, the material handler verifies every manufacturing line station to have a panorama of how much material needs to replenish. When all the stations were confirmed, the material handle supplied them with the fabrics in a mini-warehouse inside the clean manufacturing room. Then the inventory of material used to replenish the line is updated to generate a picklist. The picklist is transported to a passthrough between the clean manufacturing room and the warehouse, where the warehouse is responsible for picking it up and getting the materials. Lastly, the material is delivered to the passthrough, where the material handle gets into the clean manufacturing room and fills up the mini-warehouse. To keep the organization in the workplace, a 5s will be implemented; it helps with the organization, product flow, time looking for things, poor space utilization, supply shortage, and hidden inventories. Also, standardization must be implemented to keep an organized workplace and process steps.

Results and Discussion

Part of the project plan is to identify the components per manufacturing line. To meet with it, a voice of the customer (VOC) study was performed to understand the needs of the process. A study of raw material that enters manufacturing in two days was carried out to know the inventory of the manufacturing room. Two batches of products are generated daily, and the mini-warehouse filling process occurs every two days. Looking across manufacturing lines A, B, C, and D require about 70 minutes to be replenished (~17.5 minutes per line). The material handler travels about 890 ft in its work route to comply with the replenishment process for the 10.5 carts. A time study discovered that the complete process takes approximately an average work time of 1.30 hours, of which it was possible to identify the activities that contributed and those that did not add value to the process.

An inventory study was made for the mini-warehouse inside the manufacturing cleaning room, and it goes from about 3 to 5 days, and this is the cause of the surplus of raw materials inside the manufacturing room. Considering the worst scenario, in which the supplier's lot size is its largest quantity, multiplying it by the space of days left for the replenishment of the mini-warehouse, refer to equation (1), the two lots generated per day, and divided by the quantity supplied, we would need 1 to 5 bins per material in the manufacturing cleanroom mini-warehouse. The average daily consumption was calculated by taking a few consumptions amount and looking for a representative average amount using the equation (2). By multiplying the average daily consumption by the two days of manufacturing and dividing by the quantity supplied, we obtain the necessary bins for the manufacturing lines using the equation (3).

Table 1.0
Inventory Analysis for Clean room

Item	Qty Supply	Smallest Lot size	Maximum Lot size	Daily average	Bin
PK0001	450	50	500	112.51	5
PK0002	450	150	500	221.02	5
PK0003	560	48	504	523.06	4
PK0004	1080	50	50	1.67	1
PK0005	640	252	252	217.27	2

$$Bins_{MFG\ line} = \frac{Daily\ average}{supplier\ quantity} * 2 \quad (1)$$

$$\bar{X} = \frac{\sum(x_1 + x_2 + x_3 + x_4 + x_5)}{N} \quad (2)$$

$$Bins_{CEA} = \frac{Maximum\ lot\ size}{supplier\ quantity} * 4 \quad (3)$$

Table 2.0
Inventory Analysis for Manufacturing Lines

Item	Qty Supply	Daily average	Bin MFGline
PK0001	450	112.51	1
PK0002	450	221.02	1
PK0003	560	523.06	2
PK0004	1080	1.67	1
PK0005	640	217.27	1

A visual replenishment system was designed to have an adequate inventory level on the manufacturing floor. This Kanban system includes two types of signals, a bin system, and an inventory level system. Using bins, it identifies the number of products in the necessary quantities at the critical moment in each manufacturing line.

Conclusions

It was possible to develop a storage system using bins. All the containers have a standard size that allows you to put any raw materials we will be placing on these carts. Each part of the manufacturing lines can cover a workday or two manufacturing batches.

Figure 2.0
Actual Cart / Cart Prototype

Future Work

For this first phase of implementation, the primary five raw materials that supply lines A, B, C, and D were chosen. Future work will be applying the system to all the manufacturing lines inside clean room and develop a program to deliver the picklist to warehouse without material handler transportation.

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References

Online Source

[1] PlanetTogether, “Five Principles of Lean Manufacturing,” PlanetTogether. [Online]. Available: https://www.planettogether.com/blog/five-principles-of-lean-manufacturing. [Accessed: 24-Mar-2023].

[2] Person, S. Elizabeth A., and F. Cudney, “Lean systems: Applications and case studies in manufacturing, service,” Taylor & Francis, 26-Sep-2013. [Online]. Available: https://www.taylorfrancis.com/books/mono/10.1201/b15781/lean-systems-sandra-furterer-elizabeth-cudney-david-dietrich. [Accessed: 22-Mar-2023].

[3] “Kanban system applications in healthcare ... - wiley online library.” [Online]. Available: https://onlinelibrary.wiley.com/doi/10.1002/hpm.3276. [Accessed: 22-Mar-2023].

[4] Person, S. Elizabeth A., and F. Cudney, “Lean systems: Applications and case studies in manufacturing, service,” Taylor & Francis, 26-Sep-2013. [Online]. Available: https://www.taylorfrancis.com/books/mono/10.1201/b15781/lean-systems-sandra-furterer-elizabeth-cudney-david-dietrich. [Accessed: 22-Mar-2023].

Book

[5] P. Marksberry, The modern theory of the toyota production system: A systems inquiry of the world's most emulated and Profitable Management System. Productivity Press, 2013.

[6] B. Carreira, Lean manufacturing that works: Powerful tools for dramatically reducing waste and maximizing profits. New Delhi: Prentice-Hall of India, 2007.

[7] Y. Monden, Toyota production system: An integrated approach to just-in-time. Boca Raton u.a.: CRC Press, 2015.