International journal of science, engineering, and information technology
Volume 03, Issue 02, July 2019
Journal homepage: https://journal.trunojoyo.ac.id/ijseit

Storage Layout on Spring Company using Shared Storage and Analysis Market Basket

Rifky Maulana Yusron[a], Emon RIfa'i[b], Yudha Dwi Putra Negara[c]

[a]Department of Mechanical Engineering University of Trunojoyo Madura, Bangkalan, Indonesia
[b]Department of lndustrial Engineering University of Trunojoyo Madura, Bangkalan, Indonesia
[b]Department of lnformatics Engineering University of Trunojoyo Madura, Bangkalan, Indonesia

A B S T R A C T

Spring manufacturing company has finished goods warehouse, some storage area using manufacturing near-net-shape product. In observations made on finished goods warehouse for preparation and arrangement of product is less neat, especially on layout of a storage area in near-net-shape warehouse, resulting in slow arrangement of products, slow process of servicing the product, slow delivery of product, and a waste of space in finished goods warehouse. The aim of this study is to provide proposed improvements near-net-shape warehouse layout with a combination of two methods, namely shared storage and market basket analysis. Function of both make finished goods warehouse layout that takes into account consumer demand for products most in demand will be placed closest to warehouse door, and products that are often purchased together will be brought closer. Result of a combination of shared storage methods and market basket analysis can minimize mileage material handling, minimizing setup time, and service, so process becomes smooth delivery and avoid delays. Results from this study are shaped layout proposals are made based on calculation of shared storage methods and market basket analysis, so that layout products previously still unregulated to regulated, and service will be faster with placement of frequently purchased products and products that are frequently purchased simultaneously when placed at front. Products are placed in front of, among others. The most frequently purchased products BLS with 10.756 products and lowest purchased are K59 with 920 products.

Keywords: Design Layout, Market Basket Analysis, Shared Storage, Spring Manufacture, Warehouse

Article History
Received 12 January 19 Received in revised form 08 February 19 Accepted 16 March 19

1. Introduction

Facility layout and production planning, as two important phases during flexible production mode, have a significant effect on production efficiency and cost with the changing of consumer demand [1]. The layout of the warehouse is one support and an important part of one system production [2]. effective facility planning can significantly reduce the operational costs of companies [3]. In this research we observe an industrial companies that produce springs for vehicles, either in the form of leaf springs or coil spring produced by the cold or hot process, with a license from Mitsubishi Steel Manufacturing, Japan. Problems that exist in the warehouse of goods so among other things, the structuring system of goods which not neat where the same type of goods not in one storage area but rather in several storage areas, poor and regular shelf placement, less efficient storage space with service points so operators service takes a long time to take the goods that you want to send, the narrow distance of the rack to the operator line service and structuring so that the operator service and structuring is difficult in the process taking and structuring, and often late service due to a product the grouping is not good because of the part the service must take a few items who want to be sent to a different place with a less effective distance.

Efforts to reduce requirements storage space on dedicated storage, several warehouse managers use a variety from dedicated storage where placement the final product is arranged more carefully, i.e. by using the Shared storage method which will create a warehouse layout to be efficient due to the advantages of the method this regulates product placement carefully and as much as possible use storage space, so it doesn't happen waste of space [4]. Market Basket Analysis is a function of the Rule Association Mining which is usually used for study consumer habits [5]. Advantages Market Basket Analysis method that is can know the frequency of items that are often purchased and items that are frequently purchased together, which later often goods purchased and frequently bought items simultaneously in one time purchase will be collected and brought near, so the process service can be smooth and minimize slow service

* *Corresponding author.*
E-mail address: rifky.myusron@trunojoyo.ac.id

E-ISSN 2548-4214

2. Literature Review

Layout the factory is the procedure for organizing factory facilities to support smooth operation in the production process. These settings will take advantage of the area for placement machines or supporting production facilities others, fluency in material movement, good material storage temporary or permanent, work personnel and etc [4].

Economically. So that the main goal to be achieved from a factory layout namely

- Manufacturing process facility layout must be designed, so form including the arrangement of machines, flow planning, so the process manufacturing can be carried out with efficient way[6].
- Minimizing the transfer of goods. The layout must be designed such as that the transfer of goods lowered to a minimum, if possible component in the circumstances processed when moved.
- Maintain flexibility of arrangement and operation In a factory there are circumstances where capability changes are needed production, and this must be planned from the beginning.
- Maintaining the turnover of half the goods so tall Efficiency can be achieved if the ingredients walk through the operation process inside the shortest time possible.
- Reducing investment in layout equipment the right engine and right department can help decrease the amount of equipment that is needed.
- Save on the use of building space Every square meter of floor area inside a factory costs money. So every square meter must be used as well as possible.
- Increase labor inequality Good layout can be among others reduce the removal of material done manually, minimizing on foot.
- Provides convenience, safety, and comfort for workers inside carry out work.

Market basket analysis (MBA) is a technique in data mining that usually used to predict the customers purchasing [7]. Market Basket Analysis is a function from the usual Rule Mining Association used to learn habits consumers by looking for item set frequencies which are often bought and items that are purchased on a regular basis simultaneously [8]. Market Basket Analysis is mathematical techniques that are usually used marketing survey to look for relationships Individual or group product terms [9]. This analysis itself is a survey of the events that are it's very common inside supermarket, namely taking goods in a way simultaneously by customers when visiting supermarket [10]

Shared storage can be considered as fast moving goods system of a product, if each pallets are filled inside different warehouse areas from time to time [11]. Depends on the amount from the product in the warehouse on time delivery arrives, it will be possible that 5 pallets the filled will be in the storage space only 1 day. While 5 other pallets inside the same shipment will be in the warehouse for 20 days. From a perspective on position storage space in a warehouse, 5 pallets will very fast-moving; leftover palette seen as slower, maybe moderate transfer. Shared storage can take advantage of differences that can not be separated i.e length of time from an individual pallet to live in a warehouse.

The purpose of Market Basket Analysis for identify the product, or group products that tend to have a correlation. Market Basket Analysis is a tool powerful to be applied in the strategy cross-selling. The results of this analysis can be used to organize spatial planning, organizing products that often sell together, and can also be used to increase promotion efficiency products.

3. Methods

Data collection conducting by direct observations and measurements dimensions and location of goods warehouse product demand during 3 months at PT. Indospring, Tbk with using a direct measure and guidance from the field supervisor. other than that data is also obtained from company documents such as production data and shipping data. After all the required data has been collected, then the next step by data processing by the method already determined. Things like lighting, noise, air changes, dust, dirt, must become attention of the planner. The right machine arrangement can also prevent accidents work.

4. Result

For using the Shared storage method as follows. Product used in this study i.e. there are 45 types of products, first step we determine the number of average product demand per month. Before calculating the garage demand per month, the number of products K 7H we ordered for 3 months first, after that it can be counted like equation 1 and the K 7H demand during observation can see on table 1.

$$\overline{DI}\,(K\,7H) = \frac{1743}{3} = 581 \quad (1)$$

Table 1. K 7H demands.

Month	Demand
November 2018	535
December 2018	42
January 2019	1166
Total	1743
Average	581

Then we calculate the order frequency products can be seen from the number of each type products ordered every month. After known frequency of product type every month, then added up and divided by number month. Here are the calculations

$$\overline{FP}\,(K\,7H) = \frac{21}{3} = 7 \quad (2)$$

Base on equation (2) we known the average frequency orders per month can be determined the number of products per order for each product by means of the number of requests per month divided by the average frequency see on equation 3.

$$\overline{DL}\,(K\,7H) = \frac{1743}{7} = 249 \quad (3)$$

To find the average lead time with calculation as follows

$$\overline{LT}\,(K\,7H) = \frac{140}{21} = 7 \quad (4)$$

to determine space needs using the equation

KR = 7 x 1100 = 7700 products.

Determination of the size of the storage area, namely:

1 storage area = shelf length x shelf width

= 117 cm x 94 cm = 10,998 cm²

Because 1 storage area contains 6 shelf level and 4 storey, wide 1 storage area is 10,998 cm² x 6 = 65,998 cm². While for the storage area equation :

$$\overline{KAP}\,(K\,7H) = \frac{(lead\ time\ x\ total\ product\ per\ day)}{total\ product\ in\ a\ area} \quad (5)$$

$$= \frac{7x1100}{4800}$$

$$= 1,604 \sim 2\ area$$

Determination of room allowance, i.e. to determine the area of the alley needed is based on the longest dimension diagonal on the forklift when carrying product

$$Diagonal = \sqrt{(p)^2 + (l)^2} \quad (6)$$

$$= \sqrt{(2{,}8)^2 + (1{,}3)^2}$$

$$= \sqrt{(7{,}84) + (1{,}69)}$$

$$= \sqrt{9{,}53}$$

$$= 3{,}08 \sim 3\ m$$

Layout storage area. Following is a layout created based on data product demand shown on picture.1

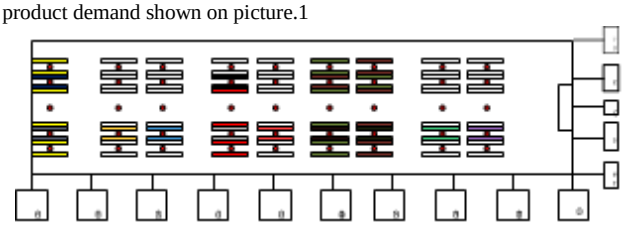

Figure 1. layout storage area based on demands

Calculate distance traveled storage (d) from the warehouse door. Calculation distance of storage location from the door warehouse i.e

$$d_{ij}(E) = 5 + 14 \quad (7)$$

$$= 19$$

Then we can find value of confidence (s) For using the basketball market method analysis. first we must find road delivery data used in the method Market Basket Analysis which is output from this method the product will be known what types are often purchased simultaneously. The number of product types in this travel document the same as the request data, which is 45 types product.

$$S_{K7H} = \frac{26}{328} = 6{,}81\% \quad (8)$$

Find for the following Confidence value (C).

$$C_{K7H} = \frac{0{,}52\%}{6{,}81\%} = 4{,}08\% \quad (9)$$

Determination of the minimum value support pay attention to the results of the support value. The hope, the product to be taken is not too little so that it can cause no visible improvement effect. However also not too much so it will only difficulty in the process of making layouts while the impact of the improvements provided small. Whereas in this study minimum support value of 1.5% is used.

Finding value of improvement ratio (I) by combination of products that qualify or are valuable above the minimum Confidence value then look for it the value of improvement ratio by using calculation as follows.

$$I_{K7H} = \frac{0{,}79\%}{6{,}81\%\ x\ 3{,}66\%} = 3{,}15\% \quad (10)$$

Table 2 shown Support value, confidence and improvement ratio of all product in spring factory observed.

Table 2. Support value, confidence and improvement ratio of product In PT. Indospring

Product Set		C	Order	S	l
K 7H	K 24H	21.43%	3	0.79%	3.15
KN 7	KN 25	16.67%	3	0.79%	1.30
KN 7	K 42H	21.43%	3	0.79%	1.67
KN7	DN	16.67%	2	0.52%	1.30
K 19H	KN 17	16.67%	2	0.52%	1.77
KN 19	KN 17	16.67%	2	0.52%	3.89
K 24	K 40	15,38%	1	0.52%	2.54
K 59	K 40	15,38%	9	0.26%	0.58
K 59	K 59H	17,65%	2	2.36%	1.32
K 59H	K 40	15,38%	9	0.52%	1.15
K 59H	K 59	17,65%	2	2.36%	1.32
D	DN	16.67%	2	0.52%	2.77
DH	KS	14.29%	3	0.79%	1.19
E	D	17.39%	4	1.05%	0.63
E	G	17.50%	7	1.83%	0.63
HN	KN17	16.67%	2	0.52%	0.49
HN	BLS	23.08%	3	0.79%	0.67
HN	D	17.39%	4	0.52%	0.49
HN	G	15.00%	6	1.05%	0.67
HN	S	18.18%	6	1.83%	0.51
IZ	K 40	15.38%	2	0.52%	0.44
IZ	K 129	20.00%	3	0.79%	0.53
IZ	BLS	16.97%	2	0.52%	0.41
IZ	KS	19.05%	4	1.05%	0.54
IZ	S	21.21%	7	1.83%	0.57
IZ	T	16.97%	28	7.33%	0.46
S	KS	19,05%	2	1.05%	2.20

After processing data by method shared storage and market basket analysis. The next step is making layout by combining the results of 2 methods. Here are the results of the layout of the combination method of shared storage and basket market analysis. From figure 2 we can see this layout model is easier to material handling and movement.

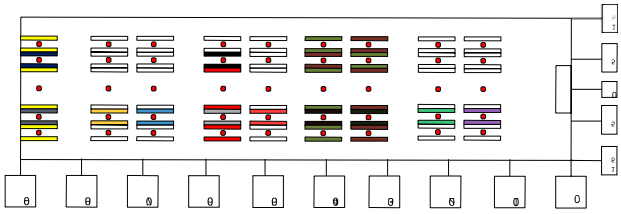

Figure 2. layout of combination shared storage and market basket analysis

5. Conclusion

Based on the results of the analysis and discussion in the previous chapter, a few are obtained conclusion as follows:

- Proposed effective layout can see in figure 2. Layout made from processing the shared method storage and market basket analysis, where products that are often bought, and products that are often purchased simultaneously put on ahead and brought near.
- Products that have been arranged in a layout Figure 4.22 has been grouped with coding, and based on support values
- By using new layout there have increasing productivity for K 7H 3,1%

REFERENCES

[1] W. Wang, Y. Hu, X. Xiao, and Y. Guan, "Joint optimization of dynamic facility layout and production planning based on Petri Net," *Procedia CIRP*, vol. 81, pp. 1207–1212, 2019, doi: 10.1016/j.procir.2019.03.293.

[2] P. M. Farmakis and A. P. Chassiakos, "Dynamic Multi-objective Layout Planning of Construction Sites," *Procedia Eng.*, vol. 196, no. June, pp. 674–681, 2017, doi: 10.1016/j.proeng.2017.08.057.

[3] G. Kovács and S. Kot, "Facility layout redesign for efficiency improvement and cost reduction," *J. Appl. Math. Comput. Mech.*, vol. 16, no. 1, pp. 63–74, 2017, doi: 10.17512/jamcm.2017.1.06.

[4] G. Schuh, J. P. Prote, M. Luckert, and F. Sauermann, "Determination of order specific transition times for improving the adherence to delivery dates by using data mining algorithms," *Procedia CIRP*, vol. 72, pp. 169–173, 2018, doi: 10.1016/j.procir.2018.03.236.

[5] A. N. Sagin and B. Ayvaz, "Determination of Association Rules with Market Basket Analysis: Application in the Retail Sector," *Southeast Eur. J. Soft Comput.*, vol. 7, no. 1, 2018, doi: 10.21533/scjournal.v7i1.149.

[6] F. Kurniawan, B. Umayah, J. Hammad, S. M. S. Nugroho, and M. Hariadi, "Market Basket Analysis to Identify Customer Behaviours by Way of Transaction Data," *Knowl. Eng. Data Sci.*, vol. 1, no. 1, p. 20, 2017, doi: 10.17977/um018v1i12018p20-25.

[7] S. Halim, T. Octavia, C. Alianto, S. Halim, T. Octavia, and C. Alianto, "ScienceDirect ScienceDirect Designing Facility Layout of an Amusement Arcade using Market Designing Facility Layout of an Amusement Arcade using Market Basket Analysis Basket Analysis," *Procedia Comput. Sci.*, vol. 161, pp. 623–629, 2019, doi: 10.1016/j.procs.2019.11.165.

[8] T. Kutuzova and M. Melnik, "Market basket analysis of heterogeneous data sources for recommendation system improvement," *Procedia Comput. Sci.*, vol. 136, pp. 246–254, 2018, doi: 10.1016/j.procs.2018.08.263.

[9] M. Kaur and S. Kang, "Market Basket Analysis: Identify the Changing Trends of Market Data Using Association Rule Mining," *Procedia Comput. Sci.*, vol. 85, no. Cms, pp. 78–85, 2016, doi: 10.1016/j.procs.2016.05.180.

[10] A. Mansur and T. Kuncoro, "Product Inventory Predictions at Small Medium Enterprise Using Market Basket Analysis Approach-Neural Networks," *Procedia Econ. Financ.*, vol. 4, no. Icsmed, pp. 312–320, 2012, doi: 10.1016/s2212-5671(12)00346-2.

[11] X. Jin, K. T. Park, and K. H. Kim, "Storage space sharing among container handling companies," *Transp. Res. Part E Logist. Transp. Rev.*, vol. 127, pp. 111–131, Jul. 2019, doi: 10.1016/j.tre.2019.05.001.