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Implementation of Sustainable Material Handling System in Production Line in a Shirt Manufacturing Unit

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Abstract

With increased competition to reduce cost, industries are thriving to become more economically efficient. Material handling cost is one of the largest unnecessary cost in production which can be reduced by minor changes in production. There are limited studies related to material handling in apparel industry. This paper focuses on exploring different material handling system used in garment industry and effect of implementation of shopping cart system in one of the garment manufacturing unit.

Keywords: Shirt Manufacturing, shopping cart system, bin system, apparel industry, shirt, production efficiency

1. Introduction

Globalisation has highly increased competition in apparel industries leading to eventual decrease in profits, therefore, apparel industries have been thriving to reduce their cost. This calls industries to take actions to reduce different types of potential wastage during production. First step to reduce this wastage is achieved by the using an efficient material handling system. The material handling system provides right quantity of right material at right sequence, place and time.

a) **Objectives:**

- Explore different material handling system
- Replace current polybag system used to an economically and ecologically friendly material handling system

2. Literature Review

Material Handling System refers to procedures used to move the items, protect the items and control the items within a production. It involves manual, semi-automated and full automated equipments. The main aim of a material handling system is to provide right quantity of right material at right sequence, place and time. Right quantity requires right calculation of batch size. Although incorrect batch size(larger batch size) reduces set up time and material handling, it increases WIP (work in progress). Right material requires methods of identification using visual cards. In garment manufacturing unit, a good material handling system is important to reduce defects and increase production efficiency.

1. Defects due to poor material handling

In garment manufacturing unit, a good material handling system is important to reduce defects and increase production efficiency. There are multiple defects that can occur due to improper material handling methods. For instance:

1.1. Oil/Dirt/Stains

Stains can appear on fabrics from many sources in production viz. dirt from the factory floor, oil from machinery and dyes. Garments are never safe from stains because they can occur anytime during or after production if not kept in an area with adequate protection.

1.2. Crease marks

Visual deformation of the garment pieces are called crease marks. Crease marks increases operator hours since due to creases an extra operator has to be allocated for re- ironing.

1.3. Abrasion marks

Abrasion is discolouration of pieces due to friction.Chafing or impact with a hard or rough surface usually causes abrasion marks.

1.4. Holes

A hole is an imperfection where one or more yarns are sufficiently damaged to create an opening in the garment pieces.

2. Different kind of material handling systems used in apparel industry

2.1. Polybag System

In polybag material handling system, material are filled in plastic bags and moved from one end of production to another. This is one of the most widely used material handling system in sewing lines since it is easier to dispose as soon as production is over. Also the bags need not be returned back to the line and can be sent for recycling.

Advantages:
1. Secure movement
2. More space
3. Less investment
4. Prevents dirt, stain and oil

Disadvantages:
1. Have to bought frequently
2. Lower short term investment but high long term investment
3. Recycling also affects the environment
4. Polybags are non- rigid in nature causing creases and abrasion

2.2. Conveyor Belt system

Automatic Conveyor belt allows automated movement of material from one end in the production to other. It helps to move items without manual force.

Advantages:
1. Easy movement
2. Less labour required
3. Speed can be adjusted
4. Allows one piece flow

Disadvantages:
1. Require electrciyy
2. Non- ecofriendly
3. High investment cost
4. Difficult set up the line

2.3. Bin System

Bin system contains plastic containers of a certain length, width and breadth allowing a particular number of cut parts to be transported. Bins are filled with garment with certain number of pieces and placed in trolley.

Advantages
1. Can be reused
2. One time investment
3. More eco friendly
4. Allows bundle system
5. Prevents dirt,stain and oil
6. Has firm, flat bottoms which prevents creases

Disadvantages:
1. Difficult to move
2. Require manual force by operator and helper

2.4. Slopped ramp

Slopped ramps are angled tables that allow easy movement of goods based of gravity. It reduces manual force to be applied till an extend.

Advantages
1. One time investment
2. Eco-friendly

Disadvantages:
1. Difficult to use
2. Require manual force by operator

2.5. Shopping cart system

Shopping carts are bin systems with wheels on the bottom allowing free movement with minimum manual force. It doesn't require electricity.

Advantages
1. Easy to move
2. Can be reused
3. One time investment
4. More eco friendly
5. firm, flat bottoms

Disadvantage
1. Need maintenance like cleaning

2.6. Overhead hanger system

Many production units use overhead rail and hanger for transporting material. Factories found it is easy to track WIP on the UPS system. Some factories experience issue in line balancing. Different types of overhead hanger system are available. Example of manual hanger system and computerized hanger systems.Overhead hanger system required high investment cost. In order to replace current an eco-friendly

Advantages	Disadvantage
1. Allows one piece flow	1. Difficult to implement in part production line
2. Easy to implement in assembly section	2. High investment cost
3. Manual overhead hanger system are eco-friendly	

3. Study Background

The study is conducted in a shirt manufacturing unit of an Indian domestic retailer. The retailer has an in-house manufacturing unit of shirt, trouser, blazer and suiting. It has a capacity of 2500 pieces/day. The manufacturing unit has 10 departments with material follows a linear flow of store, cutting, fusing, embroidery, part preparation, assembly, finishing and packaging department. The unit follows a bundle system and assembly line manufacturing. The cycle time for each unit is 27 mins. It consists of 280 sewing operators, 30 cutting operators and 30 finishing & packaging workers. It works on an efficiency of 68% with an absenteeism of 5-8% and an attrition rate of 15%. The shirt manufacturing unit consists of various departments, viz. fabric check point, fabric store, trim store, cutting department, fusing department, embroidery department, sewing floor, finishing department and packaging department.

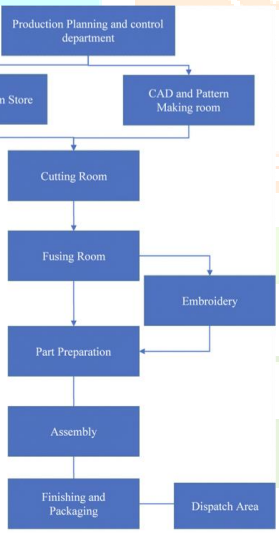


Figure 1.1 - Process Flow chart

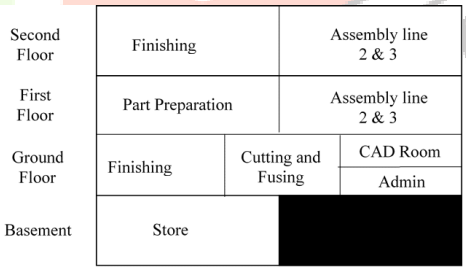
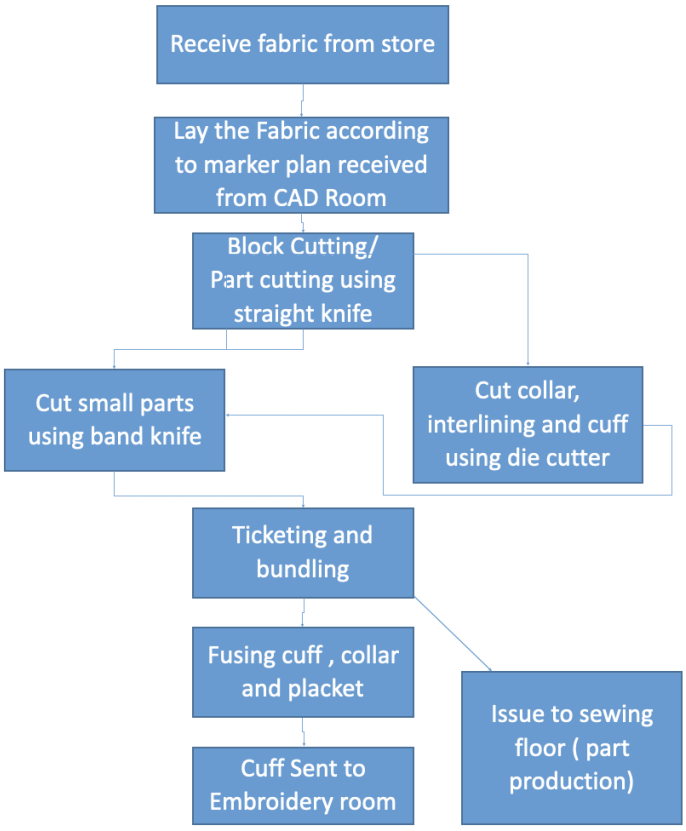


Figure 1.2 - Floor Plan of Manufacturing unit



2.1 Work flow analysis for cutting department

Figure 1.3 - Work Flow Analysis (Cutting Department)

Cutting room receives fabric from stores and CAD paper pattern from CAD room. The first process followed is laying the fabric. The process of laying is done on three tables of 7, 7.5 or 11 meter depending on requirement. After laying pins are inserted and simultaneously while pinning process is followed the layers are cut using straight knife and other auxiliaries like weights and lay holders. If the process contains checked fabric after laying and block cutting the fabric, the process of mitering and final cutting is followed by band knife cutting. In checked mitering increases the spreading and laying time by five times the normal time approximately.For cuff and collar , die cutting machine is used to cut them hence making the cutting accuracy maximum ensuring minimum defects due to cut part inaccuracy. While cut pieces are separated and kept they are collected by the ticketing and bundling workers to ticket them and send forward for fusing, embroidery or for further processing.The defected fabric parts are recut from blanketing fabric at later stage. Brown paper insertion method is used for defects in fabric rather than splicing Hence decreasing time consumed in marker making but the parts with defect are cut from the same lot of the part later.For fusing the collar , double fusing is used to increase the fall. One is called skin which is a woven fusing and other is called fixed which is dot mesh non woven fusing. Before sending the parts to the fusing belt they are laid on a paper and then using soldiering machine interlining are fixed onto the fabric to avoid any misplacement in fusing belt. Paper base for placement is used to increase number of parts fused in one go.
There are two fusing belt one is used to fuse the placket and other is used to fuse cuff and collar parts.

2.2 Work flow analysis for sewing department

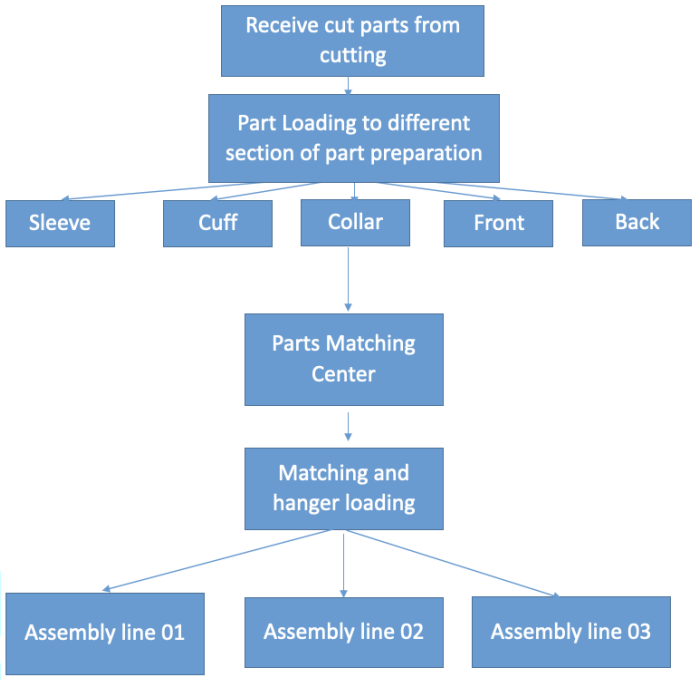


Figure 1.4 - Work Flow Analysis (Sewing Department)

Cut and fused part are received from cutting department which is loaded to various part production lines, that is , cuff, collar, sleeve, front and back. Once processed into parts they are checked in end line and bundled to send to centralized matching center wherein the parts of same bundle are matched and loaded together to the assembly lines. AVM has three assembly lines which has around 100 hangers each. They use over head assembly system.
Various folders and attachments are used to boost up production like pneumatic folders , yoke attachment folder, armhole attachment folder, Overhead lights for critical operation, binding folders etc.

2.3 Work flow analysis for finishing department

Finishing section add value to the product which attracts customers by the presenting activities of the product according to head office's requirements. Finishing department carries out various functions like thread cutting, rework station, spot removal, ironing, packaging, packaging trim attachment and to pack in cartons and make it ready for dispatch.
Finishing department has various machines like thread suction machine which due to air suction pressure removes all excess unwanted thread and lint from the garments surface giving an excess thread free garment, The spotting station has various chemicals to remove the dust , lint and spots formed during the process of production. There are various shirt folding machines which fold the shirt and make it ready for packaging in lesser time as comparative to manual folding process.

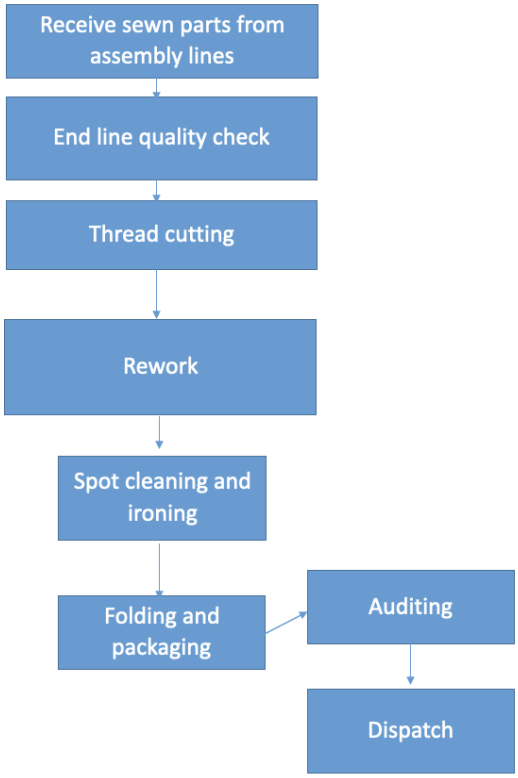


Figure 1.5 - Work Flow Analysis (Finishing Department)

4. Implementation of the project

Steps followed for implementation :

1. The available space for new material handling system is analysed.
2. Different material handling system is analysed. :Understanding the cost factor of new system vs polybags (currently in use)
3. The available space for material handling storage is calculated in cutting and part matching center.
4. The size of material handling system available in market best suited for space present and order quantity is researched.
5. The quantity of bins required according to no. of parts required and quantity of output per day is calculated

5. Findings

1. Analysis of current available space:

The available rack space was calculated and no of bins that can fit in the rack.
Space available = length of the each rack * width of the each rack * breadth of each rack
= (5.6* 10 * 6.5 + 5.4*7.5 * 6.5) cubic feet
= 627 cubic feet

The material storage rack contained 627 cubic feet of volume.

2. Material handling system analysis

1. Although unit production system is one of the best material handling system in apparel industry, there wasn't amble amount of space for installation. Also it was more expensive to install than the current system in use. Similarly, conveyor belt system had high cost involved for installation.
2. Slope system is one of the economically convenient system but required more space than other systems.
3. Bin system is comparatively cheaper to install but require manual force. Hence bin system with wheels (shopping cart system) is one of the suitable material handling system that can be installed.

3. Available space for material handling calculation

For cutting department, the size of best available bin is calculated and compared to the available space. The work in progress maintained in cutting department is for 4 days. 4 days would require 310 cubic feet of cut pieces volume which can be accommodated in 92 bins.

Bin Size	(1.3 * 1.3 * 2) cubic feet = 3.38 cubic feet
Space Availability	627 cubic feet
Total number of bins	92 bins for 4 days
Space required for 92 days	3.38 cubic feet * 92 Bins 310.96 cubic feet

Table Bin capacity in cutting department

For sewing department, per day production required is multiplied with the 2 day inventory level which is divided by number of pieces in each bundle and number of bundles in each bin giving the total number of bins.

Section	Number of bundles	Calculation	Total Bins
Front	20	(2800* 2)/ 20 *20	14
Back	30	(2800* 2)/ 30 *20	10
Sleeve	20	(2800* 2)/ 20 *20	14
Collar	70	(2800* 2)/ 70 *20	4
Cuff	70	(2800* 2)/ 70 *20	4
Total Number of Bins		14 + 10 +14 + 4 + 4	: 46 Bins for 2 days

Bin capacity in sewing department

Number of bins= Required output per day*Stock kept for 2 days /No of pieces in each bundle * No of bundles that can fit in carton

Total number of bins for each section is added together giving us 46 bins for 2 days of inventory level. Hence, 46 bins for normal working and 46 more for safety stock

For bin capacity in part matching center (inventory before feeding it to assembly), total rack space is calculated and the number of bins that can be accommodated.

Total Space Available in Matching center	8.04 ft * 3.6 ft * 9.3 ft * 2 racks + 4.5 ft * 8.04 ft * 3.6 ft * 1 rack
Number of bins that can be accommodated	35 bins
Number of pieces in 1 bin	80 front, 80 back, 80 collar, 80 cuff and 80 sleeves
Total number of garments in 25 bins	35*80 = 2800 Garments

Bin capacity in part matching center

4. Cost comparison of the new system vs old.

Investment on Polybags	Rs. 82,707 (for 4 months)
Investment on polybag for one month	Rs. 20,699
Investment on bin with wheels	Rs. 76,050 (one time)

Cost comparison

The cost is reduced to Rs. 76,050 which is a one time cost whereas polybags cost 82,707 quarterly.

6. Conclusion

This research has been carried out in a way that its findings and suggestions also could be practiced and implemented in other companies with similar situation. The concepts, methods, and theories mentioned and proposed in this study are general and well tested. The cost is reduced by multiple folds and also the bins can be returned back to the initial point without disposing the plastic bags which also reduces the effect on the environment. Hence the new system is more cost effective and economical system was installed.

7. Limitations & future scope

The shopping cart system is a short term solution to the problem, the industry is moving towards automation in material handling system day by day. Although it is cost effective in implementation, it doesnt have as major increase in productivity as anoverhead production system.

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