Inventory Management System for a General Items Warehouse of the Textile Industry

MUHAMMAD ASAD ALI[1], JAWAD ALI GUL[2], SYED MEHMOOD HASAN[3], SATYA SHAH[4]
Engineering Operations Management Group – Electronics Engineering[3,4]; Industrial and Manufacturing Engineering[1,2]
Royal Holloway University of London[3,4]; NED University of Engineering and Technology[1,2]
11 Bedford Square London WC1B 3RF[3,4]; University Road – Karachi[1,2]
UNITED KINGDOM[3,4]; PAKISTAN[1,2]

Abstract: - This research is based on Inventory Management System for a General Items Warehouse of the Textile Industry. The overall inventory is managed by applying classification tools such as ABC, FSN & HML that categorize inventory based on consumption value, issuance rate and unit price respectively. Also, it helps to appropriately position the items on the desired rack and position. The optimized layout is designed that reduces the retrieval time, uplift the storage capacity, and have the cross aisles that reduces the retrieval time of any item from the warehouse. The system for proper traceability & tracking of the items is also studied that is based on the 1D Barcode. This whole study improves the overall operation of the Supply Chain.

Keywords: - inventory management; classification; layout; tracking; FSN; fast-moving, slow-moving, and non-moving items; warehouse; textile industry; retrieval time; traceability; 1D barcodes; one-dimension barcodes.

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1 Introduction

The warehousing is one of the principle or component of supply chain, the products or items are stored to meet the demand. The flow of items or products can be controlled through the warehouses. These items need to be managed continuously after desired period, otherwise it may affect on cost and time [1]. In this era of industrial globalization, warehouse inventory management system has got much significance because it is contributing to the overall profit. The products are stored in the warehouse on large scale in very efficient way and meeting the requirement whenever needed. The warehouses are the ultimate requirement to store the different type of items to meet the production and customer demand [2].

The need for the classification of SKUs with an automated traceability and tracking system arises from the fact that unclassified SKUs lead to advanced retrieval time and causes delays in other warehouse operations, a layout with no prior planning of space utilization for SKUs and no Storage Location Assignment Policy (SLAP) may lead to paucity of the space, whereas, in contrast to automated system, a manually handled warehouse system may cause human errors and which could further effect utilization of the warehouse [3].

The primary goal in warehouse is the management of movement and storage of goods in such a way that they can easily be identified and are traceable in the most efficient way [4]. This paper reveals the methods of how an inventory management system should work, what classification techniques should be adopted with an automated traceability and tracking system and how should be a layout designed with what factors and policy being adopted.

However, an extensive study was performed to address such questions to fulfill the objective of this study in such a way that, different classification techniques like ABC, FSN and HML classifications were reviewed and FSN was selected amongst of all for some reasons based on the objective of this study for decline in retrieval time, which are addressed in classification section. Moreover, a tracking and traceability system comprising of barcodes, scanners and an automated excel generated algorithm was proposed to get the process automated meanwhile eliminating human errors, finally an optimized layout was designed considering classification technique as FSN and a SLAP for the proper placement of SKUs.

2 Problem Formulation

An Inventory Management System is the matrix of technology, process and procedure that overlook the control and maintenance of the stocked products, whether the products are company's assets, supplies, raw materials and finished goods.

There are several inventory models which are used to manage inventories such as ABC, FSN, VED etc. In single criterion classification, the different inventory management techniques such as ABC, FSN, VED and SDE are used individually with a single criterion defined for the classification of inventory items.

ABC (always better control) is an analytical tool for managing inventory. It enables the management to identify the high value items and low value items, for which each inventory item's unit price and usage are considered. The technical problems associated to protecting each item are also identified which helps in identifying the level of control for items. The high value items have more sophisticated level of control that's why their safety stocks are kept to minimum to avoid extra cost. On the other hand, low value items have large safety stocks and have lose control. There are three categories of items according to their contribution to total inventory value i.e. A, B and C category.

Furthermore, ABC is used to segment inventory items, which is based on classical 80 - 20 principle proposed by Vilfredo Pareto which states that 20 percent of causes generate 80 percent of results. The researchers then proposed method for controlling the inventory according to ABC analysis. It was suggested by the researchers that A items though are of less quantity, normally 5% to 20% of the total items, but are of more value and have greater impact on total inventory cost, nearly between 50% to 80%, so they are subjected to close control or more frequent control then the other items. Also, B items are subjected to regular control with quantity ranging from 20% to 40% and value ranging from 25% to 45%, and C items are subjected to lose control though they constitute many items normally from 50% to 70% but are of less value ranging from 5% to 25%.

FSN (fast, slow, non-moving) analysis is an inventory management tool which helps to identify those items that have high rate of consumption as well as items which are still i.e., they are not moving at all. The inventory items are categorized into three categories i.e., F-category items with high consumption rate, S-category items with slow consumption rate and N-category; items with no consumption or items which are dead.

In addition, every industry require inventory to meet the demand. Where, inventory items are frequently consumed and some are not, therefore proper placement of such items are essential for easy retrieval and subsequently reduction in retrieving time, in order to classify such items FSN (Fast, slow and Non-moving) method is used [5], which is based on the consumption pattern of items, that are fast moving and are placed at higher level due to greater consumption. This analysis is used to control the purchases of the items which are possible by identifying the unit prices of each item. In this classification, the items are classified into H, M and L categories referring to High price items, medium price items and Low-price items. In addition, some of the items in industry need special cure due to high cost and are important items. For such items HML (high, Medium, and Low item) classification method is used which is based on unit price of items.

A company holds inventory due to uncertain market conditions, abrupt demands, fail cushions and many other reasons. For this purpose, a company needs a warehouse. Warehouse is the place inside or outside the company which is used to keep the inventory of the company. Warehouse is very important for any company. They are amongst the key factor resulting the proper and smooth execution of the supply chain network [6], has divided the designing process of warehouse into three broad categories: Strategic, tactical, and operational planning. Layout design and determination is one of the most important and necessary tasks. Many researchers have worked on this matter to provide the optimal solution. The problems related to the design of the layouts of warehouse has been divided into two broad categories; Facility layout Design, which deals with the placement of different departments and Internal Layout design which deals with layout design of the order picking area only e.g., number of racks, number of cross isles and pick isles etc. Our main interest also lies in the designing of the Internal Layout of the warehouse but the main hindrance in this is that there is very limited research on this topic [6]. The internal layouts have further been classified into two further categories: Conventional/traditional layout and Non-traditional layout. The conventional layout incorporates those layouts in which the racks are placed either horizontally or vertically. For traditional layout the length to width ratio for an optimal layout approaches 1:2 [7].

Conventional Warehouse layouts with cross-aisles are much more efficient (in terms of retrieval time) than those without cross-aisles [8], but according to [9], even these layouts results are not as efficient to the Non-traditional Layout, which provides shorter paths by providing shortcuts. In these layouts, the pick aisles are horizontal or vertical, but the cross-aisles are not required to be perpendicular to the pick aisles.

Three major non-traditional layouts are Flying V; in which the cross-aisles forms a big V starting from the depot and all the pick aisles are parallel to each other (vertical), Fishbone layout; the cross aisles form V and the pick aisles above the V are vertical whereas the pick aisles below the V are horizontal, Chevron; it has one single cross aisle and all the pick

aisles are in V shape. This layout is suitable for very large facility and is optimal for multiple depots.

Layout alone cannot enhance the efficiency of warehouse because mostly, the efficiency of the layout is measured through the retrieval time and retrieval time also highly depends upon how things are placed within the layout meaning that efficiency depends upon it. This is known as storage location assignment policy (SLAP). According to [10] there are two main factors which control the performance of the warehouse: the specified allocated space and retrieval time. This can be achieved with the help of proper storage allocation. SLAP is generally incorporated at the designing stage of warehouse to make it effective and economical which is one of the fundamental criteria of a warehouse [11] because the mere adaptation of expensive ERP system cannot help in doing this [12]; [13]; [14]. Three main types of storage location assignment policy have been placed forward by [15]; [11] dedicated storage, random storage, and class-based storage.

Dedicated Location Strategy is one of the methods that provides the optimum allocation of the products in the storage area. In this method, each product has a fixed location in the storage area i.e., a specific location in store is allocated to a product and that space cannot be used by any other product despite the space being available at that time. In randomized or shared slot policy/strategy, any free or available space is used to place the item in the storage system [16]. Class-Based Storage system, basically a combination of Dedicated and Random Location storage policy. In this system, a maximum space required by a class/group of products throughout the year is calculated and then a fixed space is allotted to that class. In that space, the products of that specific class can be kept anywhere. This is suitable for a place where the item variety is less, and a better tracking system is available.

Barcodes (1D and 2D) are straight forward printed machine-readable patterns where data is encoded utilizing graphics and offer low fabricating cost and strong readability. They are widely used in numerous commercial applications counting transportation and warehousing. The application of barcodes in data storage and retrieval system is useful at all business levels. The barcode technology is also used in warehouse management system and logistics. Barcode technology has become very popular and is being used in many businesses worldwide. They are widely used in manufacturing companies, warehouses, shopping malls or retail stores and hospitals for the unique identification of an entity. The barcode technology is also famous in medical fields as the record keeping for each medicine is complicated even if the system is computerized, so to meet the requirements barcode technology is integrated into the system [17]. Barcodes traditionally represent the data by parallel width and spacings and may be of two types i.e., 1-D Barcodes and 2-D Barcodes.

Barcodes vary in various parameters such as configuration in multimode or alphanumeric, width and the generation algorithm of barcode. These barcodes are not readable by human eye and hence required special hardware named as barcode reader. The scanner for barcode use OCR (Optical Character Recognition) technology to decode the information that is hidden. The scanner recognizes white spaces and bars that are encoded with information, scanner extract or decode the information and display the data with actual finding and integrity. Barcodes that contain information are brought into the computer by using some cameras. The captured image contains the information. The colorful image is converted into grayscale to increase the readability [18].

QR code may be scanned from phones or scanner with access of internet, as a result user can receive the information about origin and real-time conditions. RFID tags were also used along with QR codes in many projects for determination of location through GPS, temperature measurement, moisture [19]. A traceability concept shown in [20], where the field data are collected with the help of web-based system integrated with QR code system for processing of data. To develop a system of traceability based on QR code, it is necessary to make sure the fast and easy decoding as well as code ruggedness [21]. Two-dimensional code that is QR code, is most often used [22], and keeps an adequate amount of information, maintain exceptionally great readability and coherence even on little size labels, and which moreover has exceptionally great readability in case of physical harm or damage of a portion of the code.

2.1 Classification

It is possible to employ ABC-analysis for the formation of model for rational inventory management policy which can minimize the production investment cost and can give the best possible service level to production. ABC-analysis attempts to show the importance of each item based on its value and puts a suitable level of control for each item. ABC-analysis was used to classify items

based on value. "A" item, though are less in quantity, normally 5% to 20% of the total items, but are of more value and have greater impact on total inventory cost, nearly between 50% to 80%, so they are subjected to close control or more frequent control then the other items. "B" items are subjected to regular control with quantity ranging from 20% to 40% and value ranging from 25% to 45%, and "C" items are subjected to lose control though they constitute many items normally from 50% to 70% but are of less value ranging from 5% to 25%. ABC-analysis is an appropriate technique for classifying items based on their contribution to the annual inventory cost and is the basis for material management processes.

ABC analysis is the most efficient method to control and reduce total inventory cost. The items of industry's inventory were analyzed by the following methodology.

- Items with consumption value were identified first.
- The unit cost of each item was known.
- Consumption of each item was multiplied with the unit cost of that item. In this way the total value of each item was known.
- Items were then arranged in descending order with the items having high consumption value being kept at the top.
- Items were then sorted out in three categories: items with high consumption value, B items with less proportion of the consumption value and C items with very low value.

Below is the control policy for ABC items.

Industries do not require all inventory items for manufacturing with the same frequency [23]. Some items are needed more frequently than others and some are needed very rarely. Keeping all the items in store without knowing the actual frequency of usage and demand of each item, is not always the best option for any industry. Investing capital in those items which are less required or have very low frequency of usage results in increase of total inventory costs. Avoiding this, industries use FSN-analysis to maintain inventory according to their usage or demand. FSN analysis categorizes items into three groups, F-fast moving items, S-slow moving items, and N-nonmoving items respectively. All these three categories have different inventory policies as the category suggest. Inventory items are analyzed using turnover ratio and some other techniques depending upon the nature of the data [23].

Turnover Ratio= Annual Demand/Average Inventory

Items whose turnover ratio is more than 3 are kept in Fast moving items category. These items are generally 10%-15% of total items. Items with turnover ratio between 1 and 3 are kept in Slow moving items category and are generally 30% -35% of total items. Items with turnover ratio less than 1 are considered as Non-moving items and they are generally 60%-65% of total inventory items.

FSN can also be categorized by calculating inventory holding days, after analyzing all the items based on above-mentioned criteria, different managing policies are set for each category separately which is shown in the table below.

Table 1 Particulars of FSN Analysis

Particulars	F-Class item	S-Class item	N-Class item
Stock	High	Intermediate	Low
Control	High	Intermediate	Low
Check	Tight	Intermediate	No
Safety stock	High	Low	Rare

HML analysis is used to control the purchases of the items which are possible by identifying the unit prices of each item. In this classification, the items are classified into H, M and L category referring to High price items, medium price items and Low-price items. Moreover, HML helps to maintain the level of inventory at optimum level and reduces the space and inventory holding cost up to large extent [24]. The criteria set for these three categories is mentioned by [25]:

- H-category items: about 10%-15% of items usually and are costly.
- M-category items: about 20%-25% of items and have moderately low cost.
- L-category items: about 60%-70% of items and have very low cost comparatively.

2.2 Layout

In randomized or shared slot policy/strategy, any free or available space is used to place the item in the storage system. The total capacity required by the

storage area in this type of system can be calculated by selecting the maximum value from all the occupied space in inventory.
The most difficult part of this policy is, it becomes very difficult to know the current location of a particular product and is applicable to place where there is an advance tracking and traceability system or warehouse management system (WMS).
This is basically a combination of Dedicated and Random Location storage policy. In this system, a maximum space required by a class/group of products throughout the year is calculated and then a fixed space is allotted to that class. In that space, the products of that specific class can be kept anywhere. This is suitable for products having less variation and have a better tracking system available.
But a large drawback in the above-mentioned storage optimization analysis was found that it doesn't consider retrieval time of the products which also affects the cost directly [10] so a new tool was developed to resolve this issue. This new tool considers the following factors: [10]

- Storage area layout design
- Data analysis
- Inventory management

The first tool of this new tool is performing as-is and what-if analysis in a modifiable layout of the warehouse. Certain KPIs (like distance from depot, retrieval time etc.) are set to compare the alternative layouts. As-is analysis can be used to measure the current performance of the storage system (by factor weighting method of the KPIs) and what-if analysis can be used to measure the future performance of the storage system if any changes are made in the layout for studying their effect of KPIs.
Second part consists of the analysis of data. In this section, the maximum and minimum number of locations/places required by all the products to be placed are calculated.
After successfully analyzing the data, the same SKUs are classified into fast, slow and non-moving items. And then by considering the constraints (area of warehouse, height of racks, size of ladder available etc.), total space for un-racking items and total required slots are calculated, Inputs and outputs of the storage facility are determined. Thenceforth the distances from each slot are measured in which both the vertical (from ground) and horizontal distances (from depot) are both covered which in turn provides the retrieval time of the product placed in those slots [10] and in this way the slots are classified into hot, warm, and cold slots.

- Hot slots: easily accessible and near to the depot
- Warm slots: at a little distance from depot
- Cold slots: farthest from depot

Another method that has been suggested by [26]. In that method, all the products are classified into Fast moving, slow moving and non-moving items and after that they've been further classified on the basis whether they can be placed on racks or shelves, forming the category of racking items or if they cannot be placed on racks and are to be stored on ground forming the category of un-racking items. For this, their size and weight were measured. After complete collection of data, a matrix was formed of the data of FSN and Racking and Un-racking items, and on that basis, a layout was designed.

2.3 Traceability & Tracking

Tracking is very known phenomenon and is very common but the system through which the tracking is carried out is all a matter of concern, most of the warehouses in multinational as well as in local companies use Barcode Tracking system along WMS. The reason to use barcode over RFID in these warehouses is that the setup and operational cost of Barcode Tracking system is very cheaper than RFID. In addition, barcodes are machine printable codes and can be printed easily on any paper (requiring open-source barcode) whereas RFID is small chip that cannot be printed or fabricated easily at the time of receiving of retrieving items through warehouse.
The modern network of supply chain in textile industries uses a tracking system that incorporates suppliers, producers, distributors, and retailers [27]; [28].
The modern warehouse system is making easiness in managing items or commodities. this automated tracking system has reduced workload by 25-30 percent approximately, and this rate might be increased up to 50 percent when everybody is completely trained. To implement or actualize a barcode enabled WMS, the project given the Central Warehouse with modern hardware and computer program (software), that includes computers, servers, printers, and barcode scanners. The new framework benefits in such a way that:

- The management of large shipments received has improved.
- The distribution of items becomes easy.
- Management of expiries are improved or large warehouse, location management is improved.

A detailed study and research were made to obtain some related algorithm and open sources for barcode generation. Eventually, Barcode was generated through Excel by putting Algorithm of Code 39 and changing the font to code 39, which was obtained from the font pack. Code 39 was selected for the proposal because this is currently being printed by the company and it has a simple algorithm with no prone to errors in decoding.

Classification	No of items	% of items	Total stock value	% of total holding days
H	249	10%	18,390,690	88.56%
M	500	20.00%	1,926,807	9.27%
L	1,752	70%	447,571	2.16%
Total	2,501	100%	20,765,068	100%

- Code 39 is the most used to form Barcode.
- The information to be encoded starts and ends with Asterisk '*'
- After the algorithm is applied, the code 39 font is used.
- The information is then encoded successfully.

3 Problem Solution

After collection of the data, different inventory management techniques were reviewed and came to a decision about suitability of technique as far as this case is concerned. Since, Objective of this paper includes identification of aged items and removing them as they occupy a large space in store, organizing SKUs in a proper way with the suitable inventory management technique and placing items according to their frequency of consumption for easy retrieval. Therefore, these ABC, HML and FSN techniques were finally decided to be used for some specific reasons defined below.

Since there are many inventory management techniques available but they are used according to the objective for some specific works and out of which, these three techniques, that is ABC, HML and FSN were taken into consideration for the classification analysis, as the current scenario of production site warehouse predicts to have issues like shortage of floor space, increased retrieval time, increased number of dead items. To tackle these issues, FSN analysis is the most suitable. With this analysis, dead stock can easily be identified, items which have almost no stay in store i.e., they are received and issued on the same date or items which are frequently used. FSN analysis also helps in arrangement of items based on their consumption rate which ultimately reduces retrieval time.

Moreover, ABC and HML analysis will help in finding the value of items and will ultimately give some control policies regarding where to place expensive and inexpensive items. Since there are imported items in store and they are consumed rarely (spare parts of machines etc.) but are expensive, therefore, they need to have a separate place instead of placing them in an open rack, where they could get rusted or expired off. Hence, ABC and HML analysis will eliminate such problem, which is also a concern in the objective provided.

Below are the statistics of the ABC classification applied to three-month data provided by the company.

Classification	No of items	% of items	Total value	% of total value
A	182	7%	108,596,054	74.90%
B	527	21%	29,077,150	20.06%
C	1792	71.57%	7,248,470	5.00%
Total	2501	100%	144,921,674	100%

Table 2 Statistics of ABC Analysis of Items

From the table, it was found that from a total of 2501 items, 182 are those which fall into A-category and are 7% of the total inventory items, they constitute around 75% of the total inventory value, 527 are those items which fall under B-category and are 21% of total inventory items, they contribute 20.06% of the total inventory value and 1792 items fall under C-category, and are around 72% of total items, which contribute 5% of the total inventory value.

From the statistics of ABC analysis, it is very clear that A category items need more sophisticated control policy. Since, they are most expensive items and generate more value than other inventory items. Similarly, B category items require medium control as compared to A category, and C category items can be kept in lose control as they are less valuable as compared to other two categories but require a large space in store as far as their quantity is concerned.

The total number of items in the store was 2501. The results obtained from HML analysis are shown in Table 4.2. It was found that high price items were 249 in number and 10% of the total inventory items, and these items have 88.56% of total holding days in store. Therefore, this makes it clear that they constitute a major portion of inventory cost. Similarly, medium price items were found to be 500 in number and are 20% of total items with a total of 9.27% holding days in store. Similarly, low-price items were found to be 1752 in number, which is a large portion of items as compared to the H-price and M-price items. The total percentage of Low-price items is 70% and have a stay period of 2.16% in store.

Table 3 Statistics of HML Analysis

After applying FSN on over all data without considering the category in first phase, below are the statistics in which, it was found that 144 items fall in F-class category with the stay period of 1 to 2 days, 262 items fall into S-class having 3 to 21 days of stay period and there are 880 items falling in N-class with a long stay period of 22 to 2361 days. Furthermore, above table shows a total number of SKUs to be 1286 excluding dead and temporary stock. As they were identified and separated which comprised of 791 items and items with no stay in the store comprises of 47 items. Layout for the placement of SKUs is also finalized, which is based on FSN analysis mentioned in the layout section. In a way that fast-moving items will be placed near the exit or at a feasible position in the rack for the reduction in retrieval time and for ease in picking and placing items and likewise for S and N-class items. Below are the statistics of total SKUs in table, depicting number of dead stock and those items which are received and retrieved on the same date having temporary stay in the store and the number of those items on which FSN is applied.

Table 4 Statistics of FSN Analysis on Overall SKUs

Classification	No of items	% of items	Total stock value	% of items holding days
F	144	11.19%	3,998,345	7.24%
S	262	20.40%	4,697,448	8.51%
N	880	68.40%	46,522,119	84.25%
Total	1,286	100%	55,217,911	100%

Place and classifying items without grouping them into category also makes it difficult for the worker to place and retrieve items and causes problems when they are very in need of that item. Therefore, FSN is also applied in each category to find which items are fast, slow, and non-moving based on category. It will make the situation easy in such a way, now workers would just need to know the place of a particular category and can retrieve or place items easily. Finally, items were placed in group's category wise as shown below.

Table 5 Fast, Slow and Non-moving Items in Each Category

Category	F	S	N
Mechanical Items	25	53	184
Machine Spare Parts	35	73	257
Electrical Items	38	79	251
Printing & Stationary	13	29	95
General Items	18	14	79
Leno Threads	3	3	7
Oil & Lubricants	1	1	5
Packaging Materials	1	3	11
Medicines	1	1	0
Chemical Items	1	1	2
Computer Items	1	1	0

Above table, depicts the items based on FSN in each category, and found which category is fastest moving in all categories by considering the stay period of each category. However, the above arranged category is in the order that Mechanical items category is fast moving then mechanical spare parts is fast then electrical items and so on. 25 items are fast in mechanical items and 35 items in machine spare parts which are greater in number but the items holding time in those machine items is less than those in machine spare parts and this how the priority in category is decided with an order arranged shown in table.

Table 6 Dead Stock in Each Category

Dead Stock	No of SKUs
Machine Spare parts	785
Machine Items	214
Electrical Items	153
General Items	8
Computer Items	1
Oil & Lubricants	1
Printing & Stationary	6

Dead stock are the items consumed rarely and have very long holding period and needed to be identified and removed because it consumes high holding cost and a large space which could be utilized by those items which are fast moving.

Therefore, dead stock category wise was identified and decided to place them on the first floor of the main store as its empty and not being utilized anymore, this is how enough space will be available in the store and will be able to place those items at desired place, there will not be any blockage in pathways, worker can move easily for placing or retrieving items. It can be Seen in Table 8 that many dead stocks are found in Machine spare parts, since spare parts are rarely utilized whenever there is a problem or breakage of machine parts, then machine items are on second number having 214 items considered as dead stock and so on.

Layout Design

Before designing a new layout, the current layout must be analyzed so that mistakes in the current layout do not repeat in the new one and so it can be used for comparison of current and proposed. Once when done with visual observation, parametric values were needed to be collected like racks size, placement of racks in the provided area, their distance from the depot. Through this a current layout was drawn. Furthermore, fifty sampled SKUs were randomly selected, and their distance from depot was measured with the help of measuring tape. The measured distance thus was divided with the average worker's walking velocity, resulting the estimated retrieval time of the sampled SKUs. Furthermore,

with the help of the "Classification Data", the category to which a specific SKU belongs.

After performing the above-mentioned method, it was found that no classification was being followed in the current layout (neither FSN, nor ABC). the condition was this bad that in many places the non-moving items and C classed items were placed near depot and the fast-moving items and A classed items were placed farthest from the depot. Storage location assignment problem deals with the placement of items in the warehouse or store. This tool helps in increasing the efficiency of the layout and its productivity.

Once all the Pre-Requisites for the Implementation of SLAP were performed, Finally, SLAP was implemented. The initiation for the implementation was taken on the excel file, where a specific place was allotted to each SKU. Then, it was further traced in the layout for proper identification of the placement of each category on the layout so that it can easily be understood by the labors and staff of the store.

SKU Classification

Through the data provided by the company regarding their SKUs, they were classified into ABC, FSN and HML. Through detailed study of the classifications, FSN was selected to arrange the items in storage location assignment policy. The following facts which defend the selection of FSN are:

- Retrieval time of the SKUs was to be reduced so FSN was preferably best as it arranges the items based on the frequency of their movement.
- Forming a storage assignment policy based on HML wouldn't result in a desired outcome as most of the high-cost items are rarely required in the factory and so are retrieved rarely and thus will block the locations near the depot. Those items which are often retrieved will be pushed back and thus retrieval time will be increased.

4 Conclusion

The following study can provide several insights related to the system of inventory management that can be effective as well as beneficial for warehouse managers and other staff of warehouse of the textile industry for general items. The study incorporates inventory management techniques that are comprised of ABC, FSN as well as HML analysis to arrange items based on their consumption rate and price. Furthermore, the category wise placement of items can reduce the holding cost and enable managers to utilize the remaining space in layout for productive task. In addition to this, employees can also find out how the retrieving as well as tracking systems work after arranging items based on their respective category. A well-managed inventory can lead to reduction in the investment cost of production as well as provide services at production level. Also, the system of inventory management can be applied to almost any industry where the movement of goods takes place whether in the form of raw materials or a finished goods. Inventory management is the most critical process in every business but if it is managed well, it will not cause continuous stock outs, high inventory cost and low inventory turnover rate.

In today's manufacturing world, every company strives to maintain balance between critical stocks and inventory holding cost, which occurs mainly due to the dead inventory. Therefore, SKUs were classified using FSN inventory management technique. It was found that there were around 37% of items having nil consumption rate or they are insignificant and occupied a large space, blocking the pathways for the worker and ultimately contributing increment in retrieval time but once FSN was applied, it was ensured that items are placed with their category, so that the worker can easily trace the location of items, keeping in mind that each category can have more than one location as FSN was applied in each category. Consequently, Items were properly arranged and placed according to their consumption rate, identification of dead stock helped in freeing extra space occupied by the dead stock i.e., clearing pathways for the worker, making it easy for the worker to place, retrieve and reporting the items, which ultimately decreases retrieval time.

Furthermore, space left after shifting dead stock to the first floor was further utilized by fast-moving and slow-moving items, which is contributing more decrease in retrieval time. In addition to this, those imported items falling into non-moving class were shifted to the first floor to be placed in Almirah, that is freeing more space for the temporary items to be placed in quarantine area (extended) and those which were fast-moving were placed within the store and control measures were suggested for categories.

In nutshell, implication of FSN technique helped in arrangement of SKUs based on their consumption rate, identified the dead stock, cleared pathways, contributed decrease in retrieval time and ultimately increased the efficiency and productivity of the workers and operation.

Once, the proper layout was designed and analyzed, it was found that the Quarantine area was increased by 33% and office area by 72% by

providing two-story office Other than this, the new store design was more efficient and secure with window drop off and cross aisles for shifting between the pick aisles. This new layout also had a pathway from outside directly to the lift for proper space utilization. Further implementation of the new storage assignment location policy insured to increase the efficiency of the layout, by making sure that the fast-moving items are placed nearest to the depot, ensuring their quick retrieval. Other than this, it became easy for existing and new workers to identify the location of an SKU as it was made sure that items are placed with their categories, though one category can have more than one location as they are also divided into Fast, slow and non-moving and secondly the racks coding was coded in such a way that they could easily be interpreted by the workers. This helped in a further decrease of the retrieval time.

In short, the new layout and the storage location assignment policy increased the efficiency of layout by reducing the retrieval time and distance of the SKUs, thus simply improving the productivity of the workers.

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