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Jurnal Teknik Industri, Vol. 24, No. 2, December 2022 DOI: 10.9744/jti.24.2.141-150 ISSN 1411-2485 print / ISSN 2087-7439 online A Simulation-based Optimization Approached to Design a Proposed Warehouse Layout on Bicycle Industry Farrel Stefan Sienera1, Tanti Octavia1*, Desi Winoto2 Abstract: The finished goods must be stored in a warehouse before the items are dispatched. Due to the increasing demand in 2020, there will be an increase in the quantity of items, which will cause the finished goods warehouse at PT X to reach capacity. This issue lengthens the flow through the warehouse and makes it easier for the items to sustain damage. To improve capacity, the firm is building a new finished goods warehouse, and it wants to organize the two warehouses so that the displacement time is as short as possible. This study utilized simulations to calculate the time and dedicated and class-based storage strategies to establish the layout. This study utilized simulations to determine the time and dedicated and class-based storage approaches to establish the layout. According to the findings, the dedicated storage technique has a total displacement distance of 703,952 meters and an average moving duration of 3.37 minutes per pallet. These findings are not as useful as the class-based storage technique, which has 705,961 meters and an average pallet turn time of 3.53 minutes. Keywords: Facility planning, warehouse, class-based storage, dedicated storage, simulation Introduction As one of many logistics processes, the warehouse process currently holds an irreplaceable position in business logistics systems and in supply chain logistics systems. Today, warehouses play a more vital role in company's success (or failure) [1]. The effectiveness of Indonesian supply chain firms' warehouses is increased by proper warehouse design and efficient operations [2]. In general, warehouse activity consists of receiving, put away, storage, picking, and shipping. Among the activities perform- ed within a warehouse, order picking activity costs around 55% of the warehouse operating costs [3]. Particularly in warehouses that handle many large units, workers visit many trips per location to fulfill customer orders in a system called picker-to-part order-picking systems. The efficiency of the ware- house is highly affected by warehouse design and planning in manufacturing [4]. Thus, designing a good warehouse layout is a must-do job for a company to obtain a smooth operational process. A good warehouse layout means the layout needs to be suitable to its warehousing processes. Several researchers have relaxed one or two of the 1Faculty of Industrial Technology, Industrial Engineering Department, Petra Christian University. Siwalankerto 121-131, Surabaya 60236, Indonesia. Email: farrelstefan@gmail.com, tanti@petra.ac.id 2PTX,SupplyChainDepartment.Email:kwikdesi28@gmail.com *Corresponding Author supposed design rules in traditional warehouse designs and studied aisle designs in unit-load ware- houses. These studies, the aisles are angled to reduce travel distance between a pick-up-and-deposit point and a pallet location [5]. Picker-to-part order-picking systems are one type of picking order systems. Pan et al.[6] stated that warehouse design and layout have a significant impact on the warehouse's efficiency [6]. To increase storage space and shorten trip times, Sari suggested a layout for a floor tile warehouse utilizing heuristics approach [7]. Furthermore, Gong et al designed a class-based storage Warehouse using a particle swarm optimization algorithm [8]. Bicycle manufacturer PT X sells its products both domestically and abroad. With three different brands and several supply strategies, including make to order and make to stock, currently PT X offers 984 types of bicycles. Since the business has grown in terms of demand quantity, the capacity of warehouse needs to be evaluated as well. The company's completed goods storage is currently at up to two times capacity due to increased bicycle production brought on by high demand. The company has made some attempts to carry out the warehousing process without any additional space, including placing goods in aisles of shelves, placing in areas near the raw material warehouse, and erecting tents outside the warehouse, when the increase in production size was not as significant as it is today. These efforts, however, are not actually improving the situation. It slows down warehouse 141 Sienera et al./ A Simulation-based Optimization Approached / JTI, Vol. 24, No. 2, December 2022, pp.141-150 operations and increases the risk of damage to bicycle crates. Due to expanded capacity, the company has opted to build a new completed goods warehouse. In order to achieve the best average moving time, rearrange the bicycle location in the scheme at the same time. Methods The optimal guide between space area and material handling is determined by the warehouse layout system, which aims to minimize overall costs [9]. The issues in this research were resolved using

1**the dedicated storage** approach **and the class-based storage** method. **The**

workflow for the layout method is as follows. Data Collection Three techniques could be used to gather data: direct observation of the finished goods warehouse, interviews, and data that belonged to the company, such as data incoming and outgoing of the number of bicycles in warehouses, the location of the warehouse. Interviews were conducted with the finished goods warehouse department and the IT department managers. Locating the Center of Gravity The center of gravity can be located by looking at the point where the area's diagonals cross. According to their dimension, objects are divided into three groups;

however, the center of gravity used in this study is just two dimensions. Equations 1 provides the formula for computing the center of gravity in two dimensions by determining the building's surface area (A), x-coordinates, and x-coordinates of the building, n is number of facilities in the building [10]. Xi = $\sum\sum jn$=jn=11$AAjxjj$; Xi = $\sum\sum jn$=nj=11$AAjxjj$ (1) Calculating Shelf Distance In warehouse, the distance from the conveyor to the rack and the distance from the rack to the loading dock are determined using the rectilinear distance method. The center points of both sites are found to calculate this approach (0,0). Equation 2 illustrates how to use the findings of the center of gravity determination to calculate rectilinear distance using that method [11]. Dii = $\{Xi - Xi\}$ + $\{Xi - Xi\}$ (2) Dedicated Storage After determining the distance between the shelves, the dedicated storage approach is employed as the initial layout strategy. The dedicated storage approach designates a certain spot in the warehouse for each item to be stored in order to maximize efficiency [12]. Because one site for storing products can only be utilized by the goods and cannot be mingled with other goods, this method is often referred to as a fixed lot storage method. Class Based Storage The class-based storage method is the second layout technique. In a warehouse that blends random storage with dedicated storage methods, the class- based storage method keeps things organized [13]. The storage area will be divided into several predetermined classes using this manner, and these classes will be used as devoted. Items that have been separated into classes will be randomly put to decide their placement, but they are not permitted to stray outside of their class. ABC Classification The ABC classification will be used for class division in the class-based storage approach. A technique for categorizing products and ranking them from highest to lowest value is ABC classification. [14]. This analysis is based on Pareto's law, which argues that although though the value group only accounts for 20% of the total, it has the greatest impact, accounting for 80% of the total. Space Requirement ($\boldsymbol{S}$) Using the storage system and ABC categorization above, it will be necessary to calculate the required space in order to determine the area needed on the shelves for each product. This strategy is essential to ensuring that each type of good stocked in the warehouse has several storage spaces that are in line with the production volume of goods. The formula for calculating space requirements is shown in Equation 3 [15]. S = $arerage$ $illrr$ lr $lrrlrr$ (3) $cllrll$ $calacirx$ Throughput ($\boldsymbol{S}$) The number of actions necessary to convey items to the warehouse must be calculated to estimate the throughput value. To gauge a company's degree of production and processing speed, this term is widely Figure 1. Overhead view of the current warehouse layout utilized. Equation 4 displays the throughput calculation formula [16]. S = $arerage$ $illrr$ lr $lrrlrr$ (4) $laller$ $calacirx$ Simulation After determining the layout of finished goods place- ment in the warehouse, a simulation is performed to determine the movement time. Using computer technology and certain presumptions, simulation is a technique for scientifically examining a system by imitating the actions or processes that take place in it [13]. The design of this system is an exact replica that is defined based on its actual condition and utilized as a tool for making decisions. There are three types of simulation models: static and dynamic simulations, deterministic and stochastic simulations, and conti- nuous and discrete simulations [14]. The Promodel 7.0 software is used in this study's simulation. Verification and Validation The simulation findings are then put through a verification and validation procedure to make sure the model was constructed correctly and that it accurately represented the system's initial condition. A simulation must run a replication test to see whether the number of replications is adequate before completing validation. Equation 5 illustrates the replication test formula by calculating the value of the t-distribution ($sral$), standard deviation (s), maximum error (α), and average moving time ($\bar{s}$)[15]. N =́ ($rval$×r α×$\bar{r}$) 2 (5) Results and Discussions Current Warehouse Layout The warehouse has a current size of 5600m2 (80 x 70). The storage facility has enough for 57,500 bicycles. Selective pallet racking, shuttle racking, and mezzanine racking are the three types of racks that are employed. According to brand, the bicycle placement area is split. Figure 1 displays the layout of the current warehouse. Warehouse Layout Design A new completed products warehouse will eventually be built, and as part of the warehouse design idea, chosen pallet racking will take the place of the mezzanine racking. The brand B and C bicycles will be stored in the current warehouse, while the brand A bicycles will be kept in the new warehouse, giving the finished goods warehouse a potential capacity of

122,400 bicycles. The warehouse layout's design is shown in Figure 2. Calculation of Current Warehouse Mileage After calculating the distances between the incoming and exiting finished goods, the current total mileage is estimated considering the average bicycle entering and leaving the warehouse, the necessary amount of space, the throughput per space demand, and the mileage. Average Bicycle Entry and Exit Data on bicycle entrances and exits were gathered between January 2021 and December 2021. The average number of times the bicycle entered and exited each SKU was calculated after the data had been processed. Examples of average data are shown in Table 1. Space Requirement (S) In this computation, the largest value between the average value of bicycles incoming and exiting is considered. This is thus because certain bicycle SKUs lack information on departing or arriving bicycles, while other bicycles have more information on departure than on arriving bicycles. Table 2 provides an illustration of the space needs' outcomes. The needed number of columns is produced after rounding up. Throughput (T) The throughput calculation measures the amount of Figure 2. Overhead view of the warehouse layout design Description: selective pallet racking (A1-L); shuttle racking (S1-S6); mezzanine racking (MZ) Table 1. The average incoming and exiting finished goods SKU The average of The average of exiting incoming finished finished goods goods B1 41 6 B2 26 7 Table 2. The example of the space requirements calculation SKU The The The S average average maxi- (column) value value mum (incoming (exiting value finished finished goods) goods) B1 41 6 41 0.68≈1 B2 26 7 26 0.43≈1 Table 3. The result of the throughput calculation SKU Bicycles for T input T output each pallet B1 10 B2 10 4.1≈5 0.6≈1 2.6≈3 0.7≈1 Table 4. The example of T/S calculation SKU S T T/S T T/S incoming incoming exiting exiting B1 1 5 5 1 1 B2 1 3 3 1 1 Table 5. The Example of Current mileage result SKU S T/S Incoming T/S Exiting incoming mileage exiting mileage (m) (m) B1 1 5 278.25 1 50.35 B2 1 3 166.95 1 50.35 bicycle movement that takes place in the finished goods warehouse. The average number of bicycles incoming and exiting each SKU is used in this computation. The throughput value is rounded up. The Table 3 is an illustration of the computation procedure. Throughput per Space Requirement (T/S) Throughput and space needs are calculated to determine how much activity comes from each space requirement. The more activity the SKU requires, the higher the T/S value. The shelf location nearest to the exit will receive priority placement for items with the greatest exit T/S value. The mileage of each SKU will then be calculated using the results of this compu- tation. Table 4 shows an example result of throughput divided by space requirements Current Mileage This formula is used to determine the mileage produced by each bicycle SKU. According to the calculations, the total mileage for the arriving trip is 435,986 meters, and the total mileage for the outgoing trip is 257,313 meters. This results in a total distance traveled of 693,300 meters. Therefore, placement nearest to the exit will be given preference to the shelf

3**with the highest T/S value**. An illustration of **the** outcomes of **the**

current mileage computation

3**is shown in Table 5. Proposed Warehouse Layout**

Design The suggested warehouse layout design uses both

1**the class-based storage** approach **and the dedicated** stora- ge **method. The**

warehouse's shelf configuration is Figure 3.

3**The application of dedicated storage method** Table 6. **The** results of **the**

dedicated method's mileage Rack Column Distance for Distance for SKU S *S*/*S* *S*/*S* Mileage for No. incoming outgoing Input Output incoming product (m) product (m) product (m) Mileage for exiting product (m) G1 D1 7 7 78.21 59.70 35.60 35.62 D1 F1 E1 A1 L 16 16 1 4 48.01 41.84 43.13 121.96 53.46 53.48 53.53 53.55 D3 decided using both techniques. The purpose of this proposal is to determine which strategy will result in the ideal changeover time. The class-based storage approach is organized to consider the number of bicycles leaving the warehouse, whereas the dedicated storage method is organized to take into account the average number of bicycles entering and leaving the warehouse. Dedicated Storage Method The investigation of the dedicated storage technique goes through the same steps as the current situation. The shelves are held in place by 881 column racks. The application of racks with the dedicated storage mechanism is shown in Figure 3. These findings indicate that the overall mileage of the entry is 477,296 m, and the exit mileage is 226,235 m, for a total mileage of 703,532 m. Table 6 shows an example of the results of calculating mileage using the dedicated method. Class Based Storage Method Calculating the average number of bicycles entering and leaving the warehouse, performing an ABC classification analysis, calculating space require 2 7 4 8.5 9.5 965.37 8.5 2166.99 676.57 1819.13 ments, calculating throughput, calculating Table 7. The results of the ABC classification calculation in 2021 SKU Usage Percentage of usage Class A247 157 10.67% A249 143 9.72% A throughput divided by space requirements, determining bicycle rack areas, and calculating mileage are all steps in the analysis process for this

1**class-based storage method. The** class-based **method**

analysis process follows the same steps as the dedicated method, except that frequency and ABC classification analysis are used for class division.

2**Class A contains 80% of the** cumu- lative **value of** the percentage, **class B contains 15% of the** cumulative **value of**

the following percentage, and

2**class C contains 5% of the** cumulative **value of the**

remaining percentage. Table 7 shows an example of the ABC classification. Total Mileage Results Comparison The mileage comparison findings are shown in Table 8, with the current situation having the least overall Figure 4. The application of class-based storage method shelves (The colors yellow and orange indicate class A; The colors green and purple indicate class B) Table 8. The results of the class-based method's mileage SKU S T/S T/S (pallet) (Incoming) (Exiting) Total distance for incoming product (m) B200 27 9 4 2,265.75 B206 10 10 3 803 distance. This is due to the fact that there is now just one warehouse. Two warehouses are utilized in the proposal's examination of dedicated and class-based techniques. The entry to the two warehouses utilizes the same conveyor as the previous warehouse, but each has its own loading dock for egress. As a result, the transfer time at the time of put away to the new warehouse is longer than under the present circum- stances, making it impossible to compare the current circumstances to the proposed technique. A compa- rison of the overall mileage results is shown in Table 9. Data Collection for Inter-Arrival Time Direct observation is used at the finished good warehouse to get data on the timing of bicycle arrivals on the conveyor. To determine what distribution will be created, the time data is multiplied by 100 and then put into a Promodel's stat fit. Figure 5 shows the bicycle's arrivals are lognormal distributed. Total distance for exiting product (m) 161.44 45.07 Rack No. Column Distance (incoming product) (m) E2 F1 E1 1 1 1 82.88 87.52 81.35 E2 2 80.30 Table 9. Comparison of total mileage Current condition Class based optimal Dedicated optimal Total exit Total entry mileage (m) mileage (m) 257,314 253,709 226,235 435,986 449,150 477,296 Distance (exiting product) (m) 12.44 13.95 13.97 15.02 Total mileage (m) 693,300 702,860 703,532 Figure 5. The example of the stat fit test Transfer Time Data Retrieval Direct observation is used to gather information about the time of movement at the warehouse and determine how quickly materials are handled. In order to later determine the material handling speed from the distance of the rack divided by the duration of movement, the time that has been obtained is then adjusted to the location of the rack as it is moving. The average speed of material handling in the warehouse was 2.17 m/s, according to 40 times of time data gathering. To determine how long it takes to go to and from the rack, this speed is multiplied by the separa- tion between the shelves in and out. Simulation Process The following step involves running a simulation to determine the typical pallet transfer time in the completed products warehouse. The simulation is then updated with time data that was gathered in the earlier step. The proposed warehouse layout from

1**the dedicated storage** technique **and the class-based storage**

Normal > Average time 3.32 min in system 3.37 min 3.43 min Table 11. The Result of Replication Test Variable Value Average Time 3.222781 Stdev 0.018567 Alpha 5% s 2.776 N 5 N' 0.319857 Table 12. The result of the simulation output Method Current condition Dedicated Class based Average time 3.25 min 3.37 min 3.53 min Replication Test The replication test results showed that the simulation's replication was done correctly since the outcome of N' is smaller than the value of N. The replication test's findings are presented in Table 11. Figure 6. The result of statistical tests Table 13. The comparison proposed method Average moving time Total entry mileage Total exit mileage Total mileage The number of columns used Honeycomb loss Dedicated storage 3.37 min 477,087 m 226,865 m 703,952 m 881 A lot because one column cannot be mixed with other SKUs Class based storage 3.53 min 451,353 m 254,608 m 705,961 m 742 A little because one column can be mixed with other SKUs N' is less than the value of N. Table 11 shows the results of the replication test. Simulation Output The two proposed techniques are also put through the simulation procedure. The scenario was repeated five times over the course of 384 hours. Conclusion: Compared to

1**the class-based storage** technique, **the dedicated storage method**

Industrial Engineering, 62(2), 2021, pp. 527-535. doi:10.1016/j.cie.2011.11.001 8. Sari, T.P., Ridwan, A.Y., and Aurachman, R., Designing Floor Tile Warehouse Layout Using Heuristic Approach Method to Increase Warehouse Capacity and Reduce Travel Distance, International Journal of Innovation in Enterprise System, 1(1), 2017, pp.44-52. 9. Gong, D.C., Sooksaksun, N., and Kachitvichyanukul, V., A Class-Based Storage Warehouse Design using a Particle Swarm Optimization Algorithm, International Journal of Operational Research, 13, 2012, pp. 219-237. doi:10.1504/IJOR.2012.045188. 10. Dukic, G. and Tihomir, O., Warehouse Layouts, Warehousing in the Global Supply Chain: Advanced Models, Tools and Applications for Storage Systems, 2014, pp. 55-69. doi:10.1007/978- 1-4471-2274-6_3. 11. Tiwari, S., Dixit, S., Kumar, V., and Rastogi, A., Analogy among Center of Gravity, Center of Mass, and Centroid of Rigid body: Analysis of Formula for Their Respective Calculation as per Configuration of Body and Utilization in Composite Application, Applied Functional Materials, 2(2), 2022, pp. 7-13. Doi: 10.35745/afm2022v02.02.0002. 12. Tellez, G., and Sarrafzadeh, M., On Rectilinear Distance-Preserving Trees, VLSI Design, 7(1), 1998,pp. 163 – 166, doi: 10.1109/ISCAS.1995.521476. 13. Dianto, C., Widiandoko, F., Rahmanasari, D., Yuniaristanto, and Sutopo, W., Redesign Production Layout Using Dedicated Storage Method: Case Study of PT.Solo

Grafika Utama. IOP Conference Series: Materials Science and Engineering, 943, 012042, 2020. doi:10.1088/1757-899X/943/1/012042. 14. Gozali, L., Marie, I.A., Natalia, Kustandi, G.M., Adisurya, E., Suggestion of Raw Material Warehouse Layout Improvement Using Class- Based Storage Method (case study of PT. XYZ), IOP Conf. Series: Materials Science and Engineering, 1007, pp. 1-10, 2020 15. Yu, Y., Koster, D., René, Guo, X., Class-Based Storage with a Finite Number of Items: Using More Classes is not Always Better, Production and Operations Management, 24(8), 2015, pp. 1235-1247. doi:10.1111/poms.12334. 16. Rao, S.S. and Adil, G.K. Class-based Storage with Exact S-shaped Traversal Routeing in Low-Level Picker-to-Part Systems, International Journal of Production Research, 51, 2013, pp. 4979–4996. doi: 10.1080/00207543.2013.784419 Sienera et al./ A Simulation-based Optimization Approached / JTI, Vol. 24, No. 2, December 2022, pp.141-150 Sienera et al./ A Simulation-based Optimization Approached / JTI, Vol. 24, No. 2, December 2022, pp.141-150 Sienera et al./ A Simulation-based Optimization Approached / JTI, Vol. 24, No. 2, December 2022, pp.141-150 Sienera et al./ A Simulation-based Optimization Approached / JTI, Vol. 24, No. 2, December 2022, pp.141-150 Sienera et al./ A Simulation-based Optimization Approached / JTI, Vol. 24, No. 2, December 2022, pp.141-150 Sienera et al./ A Simulation-based Optimization Approached / JTI, Vol. 24, No. 2, December 2022, pp.141-150 Sienera et al./ A Simulation-based Optimization Approached / JTI, Vol. 24, No. 2, December 2022, pp.141-150 142 143 144 145 146 147 148 149