Stabilization of FIFO system and Inventory Management

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Abstract -*Every organization needs inventory for smooth running of its activities. It serves as a link between production and distribution processes. The investment in inventories constitutes the most significant part of current assets/working capital in most of the undertakings. Thus, it is very essential to have proper control and management of inventories. The purpose of inventory management is to ensure availability of materials in sufficient quantity as and when required and also to minimize investment in inventories. Raw materials, goods in process and finished goods all represent various forms of inventory. Because of the large size of the inventories maintained by firms, a considerable amount of funds and space for storage of materials is required to be committed to them. It is therefore absolutely imperative to manage inventories efficiently and effectively in order to avoid unnecessary investments. A firm neglecting the management of inventories will be jeopardizing its long run profitability and may fail ultimately. The reduction in excessive inventories carries a favorable impact on the company's profitability .The main objective of the project is to set a proper inventory management and to design a new rack system in order to utilize the space effectively and to stabilize FIFO system which will help them in keeping OEM's record accurately. Inventory management techniques is used to set a proper stock level and Prioritized scheduling technique is suggested to reduce the loss hours due to no material supply. Overall, this project will help the company to keep proper stocks to make sure the availability of components whenever needed so that loss hours could be reduced and also by adopting newly designed racks with FIFO system of storage it will help the company to have accurate OEM's record..*

Key Words: *ABC analysis, Flow racks, FIFO system, Inventory management, Priority Scheduling, Storage system, XYZ analysis.*

1. INTRODUCTION

Inventory control is vitally important to almost every type of industries, whether product or service oriented. Inventory control touches almost every facet of operations. A proper stock must be maintained `to make sure the availability of materials when required. Inventory control is the activities that maintain stock keeping items at desired levels. There are many types of inventory they are Raw material Inventory, Work in progress inventory and finished goods inventory. In manufacturing since the focus is on physical product, inventory control focus on material control."Inventory" means physical stock of goods, which is kept in hands for smooth and efficient running of future affairs of an organization at the minimum cost of funds blocked in inventories. The fundamental reason for carrying inventory is that it is physically impossible and economically impractical for each stock item to arrive exactly where it is needed, exactly when it is needed.

1.1 Inventory Management Techniques

Safety Stock: The safety stock is defined as "The additional stock of material to be maintained in order to meet the unanticipated increase in demand arising out of uncontrollable factors". In simple it is a stock which is used to protect against uncertainties. Because it is difficult to predict the exact amount of safety stock to be maintained, by using statistical methods and simulation, it is possible to determine the level of safety stock to be maintained.

XYZ Analysis: It is a classification of components into 3 categories based on the variation in the demand of the components therefore it provides the knowledge essential for decision making in stock management. Here the components will be categorized into X, Y & Z, where X is a group of components with less variation in demand i.e., (0-10% variation), Y is a group of components with 10 – 25% variation in demand and Z is a component with more than 25% variation in demand. Based on previous customer schedule data the variation in demand is calculated for each component. XYZ analysis is useful for forecasting future demand for the sub suppliers. By considering the variation data future forecast can be done.

ABC Analysis: The ABC analysis facilitates arrangement of products or materials into sets in consideration of a given criterion. It enables to manage the assortment groups without consideration to single elements that can be in large quantities. The assignment can be made according to following criteria: value of sale, demand for a give product. In the obtained cumulated sale value one can distinguish three groups of products:

- Group A – Components causing 80% of total cost.
- Group B – Components Causing 15% of total cost.
- Group C – Components causing 5% of total cost.

The ABC classification will help for allocation of components to the racks.

FIFO System: FIFO is a First In First Out system which says "the component which comes first have to dispatch or issue first". This system will help for tracking of the component which will be useful in maintaining OEM's record. The implementation of the FIFO system will help the organization by eliminating the misplacement of components and storage of old component.

Priority Scheduling: Priority scheduling is a method of scheduling processes based on priority. In this method, the scheduler chooses the tasks to work as per the priority, which is different from other types of scheduling Priority scheduling involves priority assignment to every process, and processes with higher priorities are carried out first, whereas tasks with equal priorities are carried out on a first-come-first-served basis.

2 GENESIS OF PROBLEM

The problem observed lies in the way components are stored, organized and retrieved prior to packaging, issuing and supplying . Due to space and time constraints, there is no first in first out system used currently. The employees who store components from the Work In Process area and place them in racks simply put them in the designated areas wherever there is space. They may stack items, stuff new items into half-filled boxes inside the rack, etc. So when the packagers who are responsible for picking up items from the shelves come to get what they need, it may not be possible for them (even if they wanted) to pick up the oldest manufactured batch of component.

The other issue is that the packagers and issuers themselves do not have the time to sort through the stored bins of components to find the oldest ones first. This is creating a big problem as older items may just sit and gather rust, while the newly manufactured items are sent out well before.

A final problem they are facing is lack of traceability in the rack. Since the batches of the manufactured products are simply not organized in terms of manufacturing date (no FIFO), it is not possible to pinpoint where a particular manufactured batch is. For example, if it is found out later that the batch manufactured in March 2015 is faulty, there is no other way but to take all the batches of that particular item and rework them.

3 Objectives

3.1 Goal Statement

Primary objective

- To design a new rack system with FIFO method of storage

Secondary objective

- Improve Inventory Control – raw materials WIP and finished goods
- Ease Shipping and Receiving
- Find a better way to handle storage and retrieval of Work-In-Process components
- Minimize loss, excess handling, potential damage
- Make it easy so anyone could use the system to locate and retrieve components

3.2 Opportunities

- To improve the way of storage by adopting FIFO system
- To make the tracking of components easier.
- To reduce the Loss Hours Due to no material supply when needed by adopting prioritized Scheduling
- To utilize the space more efficiently.
- To increase the storage capacity of racks by designing new racks.

4. Methodology

The methodology followed is PDCA cycle (Deming's cycle)

The four phases in Plan-Do-Check-Act involve:

- Plan: Identifying and analyzing the problem.
- Do: Developing and testing potential solution.
- Check: Measuring how effective the test solution was, and analyzing whether it could be improved in any way.
- Act: Implementing the improved solution.

5. Data Analysis

5.1 Plan

5.1.1 Selecting Improvement opportunity

It is observed that the FIFO system has not been implemented because of that they are facing more problems in storage of components. So it is found that there is an opportunity for improvement in this area.

5.1.2 Analyze Current Situation

From the observation it is found that there is no proper:

- Inventory maintenance
- Storage system
- Scheduling technique

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Due to which there is more loss hours because of no material supply on time when needed and also floor space is being utilized for the storage of racks which looks odd and also tracking of the component has become tougher because of random picking of components without considering the manufacturing date.

Current Rack details

Currently they are using Static Racks. It is more space consuming and it is very difficult to track the component because the employees who store components from the Work in Process area and place them in the racks simply put them in the designated areas wherever there is space.

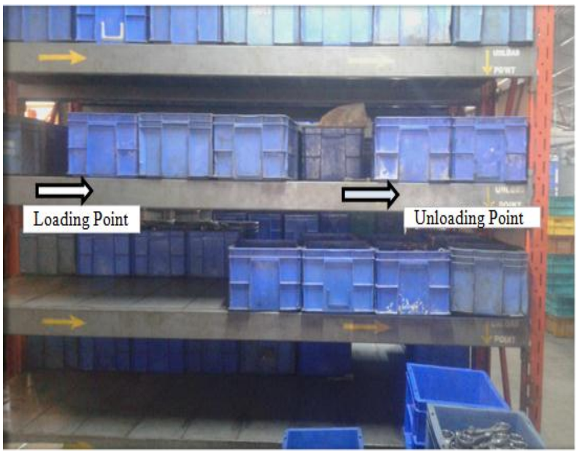

Fig 5.1

Figure 5.1 is a picture of Static racks currently in use. We can clearly see that the design of the racks itself responsible for the issue because as older items which are stored in the second column may just sit and gather dust, while the newly manufactured items are sent out well before. For better understanding it is shown in the 2D format below: Fig 52

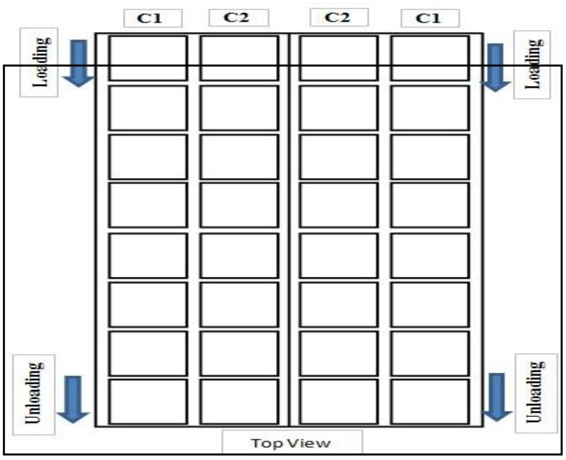

Figure 6.2 shows the top view of the arrangement of bins in the rack. Racks are in 2 sizes L & XL. L size racks contains 2 columns and 5 rows, and can hold up to 16 bins in each row. Whereas XL racks contains 2 columns and 5 rows and can hold up to 21 bins. Loading can be done only in sideways from both ends because of that the packagers & Issuers who are responsible for picking up items from the racks, it may not be possible for them (even if they wanted) to pick up the oldest manufactured components, because of that the older components in C2 column remain stagnant.

The other problem they are facing is lack of traceability in the racks. Since the batches of the manufactured products are simply not organized in terms of manufacturing date (no FIFO), it is not possible to pinpoint where a particular manufactured batch is. For example, if it is found out later that the batch manufactured in Jan 2016 is faulty, there is no other way but to take all the batches of that particular item and rework them.

5.1.3 Identifying Root Causes

Cause and effect diagram

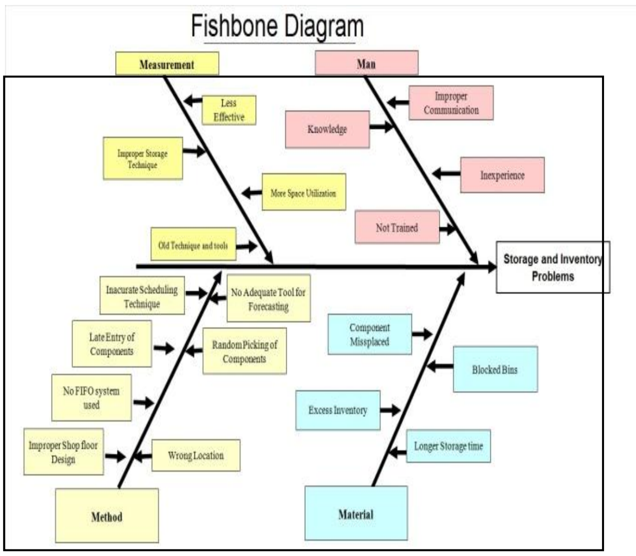

Fig 5.3

Major Problems Effecting to Storage and Inventory
Excess Inventory
Improper Scheduling Technique
No FIFO system followed
More space utilization for storage
Random picking of components

Improper shop floor design
No adequate tool for Forecasting
More Loss Hours

Table 5.1: Major problem affecting Storage and inventory

5.1.4 Generating and choosing solutions

Inventory problems:

From the process flow it is observed that Forging/casting and Machining processes are outsourced. So we have to maintain stock for these two stages. In order to maintain stock for these two stages the average customer schedule data is collected. In order to find average schedule data the customer schedule data of the month November and December 2016 is collected. From that data the stock level calculation is done. The calculation is done as shown below,

For example I have considered the component Toyota Liver shaft:

- Average schedule = 2000 units
- Production per day = 870 units
- Number of days required for processing 2000 components = 2.29 days
- Minimum Level = Production per day * (Number of days required for processing + 1)
  =870*(2.29 + 1)
  = 2870 units
- Maximum level= Production per day * (Number of days required for processing + 1)
  = 870*(2.29+3) = 4610 units

Like wise the stock level is calculated for each component is calculated.

Scheduling problems: Earlier the scheduling was not proper so the priority scheduling is suggested. The quantity for scheduling is calculated by considering new stock level. For prioritization the shifts that can be run with the available units is calculated for each component and based on that data prioritization is given. And the detail calculation is shown below:

Example I have considered component Toyota Liver Shaft:

Total Availability as on Date = 2770 units

Customer Schedule for Month Feb'17 = 1450 units

Quantity Available for issuing to line = 2770 units

Quantity required to satisfy demand from the line = 0

Stock after issuing = Quantity after issuing – customer schedule = 1320

Min Quantity to be maintained = 2870

Quantity to be scheduled = Min Quantity + Stock after Issue = 4190

Production per Shift = 290

Total shifts required for Processing = Customer Schedule for Month Feb'17/ Production per Shift = 5

Shifts that can be operated with Available units = Quantity Available for issuing to line / Quantity Available for issuing to line = 10

Remaining Shifts = Total shifts required for Processing- Shifts that can be operated with Available units = -5 = 0

Based on the shifts that can be operated from the available units the priority is given to the production as well as the suppliers.

Like wise prioritization is done for all the components.

And also for the Forecasting of the demand the XYZ Analysis is used and it is shown below in Fig 5.4:

XYZ Analysis

Component Name	Nov '16 Schedule	Dec'16 Schedule	Jan'17 Schedule	Mean	Standard Deviation	Variation	Grade (X/Y/Z)
TOLS1001	2000	2000	2000	2000	0.0	0%	
TOLS1004	7000	7000	7000	7000	0.0	0%	
TOSH1001	8000	8000	8000	8000	0.0	0%	
TOAL1003	3000	3000	3000	3000	0.0	0%	
TOAL1004	3000	3000	3000	3000	0.0	0%	
TOLS1003	1800	1800	2000	1866.7	115.5	6%	X
MARA1006	58130	54286	50000	54138.7	4067.0	8%	
ROGS1004	35000	35000	40000	36666.7	2886.8	8%	
ROGS1005	35000	35000	40000	36666.7	2886.8	8%	
ROGS1006	35000	35000	40000	36666.7	2886.8	8%	
BARA1044	235000	190000	230000	218333.3	24664.4	11%	
TOER1004	5000	5000	4000	4666.7	577.4	12%	
YMGS1011	31280	37493	40000	36257.7	4489.3	12%	
YMGS1009	32595	31908	40000	34834.3	4486.8	13%	
HSCR1001	91158	75577	100000	88911.7	12365.5	14%	
MARA1007	52160	38990	50000	47050	7063.2	15%	Y
YMGS1010	29679	37560	40000	35746.3	5394.2	15%	
TOLS1002	8000	6000	6000	6666.7	1154.7	17%	
YMCR1005	32300	25700	40000	32666.7	7157.0	22%	
BACR1015	32000	20000	25000	25666.7	6027.7	23%	
DARA1001	18144	27216	30000	25120	6199.7	25%	
TOSH1002	3000	2000	2000	2333.3	577.4	25%	
ROCR1003	40000	40000	65000	48333.3	14433.8	30%	
YMRA1005	12968	18938	25000	18968.7	6016.1	32%	
SMGS1005	35385	17771	30000	27718.7	9025.9	33%	
HSRA1004	48208	30120	60000	46109.3	15050.1	33%	
BACR1019	10000	8000	15000	11000	3605.6	33%	
YMCR1006	5300	5500	10000	6933.3	2657.7	38%	
DURA1005	6000	18750	18000	14250	7154.5	50%	Z
DURA1006	6000	18750	18000	14250	7154.5	50%	
HSGS1002	45661	15060	50000	36907	19044.0	52%	
BARA1019	10200	11000	25000	15400	8323.5	54%	
DURA1004	12000	43500	40000	31833.3	17265.1	54%	
DURA1003	2700	10400	12000	8366.7	4972.3	59%	
HSGS1001	178904	30120	150000	119674.7	78891.6	66%	
SMGS1006	18989	3217	15000	12402	8200.7	66%	
YMRA1012	91437	63348	0	51595	46837.8	91%	

From the variation in the demand data the forecasting is done.

Proposed Flow rack system

Flow Racks

Carton Flow Rack is a high-density type of Storage and Picking System. It utilizes a first in/first-out rotation of cartons by using gravity flow to bring product from the loading to the picking aisle of the System. The components of same type can be loaded on the same lane from the back, so that the oldest product is always in the front of the lane.

A possible solution to this problem is replacing the static racks with Bin flow rack. A method that provides excellent storage density combined with picking efficiency is Bin flow rack. This system utilizes a track of rollers and guidelines installed at an angle of approximately 3/8" per foot. The component is loaded in the back and flows via roller to the front, where it is picked. Most gravity flow racks are 7'-10' deep, permitting multiple bins of the same product to be stored in each lane on a first in, first out (FIFO) basis. This automatically eliminates the current problem of storage & tracking of components. As soon as a Bin is filled it is loaded from the back on the appropriate lane that can be organized on the basis of frequency like in the current system.

If flow racks replace the static racks then a couple of changes have to be made. A stocker has to be trained to make sure that flow racks are loaded and unloaded correctly. His job would be to remove the bins from the picking end and to stock the bins from back end as shown in Figure 6.6. The warehouse supervisor can make sure that the packers grab the products from the front end only. The most frequently shipped components can be placed at the most accessible height to save time. Stoppers are used for holding the bins at the picking end so that they wouldn't slide abruptly if the front bin was removed. Another advantage of this system is that if the packer picks up more items than he requires he can always put it back in the appropriate lane without having to worry about FIFO as the oldest items are always in front.

In order to make the system efficient the storage and picking methodology can be altered. Product stored in a forward pick area can be placed in a different storage medium than product used as backup storage. Forward pick areas have high degrees of picking activity, so the storage medium must compliment that. Backup storage tends to be handled in larger unit volumes and therefore have lower and different storage needs. The items for which FIFO is not a concern can be stored in static shelves so that space and money is saved.

A number of things need to be considered before implementing a flow rack system. The area currently available in the department has to be measured to see how many flow racks can be placed in the available space. We also need to estimate the number of bins a flow rack can store in comparison with the current shelves.

Since all items placed on flow racks have to be stored in bins we need to take into account the size of that so that it will be useful in designing of flow racks. For the allocation of components ABC analysis is done.

ABC analysis is a technique used to find out the component to which the more importance has to be given. Here the components will be categorized into 3 ways A B & C, the components which is causing 80% of the total cost will be categorized as A type and the components which is causing 15% of the total cost will be categorized as B type and remaining 5% as C type. This detail is shown below

Table 5.2 ABC Analysis

ABC Analysis							
Sl No	Component Name	Cost per unit	Total Quantity	Total Cost	%	Cumulatiuve %	Grade
1	BARA1044	14.06	212500	2987750	11.26%	11.26%	A
2	YMRA1010	22.65	114430	2591840	9.77%	21.03%	
3	HSGS1001	16.13	104512	1685779	6.35%	27.38%	
4	ROGS1005	47.39	35000	1658650	6.25%	33.63%	
5	ROGS1006	47.39	35000	1658650	6.25%	39.88%	
6	ROGS1004	46.17	35000	1615950	6.09%	45.97%	
7	YMRA1012	17.19	77393	1330386	5.01%	50.98%	
8	TOER1004	240.34	5000	1201700	4.53%	55.51%	
9	MARA1006	20.20	56208	1135402	4.28%	59.79%	
10	MARA1007	20.20	45575	920615	3.47%	63.26%	
11	TOAL1003	226.86	3000	680580	2.56%	65.83%	
12	TOAL1004	226.86	3000	680580	2.56%	68.39%	
13	TOSH1001	84.27	8000	674160	2.54%	70.93%	
14	YMGS1011	18.88	34387	649227	2.45%	73.38%	
15	YMGS1009	18.88	32252	608918	2.29%	75.67%	
16	YMGS1010	18.03	33620	606169	2.28%	77.96%	
17	HSRA1004	14.28	39164	559262	2.11%	80.07%	
18	SMGS1005	18.91	26578	502590	1.89%	81.96%	B
19	HSGS1002	15.27	30361	463612	1.75%	83.71%	
20	DURA1004	15.33	27750	425407.5	1.60%	85.31%	
21	DARA1001	18.61	22680	422075	1.59%	86.90%	
22	DURA1005	28.06	12375	347242.5	1.31%	88.21%	
23	DURA1006	28.06	12375	347242.5	1.31%	89.52%	
24	YMRA1006	20.59	15953	328472	1.24%	90.75%	
25	TOLS1002	44.02	7000	308140	1.16%	91.92%	
26	DURA1003	37.59	6550	246214.5	0.93%	92.84%	
27	HSGS1003	16.13	14193	228933	0.86%	93.71%	
28	TOSH1002	90.08	2500	225200	0.85%	94.56%	
29	SMGS1006	19.32	11103	214510	0.81%	95.36%	C
30	TOLS1004	30.26	7000	211820	0.80%	96.16%	
31	YMRA1005	14.53	11628	168955	0.64%	96.80%	
32	BARA1019	14.7	10600	155820	0.59%	97.39%	
33	TOLS1003	64.53	1800	116154	0.44%	97.82%	
34	TOLS1001	43.18	2000	86360	0.33%	98.15%	
35	ROCR1003	67.33	1150	77430	0.29%	98.44%	
36	HSCR1001	33.49	2033	68085	0.26%	98.70%	
37	YMCR1005	37.34	1650	61611	0.23%	98.93%	
38	YMCR1006	37.13	1650	61265	0.23%	99.16%	
39	DURA1001	34.78	1750	60865	0.23%	99.39%	
40	BACR1013	37.66	1564	58900	0.22%	99.61%	
41	BACR1015	33.49	1564	52378	0.20%	99.81%	
42	BACR1019	32.45	1564	50752	0.19%	100.00%	
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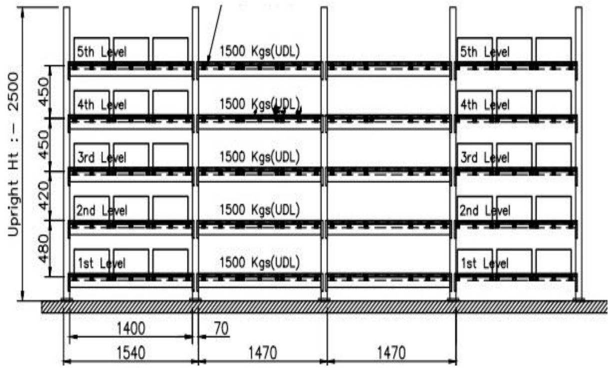


Proposed Rack system Design

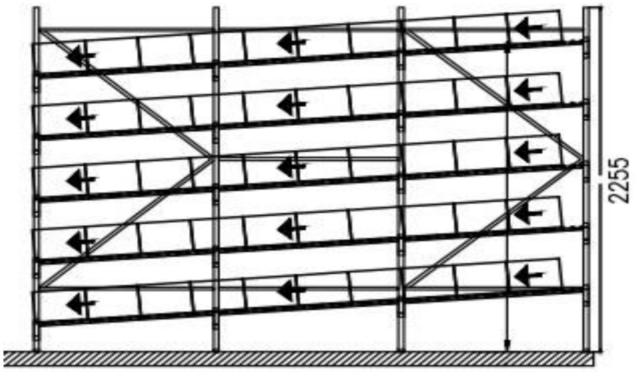
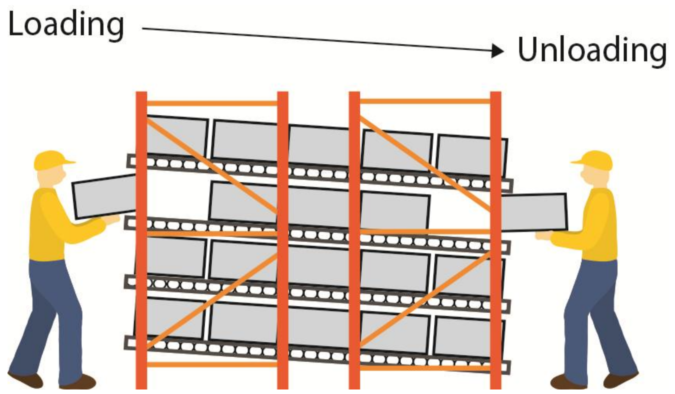


Fig 5.4 Front View

Fig 5.5 Side view



Work Procedure of Flow Rack

5.2 Do

5.2.1 Mapping out and Implement a trial run

Here the static rack is replaced with Flow rack. Number of things need to be considered before implementing a flow rack system. The area currently available for the racks has to be measured to see how many flow racks can be placed in the available space. We also need to estimate the number bins a flow rack can store in comparison with the current shelves. And also the space for the loading and unloading is measured by considering the length and width of the forklift. And also some of the departments have been shifted for the convenience.

From the proposed Rack system the following advantages can be achieved:

- Total length required for proposed racks is 140"19'.
- It can hold approximately 4200bins
- It follows FIFO system so that tracking will be easier
- Less time consuming for Loading and Unloading compared to static racks.
- Misplacement of component could be eliminated
- Storage

5.3 Check

5.3.1 Analyze the Result

- Currently Racks are consuming 100'17" and can hold only 1020 bins.
- Proposal racks consumes 140'19" and can hold approx 4200 bins.
- 4 times the storage capacity is increased.
- Tracking for OEM (Original Equipment Manufacturer) is made easier.
- Misplacement of components is eliminated.
- FIFO system has been implemented so that storage of old components are eliminated.
- ABC analysis is used for allocation of components so that picking of component is made easier.
- Proper scheduling technique is maintained and loss hours due to no material are reduced. About an average of 899 loss hours has been occurred from past 3 months i.e., from Nov- Jan, after the implementation of Priority scheduling the loss hours has been reduced. On average of 504 hours of loss is occurred in the month February and March
- Proper inventory is maintained so that excess quantity could be eliminated.

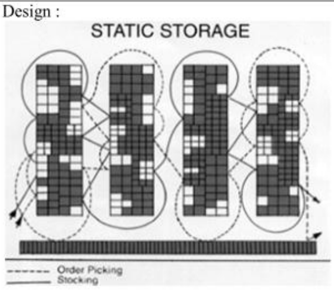
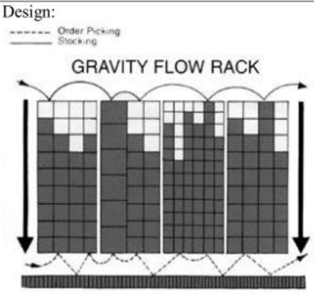
Static Racks	Flow Racks
Static storage is inefficient and labor intensive	Flow rack saves time, labor and space.
It typically requires 2 to 4 times more pickers	Only 2 pickers can manage
Twice the floor space than gravity flow systems	Floor space is saved because fewer aisles are needed to reach the same amount of products
This can cause inventory control, stock rotation and picking accuracy problems	A first in, first out stock rotation is always achieved
Design : 	Design: 
Stockers can pick components randomly	Stockers cannot pick components randomly
Traceability is difficult	Traceability is Easier compared to Static racks
Identification of component is difficult	Identification of component is easy
It can hold up to	It can hold up to 4200 bins

Table 5.3 Comparison

5.3.2 Conclusion

A better inventory management and storage system will surely be helpful in solving the problems the company is facing with respect to inventory and storage will pave way for reducing the huge investment on inventory and increasing the capacity of storage system. From the project we can conclude that the company can adopt the suggested method of priority scheduling and flow racks system so that they can have a better control on the production and their storage capacity can be increased which will also be helpful in tracking of the component for accurate OEM's record. And also for the forecasting of demand for the future months it is suggested to make use of XYZ analysis which will be helpful in raw material planning also. For the allocation of components to the racks ABC analysis is used by which we can place the component with respect to their importance. If they could properly implement and follow the norms and techniques of inventory management, they can enhance the profit with minimum cost. And if they adopt flow racks they can store more number of components in less space and can have easier access of loading and unloading and also the tracking of the components can be done easier.

From the implementation of flow racks ,What is crucially different from the existing system is that the FIFO guys (Stockers) will not just randomly pick items from the storage areas. Rather, they will pick them up in FIFO order. That means the items in the pick-up racks will be the oldest items, and if they are shipped out each time, it means that a FIFO system has been successfully implemented. Elaborating on the time saving, if only a few employees (FIFO guys) walk around for picking up items, instead of all packers doing this, it means that an individual packer's time is saved. That means we can have a few lesser packers, and designated them as the FIFO guys. Thus overall labor expense can be reduced

5.4 ACT

5.4.1 ADOPT ADAPT & ABANDON

If they implement the flow racks it is mandatory to have a proper label system. Label system is used in order to identify the component easily. By implementing flow racks we can have both advantages as well as disadvantage.
Some of the advantages we can have after implementing this system are:

- FIFO problem is solved
- Tracing of component will be easier
- More number of bins can be stored in the available space
- Loading and Unloading will be easier

The disadvantage is that other than in the pickup rack, the problem in the physically moving/rearranging items in the racks still exists for the FIFO guys.

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