Time Reduction in Picking the Product a Case Study of Roof Tile Warehouse

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***Abstract*—The warehouse has a problem with waiting time for picking products. Also, the case study has a problem with finding goods. The stored area of goods has stored at a random location. Operators work redundantly and make it difficult to find products. This paper aims to improve working time by using simulation software. FlexSim simulation software is used to simulate the models and analyze the performance by input data layout with different conditions. Generating 3D models of scenarios for simulation software. In the first scenario, create the random laying goods location model. The data used to be an input based on actual work. In addition, the other two scenarios model solutions to improve search times faster and more conveniently. The result of the simulation is 10039.01 seconds for 5 orders in a random model. Second, the classification model has 9274.78 seconds of time working and is stored together on the same side. Third, the distribution group model stores goods in separate locations. This model has a working time of 8920.49 seconds.**

***Index Terms*— ABC Analysis, FlexSim Simulation Software**

I. Introduction

A warehouse is a building for the storage of all resources and goods from industries such as manufacturing, distribution, transport business, etc. The storage management is important for the logistic operation process. The competitive advantage of good management is to satisfy customers and make more potential for the company.

The distribution is the place to dwell goods or materials before being transported to a network stocking location or end-users. It is important to manage and occupy a position within the warehouse.

In the case study, the roof-tile warehouse for the home construction industry has a problem with time searching for material. This research requires improving and reduce the time process by using simulation software based on FlexSim to optimize storage location to decrease the timing of finding goods in the storage.

The researcher took the data from the working process within the warehouse from the case study. Using information like the category of goods, working process, and daily ordered requirements for the case study.

Due to the time limitation, the researchers used a simulation software tool to show improvements. Considered outcome data from Flexsim simulation to be the result of improvement.

II. Background

A. Flexsim Introduction

Among the things of simulation software such as FlexSim [1], Siemens [2], and Arena Simulation Software [3] are often used for generating the model for determining the various solutions in industrial and engineering systems. Anyway, FlexSim is one of the software to provide the replication of realistic system situations. Zhu et al., [4] have published information research about this software is the first in the world that software integrates the C++IDE and uses graphical objects to generate simulation environments depending on input information. This simulation software provides experience in simulation manufacturing environments and health care. The interface for users considered for friendliness, analysis of input and output data during simulation, can generate the complex model and analysis data immediately based on computer processing efficiency and output statistics producing standard capability such as utilization, cycle time, and wait time [5]. Along with the present FlexSim software was developed to be easy to use and has more potential analysis of input data. This software splits a special option that analyzes and offers a solution experiment model for finding the best various solution that provides those who has a license only.

The visualization of this program helps users understand the complex process. The 3D interface has friendliness with users as shown in Fig. 1 the 3D objects.

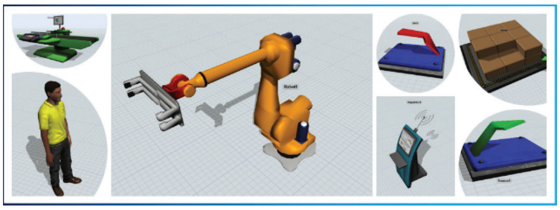

Fig. 1. The 3D objects

From the illustration, as shown in Fig. 1. The 3D object on FlexSim software creates main items and objects that are used more often for example:

• The source the object that controls and distributes item or service into the system or the model we generate

• Queue waiting for space for the item, material, goods, component, etc. This object is used for waiting in the process or dwelling on the product.

• Sink this object is meant to be the end process and shows the basic statistics including the quantity.

• Processor this object is meant to be the one process or representative of the machine in one process. And also it can input the data such as processing time to make the material into the system under different time conditions.

• Operator a representative for man-work. The routine time of working can be input to properties of the objects.

• TaskExecuters can represent many forms such as track, Forklift, AGV, plane, robot, crane, operator, and dispatcher. The task executors can be moved.

• Dispatcher is used for controlling the TaskExecuter to work at the same objects such as five operators working at the processor.

• Rack and floor storage are used for storing the items in process or material before into process. The rack can set up the data about dwell and quantity.

B. Theory

Plant layout is the works area within the factory that defines it to be. That area arranging machines and utilization of facilitating planning production. The position of goods in that area needs to be organized to help better control working capital costs.

The ABC analysis is one of the warehouse management techniques that define the rank of goods based on demand, cost, and risk data. The products are kept stocked based on profitability or sales volume. The goods are separate to classify of rank ABC.

Class A has a high value with 70%-80% of annual consumption value but has 10%-20% of total goods in inventory. The data of the A class must have high accuracy.

Class B has a medium value with 15%-20% of annual consumption value and 30% of total goods. This class regularly needed to check and record all data.

Class C has a low value with 5% of annual consumption value but has a total volume of goods in inventory high to 50%. This class could be general parts or goods that are used daily.

C. Literature Review

Tokgöz [5] reviews a software simulation named FlexSim. To investigate whether undergraduate industrial engineering students can be used and utility in simulation courses for students. The researcher has generated 6 sample scenarios for project design experience using simulation software. This paper design 6 example projects about health care, production, purchasing, inventory management, and gaming system, and then let junior and senior-level IE students use the simulation software FlexSim in real-life manufacturing. This paper explained the advantages and disadvantages of researchers and their example experience that collecting for three years. The main advantage is explained that the program is used fully, and friendly using for education and analysis of the industrial problems from input information. The main disadvantage is that reliability may not be possible and the result can be less accurate compared to the mathematics model's analysis due to random numbers in the program at that time.

Kanse and Patil [6] investigate the effect of discrete plant layout on production capacity and throughput time in the manufacturing process by using the simulation software FlexSim to generate scenarios interaction that can increase productivity and arrange a new plant layout for four products from the scope of this research. The project is about manufacturing plant layout optimization using simulation. This research shows different results. The four-component results compare with the existing layout. Finally, this paper shows the tables of four production quantity per month increases means the process time decreases and productivity increases.

Fidan et al. [7] re-designing the layout to improve production capacity and help with the disorganized material flow in the production process. Name Utilization of FlexSim Software to Identify the Suitable Layout Planning of Production Line. The researchers experimented with the simulation software FlexSim to increase capacity and re-designing the layout. the researcher collects all data need to simulate in software and generates 2 types of scenarios compared with the actual layout. The result of an experiment is improved production capacity from 11 units per day to 17 units per day which mean this paper can reveal throughput capacity is increased by 64.7%. Calculation from actual data they are collecting.

Koster et al. [8] published a special issue at the production research name Warehouse Design and Management. This paper pays attention to new technologies and methods. How do they impact inventory design and management? In particular, the e-commerce impact on the warehouse operation. This article approach allows for a thorough search of the design area and identifying candidate designs for consideration by designers. The design approach is demonstrated by designing the space picked forward. This paper offers a way to support hierarchical design decisions for warehouses. It considers the separation of design problems into a series of subproblems and use a formal model of the system to integrate solutions to these sub-problems. The conclusion of this paper shows warehousing research doesn't just focus on traditional topics such as improving efficiency in simple low-level picking situations or classic automation but on new automation technology more and more attention is being paid to such as high-density storage systems and AVS/RS systems or other factors (such as the human factor) that improve warehouse efficiency.

III. Methodology

First, we studied the existing process of material distribution like the process in and out of the area within the warehouse. Second, determine the problem that disturbs the work in process. third, solve the problem with simulation software. Finally, calculate the cost which might be reduced if implementing those solutions.

A. Actual Working

For case a study the large distribution area of 6,400 square meters stores 6 types of house construction materials as common types of cement, floor tiles, roof tile, steel, wood, sanitary, and doors in the same type. The case study in this research is the roof tile for house instruction which has a spacious area of 40 meters long and 16 meters wide. The process of picking the product up and the route of transport of the products.

The products are stored within the warehouse in a random area. All the materials have labels to identify the products, although the products do not clarify the area spot to store.

The number of products was no. 1-6 shown as Fig. 2 the type of products requirement is no. 1, 2, 4. The product was laid on the pallet on the floor storage.

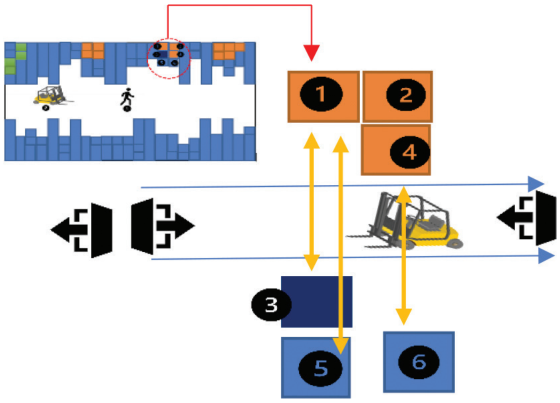

Fig. 2. How to pick up the goods

The routing for picking up product no.1-6 as shown in Fig. 2, operator no. 2 with transporter shows up with the transporter and then brings it to the exit way. However, operator no. 2 must carry pallets no. 3, 5, and 6 out of the way before picking up the required materials and then lift the pallets no. 3, 5, and 6 back to the flour storage when operator no. 2 carries pallets no. 1, 2, and 4 out already.

The product shown in Fig. 2 is the components overlapping on a pallet. The quantity input for generating the scenarios will count on a pallet for convenience and realism.

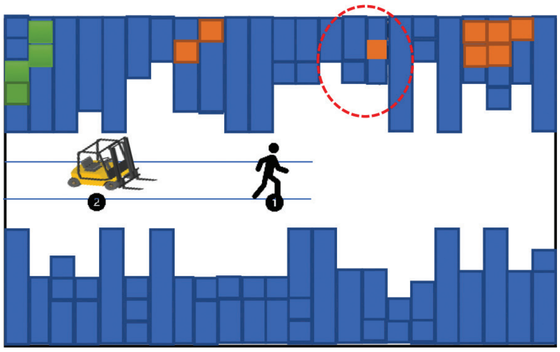

Fig. 3. Actual layout

As illustrated in Fig. 3 the actual route process for picking up the products from one order. First, operator no. 1 searches for the product requirement, and when finding the target at blocks no. 1, 2, and 4.

The actual routing process flow as shown in Fig. 3 the causing delay and waiting time that the operator must carry 3 products out to pick up the material requirement and the transporter returns to this area to carry the pallet back to the blocks again.

Because of random store products, the mean capital costs including labor and fuel are higher. This research will organize the new layout spot to facilitate transportation. And arranging the 3 types of product placement.

The researcher determines 5 orders for study in this paper and collects the working time to pick up the product following each order.

B. Determine the Data

The simulation model needs the data to generate the scenario and then collect the output analysis to show the best solution for this problem.

This research defines a Forklift as being a transporter and collecting the work time for comparison. Max speed of the transporter is 10 kg/hr. The data in Table I shows the input data has arrival time and type of products that relate to the quantity of the products. The input data for generating the model are the same for this paper.

TABLE I
INPUT TIME OF EACH QUANTITY

Arrival time (Sec)	Item Name Product	Quantity (pallet)	Type
1000	Product	120	1
2000	Product	80	2
3000	Product	80	3
4000	Product	120	1
5000	Product	60	2

* Arrival time is the time for the product appears on the model.
* Item Name Product is the identified name for the program.
* Quantity is the quantity of the product that must be input into the system model.
* Type is the classification of products that are defined by the simulation.

From Table I the data show input for generating the scenarios and quantity for the model run simulation. The quantity of products is 460 pallets, determine the type of each product is 1, 2, and 3 for classes A, B, and C as prioritized.

The next step in facilitating transport is classifying the ranks of the products and determining product along with sales valuable.

TABLE II
ABC CLASSIFICATION

Products Name	% Value	% Quantity	Class
Roof-Tile Sized 1	56%	8%	A
Roof-Tile Sized 2	26%	9%	A
Roof-Tile Sized 3	15%	32%	B
Roof-Tile small 4	3%	51%	C

* Product names are finished goods to study in this paper that are stored in the storage area,
* % Value is the percent total of the sale value.
* % Quantity is the total quantity for study.
* Class for identifying classification

As shown in Table II. ABC analysis technique distinguishes 3 types of products. A-class has roof-tile-sized no. 1 and size no. 2 for 82 percent of the total value. The red area in storage is classified as product class A. B-class represents the green area for 15 percent of the total value. The last 3 percent of the total value is a blue area was C-class.

The input data is the percent of the quantity that can conclude the product color is A-class is red for 17 percent, B-class is green for 32 percent, and C-class is blue for 51 percent at shown in Table II.

C. Design New Plant Layout

Design a new plant layout that facilitates transportation. The actual layout doesn't have space for a transporter. The researcher designs the new floor storage

The illustration is shown in Fig. 4. New layout is a new placement area designed for goods and adds more blank areas for transport. The material is stored by sitting back-to-back. The transporter drives to an area at each front.

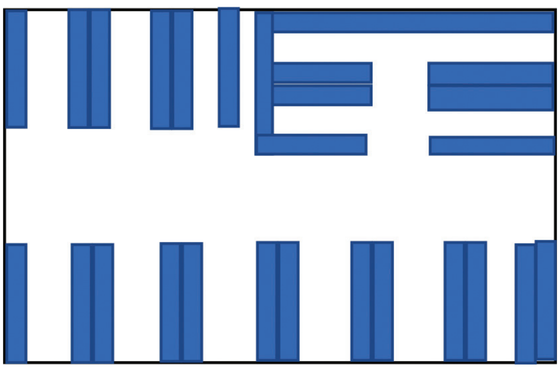

Fig. 4. New layout

This paper generates 3 models with the same data input and plant layout, but different positioning of the product based on ABC analysis for 2 models.

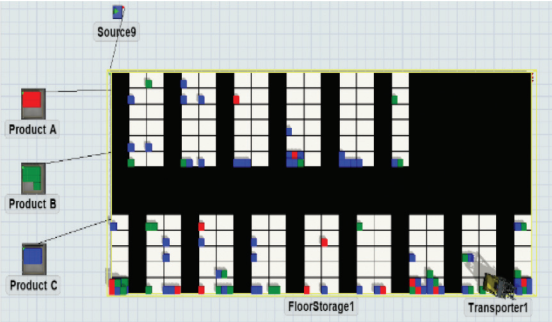

Fig. 5. Random location

From the illustration as shown in Fig. 5 random location. The simulation occupies a product with a random space area. The product appears on the layout and the Forklift will transport the product into Queue objects at specific goods.

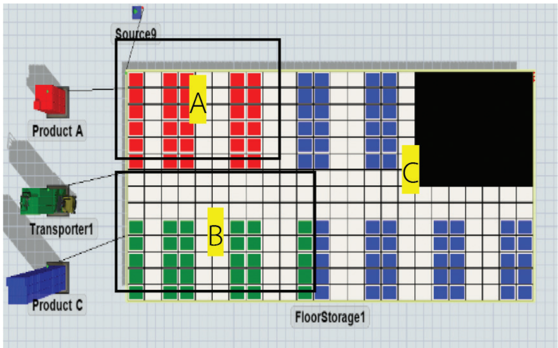

Fig. 6. Group class location

Second, from the illustration, as shown in Fig. 6. Group class location. the position of the product is based on ABC analysis data. The A-class defines to be the red area near each other. The green area is class B the position opposite of A-class and the rest of the area is for C-class.

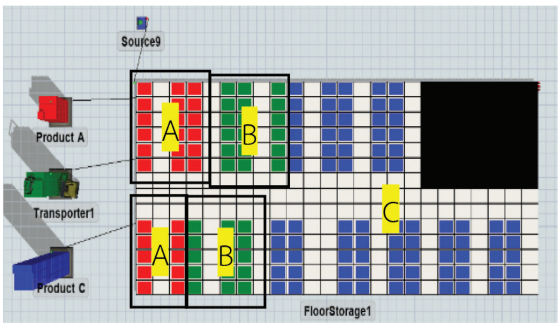

Fig. 7. Distribution group location

From the illustration as shown in Fig. 7. Distribution group location. The good's location is different from layout 2. The classification A moves opposite each other, and the transporter will notice from both sides and do the same for B and C class locations.

IV. Results

Comparison

Three scenarios simulation has runtime output when finished working. The results of forklift runtime show the different working times as shown in Table 3. The runtime of each model.

TABLE III
THE RUNTIME OF EACH LAYOUT

Models	Run Time (Sec)
Random location	10039.01
Group class location	9274.78
Distribution class location	8920.49

* Models that generate different goods locations to simulate the working time
* Run Time is the working time when input to the system until out of the system.

From the data, in Table III the runtime of each layout shows the working time that starts from the transporter picking up products at floor storage and transporting them to the customer.

The random location means the 3 products classification random location to storing and has 10039.01 seconds for finish work based on the actual workflow.

The group class location means the products have been grouped and stored in the area on the same side. The result from the analysis output of the Forklift is 9274.78 seconds for the finishing process.

The distribution class location means the location of the product has a separate group for the storing, but the location has near each other. The result of the runtime is 8920.49 seconds.

The performance efficiency after improvement can calculate from the working time before and after improvement. Comparison of the working time before and after improvement as follows:

The formula for efficiency performance is

$$\frac{\text{Actual runtime} - \text{runtime after improving}}{\text{Actual runtime}} \times 100$$

A comparison of the performance efficiency between the random location model and group class location is as the follows:

$$= \frac{10039.01 - 9274.78}{10039.01} \times 100$$

$$= 7.61\% \qquad (1)$$

And the working time of the random location model compared with a working time of distribution class location is as follows:

$$= \frac{10039.01 - 8920}{10039.01} \times 100$$
$$= 11.15\% \quad (2)$$

From percent performance at (1) and (2) shows the efficiency after improvement. The different goods location of the two models has more efficiency compared to the random location.

V. Conclusion

In the simulation output, we concluded the runtime or working time that the transporter picks products for the customer at the queue object. The large area and massive products have been laid on the pallet. The simulation software gives information about the effect of different layouts and modifications on a good's location. However, it shows statistics of reduced runtime in comparison with different simulation models.

TABLE IV
Comparison with Random

Models	Group (%)	Distribution (%)	Variance (%)
Random	7.61	11.15	3.54

* Model for prototype to compare with the other
* Group is the model random location.
* Distribution is model name distribution class location.

Table IV shows the grouping class model and distribution model compared with the random location model. The variance of the two models is 3.54%. The best solution for this problem is distribution group location which improves performance by more than 11.15 percent.

However, the solution from the idea to solve this problem came from the working time based on the software environment and actual data of the warehouse in the case study.

The reliability of the information of the existing plan model on software is familiar from the real situation but doesn't guarantee the result was the fact when adjusting the solution into the real works as depending on various factors.

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