Journal of Industrial Engineering and Halal Industries (JIEHIS)
P-ISSN 2722-8150, E-ISSN 2722-8142
Vol. 5 No. 1 June 2024, Pp 29-35
https://doi.org/10.14421/jiehis.4677

Submitted: 2024-06-19
Revised: 2024-08-03
Accepted: 2024-08-10
Online: 2024-08-15

Implementation of Class-Based Storage for Garment Accessories Warehouse Management Using FSN Analysis at PT. XYZ

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Abstract

A manufacturing company has a close relationship with warehouse operations, which function as centres for storing and managing raw materials and finished products. Proper operational expertise is essential in warehouse management to ensure that all processes within the warehouse run smoothly. The warehouse is a meeting point for various raw materials with different specifications, making it highly susceptible to mismanagement. In this context, several issues have been identified in warehouse management, such as a lack of space or empty shelves, outdated data recording processes, and improper placement of raw materials. An analysis was conducted to identify accessory items in the warehouse based on their similarities using class-based storage to overcome these issues. In this study, the FSN (Fast, Slow, Non-moving) analysis method was used to determine the grouping of garment accessory items based on their production usage and movement in the warehouse. A total of 37 types of accessory items were identified, with the majority, 23 items, classified as fast-moving, indicated by a high turnover rate above 3. The remaining items were categorized as slow-moving and non-moving, with turnover rates below three due to their lower movement. The turnover rate indicates how often or quickly an item moves and is used (enters and exits the warehouse). Thus, several underlying causes of the issues hindering the distribution process in the garment accessories warehouse at PT XYZ were identified. Subsequently, several recommendations were provided for warehouse management, such as improving the layout according to item grouping and conducting regular evaluations to ensure a balanced availability of space and stock. This strategy is crucial for enhancing workers' productivity in the garment accessories warehouse.

Keywords: Class Based Storage, FSN Analysis, Garment Accessories, Inventory, Warehouse Management.

INTRODUCTION

Manufacturing companies are inherently linked to warehousing, crucial in managing raw material availability and ensuring efficient distribution to production departments. Warehouses typically store various goods in different quantities, sizes, and movement frequencies. There are several warehouse layout issues, such as incorrect placement or overloading of storage shelves, which often cause operational problems by leading to the mixing of raw materials and complicating the search process. It is known that the most frequent process in a warehouse is the picking or distribution of materials. This process heavily relies on the implementation of product placement according to the procedures or policies of the company to ensure that the materials are easily accessible (Silva et al., 2020).

Additionally, several problems arise from less-than-optimal warehouse management, including inaccurate procurement processes, which can cause either a buildup or shortage of production raw materials. Accumulation of items can reduce the free space that could be allocated for other raw materials. Another significant issue is managing raw material inventory data. The inventory recording process, which is still manually (handwritten) and not updated regularly, will result in real-time data discrepancies (Wibowo et al., 2022). Based on the warehouse problems, improvements in raw material management are needed to ensure the supply chain process can run efficiently. It is noted that inappropriate inventory control mechanisms and placement of raw materials lead to less optimal management efficiency, resulting in increased inventory costs (Nainggolan & Siagian, 2020). Both factors are interrelated in determining the success of warehouse management.

PT XYZ is a garment manufacturing company that produces a wide range of fashion products and serves international customers from various countries. As a typical manufacturing company, PT XYZ operates a storage warehouse that houses all raw materials and finished goods for sale. Within the company, there is a dedicated warehouse for storing fashion accessories. This accessories warehouse features various large storage shelves designed to accommodate various items. However, the current layout of the accessories warehouse, which follows a common design used by many companies, presents several issues. Limited space has led to challenges in shelf management and storage organization. The lack of adequate facilities for space and shelves can negatively impact the supply chain, particularly the delivery to the main production department. Difficulties locating the products needed can impede productivity and potentially cause delays in work processes. Optimizing the availability of space and improving the layout design is crucial for enhancing supply chain efficiency. Proper storage space and layout management not only helps prevent raw material damage and mixing issues but also aims to avoid mismatches and improve overall process reliability (Sugiarto & Suprayitno, 2023).

Therefore, to reduce the negative impact of warehouse management that could be more optimal, it is necessary to conduct a study regarding the groups of raw materials in the accessories warehouse. The grouping or class-based method divides a collection of items in a warehouse into several groups based on the indicators used. This class-based method is considered very effective in improving storage management and has been proven to improve management performance in the industrial sector significantly (Tippayawong et al., 2013). This grouping process research uses the FSN analysis of the turnover ratio value. This analysis method is an application of class-based storage, which aims to determine groups of accessory raw materials based on their movement speed in the warehouse. This method can determine how often the goods are consumed or the speed at which the goods move in the warehouse (Jobira et al., 2021). Understanding this condition can serve as a valuable reference for developing more effective warehouse management strategies. Companies can enhance operational efficiency and reduce search times by implementing a class-based storage system, where raw materials are organized based on type and usage frequency. This approach will facilitate the process of retrieving and storing items and decrease the likelihood of production delays due to warehouse management issues.

Warehouse

Warehousing is a crucial component in various companies that has a purpose to serve as a storage facility. In supply chain management, the warehouse functions as a link between consumers and customers and is a benchmark for the success or failure of a company (Saderova et al., 2020). According to Mulcahy (1994), a warehouse is a place for storing various products with storage units in small or large quantities. Warehouses exhibit diversity in physical form (design and size) and usage requirements, tailored to the company's needs in managing goods and implementing applied supply chain flows. In companies, warehouses typically store raw materials received from suppliers before production and finished goods before distribution to customers.

Class-Based Storage

Class-based storage is a management approach in a storage area such as a manufacturing company warehouse. This approach can help the process of managing inventory and storing raw materials before they are distributed in the production process. The primary purpose of class-based storage is to organize the grouping of types of raw materials into certain classes (Candrianto et al., 2020). This class-based storage concept has several implementation methods: ABC Analysis, VEN Analysis, XYZ Analysis, and FSN Analysis (Madan & Ranganath, 2014). Goods or raw materials in the warehouse are grouped or placed in one place based on similar type, function, and size. The output of implementing class-based storage can be used as inspiration for designing storage and inventory management strategies by classification. It can help minimize picking time, optimize storage space, and increase response to customer requests.

FSN Analysis

FSN Analysis is one method of implementing class-based storage. The purpose of this analysis is to classify or group raw materials or products into specific classes. The grouping concept in FSN analysis is based on the speed of movement in the warehouse. Apart from that, average data on the use of each raw material is also used as a reference when calculating this method. There are three class divisions, namely class F (Fast-Moving), class S (Slow-Moving), and class N (Non-Moving) (Mor et al., 2021). Classifying the class can be determined based on the TOR (Turn Over Ratio) value, which describes the ratio of annual raw material usage and is related to the average warehouse inventory. In this FSN analysis method, the TOR value is determined based on the quantity of raw materials in the warehouse divided by the average inventory (Devarajan & Jayamohan, 2016).

METHODS

This research focuses on the condition and quantity of accessory items viewed through their movement within the storage warehouse. It is known that there are many types of storage shelves available for accessory items at PT XYZ. Each type of accessory item has diverse functions and quantities, resulting in different frequencies of movement and usage. This research uses storage stock data listed on each accessory item, referred to as stock cards. Data collection is carried out regarding stock, which includes the number of items coming in and going out within the last six months. Thus, the movement of accessory items can be understood based on the restocking (input) and usage (output) rates.

From the inventory card data collection, 37 types of accessories were identified that will be used to complement the parts of garment products at PT XYZ. All these accessory items are stored on 13 shelves, each with a specific function tailored to the brand or item specifications. Next, a classification of accessory items in the PT XYZ warehouse was conducted using the FSN analysis method, which was determined based on their turnover ratio. The output of this research is classifying accessory items based on their movement levels and providing improvement recommendations based on the characteristics of these item groups.

RESULT AND DISCUSSION

Data Collection

The collected data represents the movement of accessory items based on the current quantity, item inflows, and item usage over the past six months. The collected items vary widely, including packaging plastic, thread, labels, stickers, crunches, zippers, etc. This data will be used for further processing with the class-based storage concept, specifically employing the Fast, Slow, Non-Moving (FSN) analysis.

Table 1. Initial Data of Accessories Items in Warehouse

No	Item Name	Initial	Input	Output		No	Item Name	Initial	Input	Output
1	Coats Aptan Trd	402	4,973	3,282		20	Main Label	20,805	219,232	105,047
2	Coats Astra Trd	196	19,036	9,844		21	Metal Buckle	962	107,009	71,255
3	Coats Aptan AW Trd	290	1,710	1,121		22	Plastic Btn	26,677	41,776	7,500
4	Coats Aptan W Trd	480	4,679	3,607		23	Price Ticket	3,240	13,805	10,565
5	Coats Epic Trd	380	9,504	4,765		24	Polybag	9,786	130,565	70,911
6	Coats Nylbond Trd	381	4,720	2,642		25	Printed Sticker	32,172	139,710	92,572
7	Coats Polyester Trd	353	3,819	2,282		26	Rvt Anti Brass	401	6,530	2,879
8	Btn Anti Silver	858	20,785	19,410		27	Rvt Anti Copper	348	10,687	10,065
9	Btn Disco Ball	873	5,243	3,993		28	Rvt Anti Silver	6,000	59,293	38,088
10	Btn Matte Silver	141	10,565	7,786		29	Rvt Antique Brass	11,844	12,728	11,887
11	Btn Frosted Tin	940	2,796	2,570		30	Size Label	4,079	46,072	14,353
12	Btn Matte Black	356	6,141	5,418		31	Black Crunch	57	274	77
13	Btn Pearl Gunmetal	103	544	519		32	White Crunch	135	369	84
14	Care Label	7,370	178,967	43,296		33	Woven Hangtag	14,512	55,937	11,903
15	Co Label	16,141	134,770	54,334		34	Woven Label	19,277	21,514	1,667
16	Fit Label	18,178	59,074	18,930		35	Zipper Ideal	5,106	324,374	158,136
17	Kagan Trim	69	697	601		36	Zipper YKK	20,345	557,448	213,781
18	Leather Label	483	4,259	3,296		37	Zipper SAB	12,190	165,251	88,272
19	Leather Patch	10,215	29,431	19,216						

The next step is to calculate the turnover ratio for each accessory item based on the data collected. The following are the calculation steps to determine the turnover ratio for classification based on FSN analysis, illustrated through an example with Coats Aptan Thread. This process aids in identifying the appropriate category and management strategy for each type of accessory item.

Data Processing

1) Calculating the ending inventory (EI)

$$EI = Initial\ Inventory + Input - Output \tag{1}$$

$$EI\ of\ Coats\ Aptan\ Thread = 402 + 4{,}973 - 3{,}282 = 2{,}093$$

The calculation of ending inventory uses input and output data to determine the results. In the first calculation, the ending inventory for the item totals 2,093 units. This process involves shelving the flow of goods to ensure an accurate ending inventory level.

2) Calculating the average inventory (AI)

$$AI = (Initial\ Inventory + Ending\ Inventory)/2 \tag{2}$$

$$AI\ of\ Coats\ Aptan\ Thread = (402 + 2{,}093)/2 = 1{,}248$$

The average number of accessory items stored on warehouse shelves can be determined based on the above calculations. For example, the calculation for Coats Aptan Thread items shows an average of 1,248 units stored over the past six months. Depending on production needs, each accessory item will have a different average storage value. This variability highlights the importance of tailored storage strategies to meet specific demand patterns.

3) Calculating partial inventory for the observation period (TORp)

$$TORp = (Amount\ of\ Items\ Used)/(Average\ Inventory) \quad (3)$$

$$TORp\ of\ Coats\ Aptan\ Thread = 3{,}282/1{,}247.5 = 2.63086$$

The partial turnover ratio indicates the frequency with which a specific product or accessory item exits storage or is used in the production stages at PT XYZ. This calculation considers a specific duration, providing a more detailed view of the frequency of use for each item. For example, the calculation shows that the accessory has a turnover ratio of 2.63, meaning that the item is replaced or used approximately 2.63 times during the specified period.

4) Calculating the inventory period (IP)

$$IP = \frac{No. Days\ of\ Observation\ Period}{TORp} \quad (4)$$

$$IP\ of\ Coats\ Aptan\ Thread = \frac{180}{2.63} = 68.42$$

The calculation results above illustrate the storage duration of an accessory item in the warehouse of PT XYZ, with an inventory period value of 68.42. This value can be compared with other accessory items as a benchmark for warehouse management. The larger the inventory period value, the less frequently the item is removed or used in production, indicating a longer storage duration. Conversely, accessory items with a low inventory period value indicate a higher frequency of use in production.

5) Calculating the Turnover Ratio (TOR)

$$TOR = \frac{Number\ of\ Days\ per\ year}{Inventory\ period} \quad (4)$$

$$TOR\ of\ Coats\ Aptan\ Thread = \frac{365}{68.42} = 5.33$$

This calculation is the final stage of determining the category-based classification of accessory items stored in the PT XYZ warehouse. The calculation results show the frequency of movement and usage of these items over one year to produce garment products. Based on the calculation, a turnover ratio value of 5.33 was obtained, which falls into the fast-moving item category (TOR > 3). This finding indicates that the accessory items have a high turnover rate during the period analysed.

Table 2. TOR Results

No	Item Name	TORy	Class		No	Item Name	TORy	Class
1	Rvt Anti Copper	30.9705	F		20	Polybag	3.62991	F
2	Btn Anti Silver	25.4669	F		21	Zipper SAB	3.53192	F
3	Btn Matte Black	15.3122	F		22	Coats Epic Trd	3.51422	F
4	Kagan Trim	10.4162	F		23	Printed Sticker	3.36764	F
5	Btn Matte Silver	10.3158	F		24	Main Label	2.73452	S
6	Btn Pearl Gunmetal	9.11183	F		25	Rvt Anti Brass	2.62204	S
7	Metal Buckle	7.66969	F		26	Leather Patch	2.54304	S
8	Coats Aptan W Trd	7.19901	F		27	Zipper YKK	2.25572	S
9	Leather Label	6.92955	F		28	Rvt Antique Brass	1.96536	S
10	Btn Disco Ball	5.40515	F		29	Co Label	1.95492	S
11	Coats Aptan Trd	5.3348	F		30	Size Label	1.45972	S
12	Btn Frosted Tin	4.94909	F		31	Care Label	1.1674	S
13	Rvt Anti Silver	4.65195	F		32	Black Crunch	1.00411	S
14	Price Ticket	4.40812	F		33	Fit Label	1.00355	S
15	Coats Astra Trd	4.16558	F		34	Woven Hangtag	0.66075	N
16	Coats Polyester Trd	4.12607	F		35	White Crunch	0.61381	N
17	Coats Aptan AW Trd	3.88903	F		36	Plastic Btn	0.3471	N
18	Coats Nylbond Trd	3.77281	F		37	Woven Label	0.11576	N
19	Zipper Ideal	3.63462	F					

Data Analysis

The final stage in FSN analysis is to classify each item to determine the level of movement and usage. This classification is determined based on the turnover ratio value that has been previously calculated. This process enables the identification of item categories that require special attention in inventory management and procurement.

This classification is determined based on the annual Turnover Ratio (TOR) for the movement of raw materials for accessories stored in the warehouse. The Fast-Moving category includes 23 accessory items with a TOR value greater than 3, while the Slow-Moving category contains ten accessory items with a TOR value between 1 and 3. The Non-Moving category comprises four accessory items with a TOR value below 1.

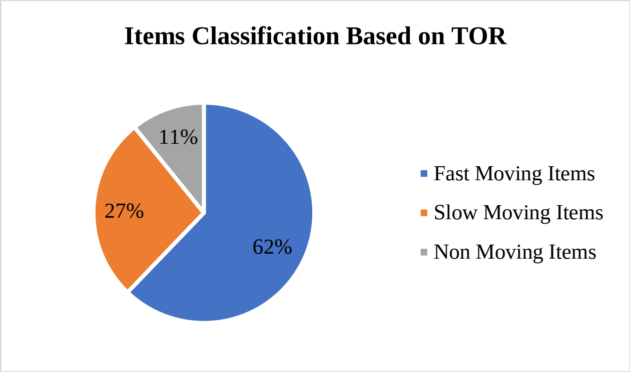

Figure 1. FSN Classification

Most raw materials or accessory items stored in the warehouse show significant movement, indicating that the supply chain process often involves transitions from supplier arrival to the production stages. In contrast, other accessory items exhibit lower levels of movement within the PT XYZ warehouse. The following is an analysis of the item classification results in the accessory warehouse.

1) The fast-moving (F) category consists of accessory items that are frequently used and have a high risk of stock depletion (Adipriyana et al., 2018). Items in the fast-moving group can be considered crucial accessories consistently required in the production process. Naturally, these accessory items are in large quantities due to the high demand from the production department.
2) In the slow-moving (S) category, items are raw materials with relatively stable movement and are fewer in quantity than in the fast-moving category. In terms of inventory, these items have a moderate quantity and have been forecasted according to production needs. Items in the slow-moving group only occasionally run out of stock. According to Widyatmoko andYudoko (2024), the causes of slow-moving items include inaccurate raw material data and incorrect categorization or classification of items. This condition leads to negative impacts such as increased inventory value, excess jobs, and discrepancies in the database.
3) Items in the non-moving (N) category can be said to have very slow movement or even no movement at all (rarely used in the production process). This effect is caused by changes in customer demand related to desired product specifications and supporting accessories. Additionally, items in the non-moving class can be considered dead stock, commonly occurring in garment companies. Dead stock arises due to uncertainty in the number of needed materials or leftover accessory raw materials (safety stock) that are no longer used (Sugumaran & Sukumaran, 2019).

Recommendation

The research results show that a high turnover value signifies that the item is increasingly important and frequently used in production. Therefore, improving the warehouse layout is necessary to optimize worker effectiveness in locating accessory items. Fast-moving items can be placed on storage shelves near the entry and exit doors. Meanwhile, slow-moving items should be placed on easily accessible shelves, but fast-moving items should still be prioritized. Non-moving items should be placed farthest from the entry and exit doors (Tambunan et al., 2018). Special attention is required for fast-moving items, which must be strictly controlled, and appropriate reserve stock must be provided (Jobira et al., 2021). The inability to manage the warehouse effectively will have a negative impact on the availability of raw materials and hinder the smooth production process of garments at PT XYZ.

The slow-moving category consists of accessory items with moderate or stable movement levels. Stock control must be conducted to allocate quantities accurately according to production needs. Periodic reviews can be implemented to ensure that procurement is only carried out as needed. Continuous periodic reviews are necessary for slow-moving items with lower safety stock requirements due to the difficulty in achieving efficiency with inventory management for this group (Pinçe & Dekker, 2011). Non-moving items are a collection of rarely used items referred to as dead stock. Data analysis modelling is necessary to make decisions based on usage patterns or demand for non-moving items to avoid the occurrence of dead stock that can no longer be used (Sugumaran & Sukumaran, 2019). It is necessary to reduce the financial loss risk experienced by PT. XYZ due to the prolonged handling cost of accessory items and to identify available space that can be used for other accessory items.

The recommended layout aims to enhance productivity, reduce the risk of damage to goods, and increase time efficiency in searching for accessory items. A well-organized layout will assure customers that products are placed according to their specifications and protected from damage that could degrade their quality. Implementing standard operating procedures for warehouse management is crucial to ensure all aspects are properly addressed (Yuliana et al., 2023). In addition to layout improvements, accurate inventory management is necessary to monitor item availability to avoid overstock and stockouts. Inventory management can be conducted using a periodic evaluation approach while simultaneously performing customer demand forecasting with a statistical approach (Cisse et al., 2022).

CONCLUSION

Based on the research conducted, the accessory warehouse at PT. XYZ can accommodate a range of supporting accessories for the main product, trousers, with 37 accessories varying in type, quantity, and size. FSN analysis reveals significant differences in the movement and usage of the stored accessory items. These items are categorized into fast-moving, slow-moving, and non-moving groups based on their movement frequency and turnover ratio. Fast-moving items have high turnover, while slow-moving items exhibit moderate movement, and non-moving items are infrequently used in production. The analysis indicates that most accessory items have a turnover ratio exceeding 3, suggesting intense distribution and supply chain activities. To address this, PT. XYZ requires improved management to minimize raw material accumulation, inventory shortages, and sub-optimal distribution flows. With this categorization using FSN analysis, the company is expected to enhance its approach to prioritizing raw materials and more effectively manage the needs and supplies of accessory items.

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