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Random Location under Fixed Zone Storage Strategy A Case Study of Automobile and Electronic Parts Manufacturing Factory

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Abstract

Nowadays, small to medium size automobile and electronic parts manufacturing factories intend to improve their Logistics Performance in conjunction with improve production process and products development for response customer service level and get competition opportunities. For this reason, this research selects one medium size automobile and electronic parts manufacturing factory in Thailand to be case study. There are 239 active Stock Keeping Units (SKUs) which be sold to customers. The concerned issue was "cannot deliver products to customer on the first request date and time" caused from spent long time for picking at finished goods warehouse. After observation and analyst data, found that there was mixed SKUs in some locations, some was empty meanwhile there were 18 pallets on the floor and location utilization was 61.31%. This research aims to design new storage strategy and develop initial program with using Visual Basic Application (VBA) for support all processes. The results after adjust storage strategy from Fixed Location to Random Location under Fixed Zone and develop initial program which can decrease picking process time by 3.93 minutes per order and increase location utilization by 23.21% moreover can increase space worthiness ratio which compare between warehouse rental cost and actual active locations.

Keywords
Storage Strategy, ABC Analysis (Inventory), Visual Basic Application (VBA).

1. Introduction

In the past, the starter businesses of automobile and electronic parts manufacturing factories in Thailand which focus on quality improvement or production process improvement or new products development from new technology which can be said that they generally intend about manufacturing on the other hand quality and new products. In the present, Supply Chain and Logistics Management is the one factor which be important for response customer service level and get competition opportunities in the present. Therefore, this research focuses on Logistics performance improvement in Automobile and Electronic Parts Manufacturing Industry.

This research selects one of medium size automobile and electronic parts manufacturing factory in Rayong Province of Thailand to be the case study which has operated for 10 years. There are 239 active Stock Keeping Units (SKUs) of finished goods which be sold to customers. The essential customers are Car Assembly Plants and Electrical Appliance Factories. Manufacturing environment in this case study is "Make to Stock (MTS)" that produces based on demand forecasts therefore every process must be done on the schedule starts from receive forecasting quantity from customer after that do production plan then produces till puts away at specific location in the finished goods warehouse for waiting the customers pick up products according to their order on the appointment date and time. The concerned big issue was "cannot deliver products to customer on the first request date and time" caused from spent long time for pick products at finished goods warehouse before delivery and there are not track and trace system for support all activities in warehouse. After observation, found that there was mixed SKUs in some locations so this was the causes that why spent the long time for picking. Moreover, there was some empty locations in spite of there were 18 pallets which are mixed SKUs and customer code on the floor therefore location utilization was 61.31%.

This research aims to design new storage strategy for supports this manufacturing environment and responses to customer requirement which change from Fixed Location to Random Location under Fixed Zone and develop initial program with using Visual Basic Application (VBA) for support all processes in the finished goods warehouse. The results after adjust storage strategy to be Random Location under Fixed Zone can increase location utilization from

61.31% to 84.52% therefore can increase space worthiness ratio which compare between warehouse rental cost (rental cost per year in Thai Baht) and actual active locations by 27.47%. Previously, there are not any track and trace system for operation after develop the initial program can improve track and trace system in warehouse to be real time tracking and updated inventory stock so the process time was slightly decrease such as picking process time by 3.93 minutes per order.

2. Method and Literature Review

2.1. Storage Strategies

In 1997, Charles has classified the storage strategies to two classifications which be Random Storage System and Volume-Based Storage System which Random Storage System Strategies was represented in The Warehouse Management Handbook which was wrote by James A. Tompkins and Jerry D. Smith in 1998 which divided the storage strategy to be six strategies thus Informal System, Fixed Location System, Part Number System, Commodity System, Random Location System and Combination System.

Lee and Elsayed (2005) developed the optimal capacity using Fixed Location System Strategy. The found that SKUs should be assigned to locations based on the ratio of their activities to the number of locations assigned therefore the highest rate SKU should be placed at the preferred openings and ones at lowest rate should be located at the least-preferred openings.

Tompkins et al. (2010) classified storage into dedicated and randomized storages. In the dedicated storage, each Stock-Keeping-Unit (SKU) is assigned into a fixed specific location and at that location, no other SKU is stored which be called that Fixed Location System. Barthodi and Hackman (2010) have proved that dedicated storage strategy or Fixed Location System Strategy utilization be only 50% of the warehouse in those warehouses where it was followed. This can be explained by the fact that when the "out of stock" occurs there are many empty locations which are not used because SKU is fixed at their own location. In addition to, Barthodi and Hackman have proved in space utilization of Random Location System Strategy which the utilization ratio is higher than Fixed Location System Strategy because all SKUs will not reach the maximum inventory level simultaneously. Random Location System Strategy requires fewer opening of locations compared to the need for this in Fixed Location System Strategy.

2.2. Pareto Principle and ABC Analysis

Lai and Cheng (2009) mentioned about derivation of Pareto Principle that it was started in the nineteen century by Vilfredo Pareto who was the famous Italian economist and sociologist who defined Pareto's Law which is well known as the 80/20 rule. He described the situation of unequal distribution of income that existed in Italy. Eighty percent of the wealth is owned by twenty percent of the people moreover he found the similar phenomenon in farming. Eighty percent of the peas are yielded by twenty percent of the peapods in his garden. The Pareto principle points out many kinds of outputs are dominated by few vital factors. The Pareto Principle was applied in many fields such as quality management, identify priority of problems and operation management tools etc.

Dickie (1951) was the first person who applied the Pareto Principle to an inventory control system for General Electric and it was called ABC analysis in the next time. Fuerst (1981) summarized the process to do ABC analysis as follow: the first, calculate total value for each type of product (item). The second, ranks items by the total value in descending order. The third, calculates the percentage of total value for each item then divides products into three groups or classifications according to certain classification criteria.

Davood et al. (2012) mentioned that there are several different classification criteria need to be applied appropriately for define inventory classification and policy such as based on price, value, criticality, availability, movement, predictability and weight. Almost researches define inventory classification and policy based on value because to decrease total inventory cost as ABC Analysis is based on Pareto Analysis which "A Class Item" is 20% of the items contribute to 80% of sales that implies that a small portion of items in Inventory contribute to maximum sales. "B Class Item" is 15% (80% - 95%) contribution to revenue and "C Class Item" is 80% of the items contribute to 20% of sales. Therefore, it is a general trend in the industry to focus on "A Class Item" (approximate 20%) which results in maximum revenue (80%). In simple terms, planning and forecasting for 'A' class items can yield maximum benefits. Torabi et al. (2012) described that conventional ABC analysis accounts for only one criterion, mostly ''annual dollar usage'', for classification of inventory items. However, there are too many other criteria (both quantitative and qualitative) that may significantly affect the classification such as: inventory holding unit cost, part criticality, the length and variability of replenishment lead time, commonality, substitutability, scarcity, durability and stock-out unit penalty.

Siriwat (2012) applied ABC Classification to classified product groups for determined the optimal order size and defined storage space zone of raw material to be appropriate to warehouse efficiency improvement

Achira (2014) applied ABC Classification for increased efficiency in automotive part company. The results demonstrated that the average time of the disbursement reduced by 24% furthermore the delivery performance increased by 10%.

Benjamin et al. (2017) replicated that inventory classification could support business-driving inventory items are efficiently managed in spite of constrained resources which there are numerous single- and multiple-criteria approaches to it.

After studied about the storage strategies method and related research papers, this research aims to designs the new storage strategy which be proper for the finished goods warehouse in automobile and electronic parts manufacturing factory. This new storage strategy is called "Fixed Location to Random Location under Fixed Zone" which is designed based on Basic Random Storage System and ABC Classification Method. In addition to develop the initial program with using Visual Basic Application (VBA) for support all processes in the finished goods warehouse before develops Warehouse Management System (WMS) in the future.

3. Procedure

This research separates the research procedure to be three phases which be shown in the figure 1. as follows:

3.1 Phase 1 is about primary data collecting at the plant, study about related information from the secondary source and plan the research procedure.

3.2 Phase 2 is called that development phase so that is about storage strategy design and develop initial program.

3.3 Phase 3 is the last phase which is about evaluation and conclusion.

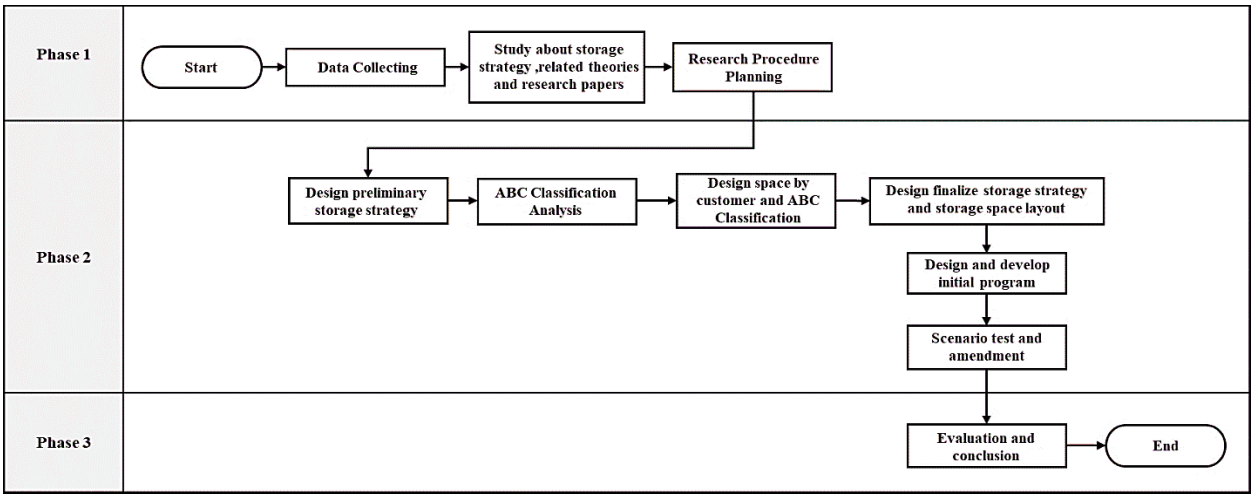

Figure 1. The research procedure of Design Storage Strategy and Develop Initial Program for Random Location under Fixed Zone System

This research applies ABC Classification Method to classify inventory categorization by stock movement which stock movement is calculated from in and out transactions technique. ABC Classification divides an inventory into three categories as follow:

- "A items" with very high movement and average daily value per order is over than 70 percent of average total daily value.
- "B items" with moderate movement and average daily value per order is about 20 to 70 percent of average total daily value.
- "C items" with low movement and average daily value per order is less than 20 percent of average total daily value.

According to criteria for classify ABC categorization, total 239 active Stock Keeping Units (SKUs) are divided into "A items", "B items" and "C items" by 42 items, 61 items and 136 items respectively then design the sample storage space layout and new storage strategy in the next step.

4. Random Location under Fixed Zone Storage Strategy

This research applies two storage strategies to design the storage strategy for finished goods warehouse of automobile and electronic parts manufacturing factory therefore new proper storage strategy is "Random Location under Fixed Zone". The logic of Random Location under Fixed Zone is represented in the figure 2.

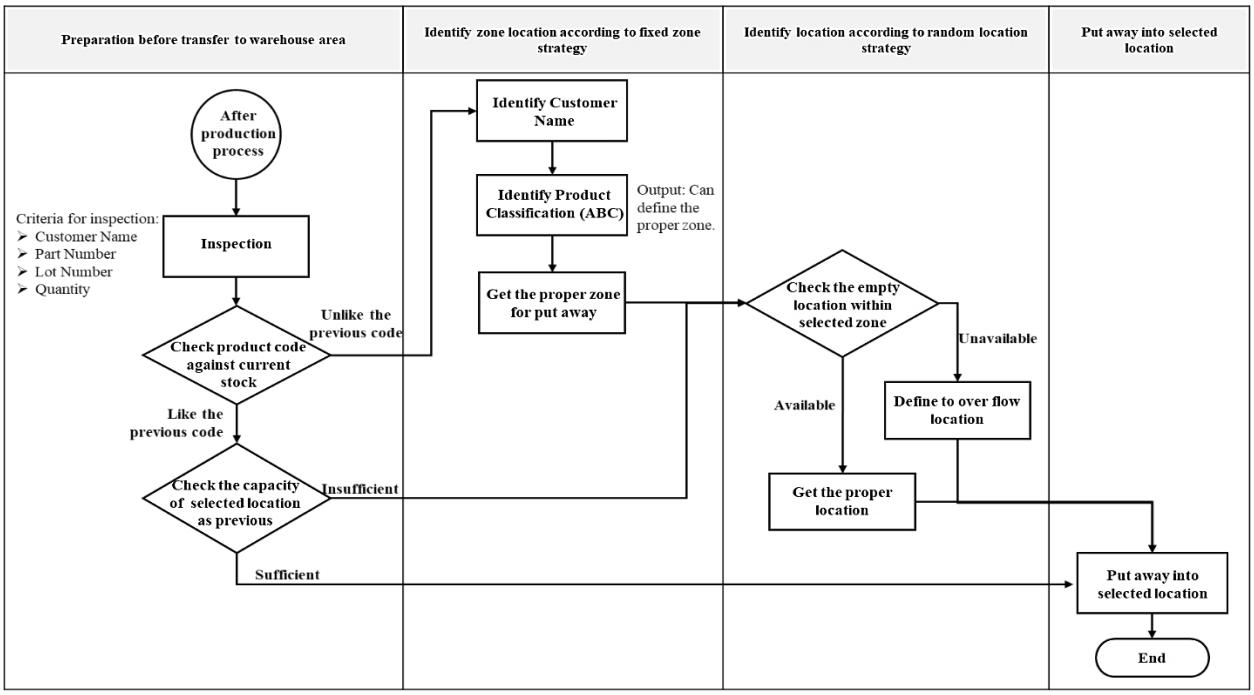

Figure 2. Logic of "Random Location under Fixed Zone" storage strategy

The logic of "Random Location under Fixed Zone" storage strategy is separated to two essential sections as follows:

4.1 Fixed zone

Definition of "Fixed Zone" in this research is about separate the storage space by each customer name in the first step then defines the location by product classification (ABC classification) which can see the sample storage space layout in Figure 3.

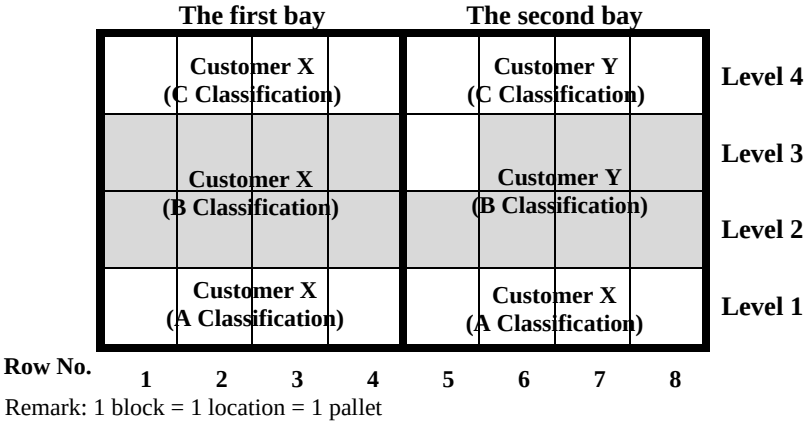

Figure 3. Sample storage space layout be separated by customer name and product classification

4.2 Random location

Definition of "Random location" in this research is about every product can put away at all location by selected zone example: Product A of Customer X is identified A Classification so if the sample storage space layout as in the figure 3., Product A will be put away at whichever location (Row No. 1-8) on Level 1 which is empty or be the same SKU as the previous products.

"Random Location under Fixed Zone" is the proper storage strategy for the finished goods warehouse of automobile and electronic parts manufacturing factory because there are not too much SKUs but there are many customer so if storage space layout is fixed location by SKU as previously, it will happen high opportunity of over and empty location situation. Therefore, there are many empty locations because no have production plan of some products, there are mixed customer code in the same location and about 20 pallets are placed on the floor because there are not available location for put away. Finally, "Random Location under Fixed Zone" is the proper solution to protect mixed customer code in the same location and support put away and picking activity causes of define layout as ABC Classification.

5. Design and Develop Initial Program

This initial program is designed and developed for support "Random Location under Fixed Zone" storage strategy at finished goods warehouse in automobile and electronic parts manufacturing factory in order to develop to be Warehouse Management System (WMS) in the next stage. Framework of this program is developed based on logic of "Random Location under Fixed Zone" storage strategy and activities in warehouse which be written by Visual Basic Application (VBA) that is under controlled by Microsoft Excel. Figure 4 shows the information structure of this program that separates to be three sections thus input information, modules on initial program and output information.

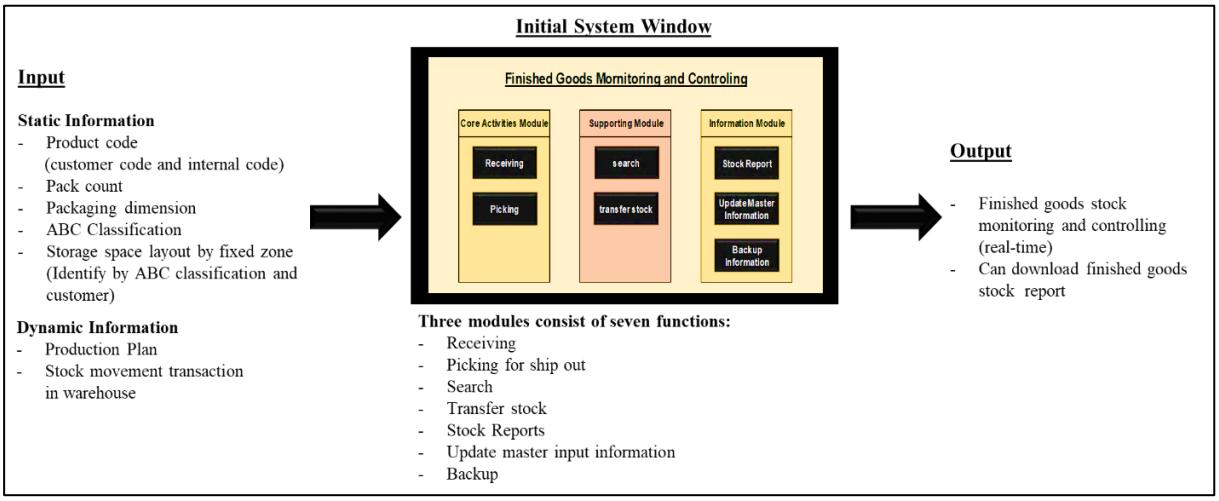

Figure 4. Program structure operate on Visual Basic Application (VBA)

5.1 Input information

There are two types of input information that be static and dynamic information. Static information is the specific information which be rarely revised such as master data of product, master data of customer and Storage space layout (identify space by "Random Location under Fixed Zone" storage strategy) on the other hand dynamic information is the daily transaction.

5.2 Module

There are three principle modules thus Core Activities Module, Supporting Module and Information Module. Core Activities Module is divided to two functions as Receiving Function for support finished goods receiving from production line and Picking Function for support picking and prepare for ship out. Supporting Module is separated to two functions as Search and Transfer Stock for supporting to find items easily including can record and track when move finishes goods within the warehouse. Finally, Information Module is separated to three functions for monitor and control inventory stock.

5.3 Output information

This developed initial program is the small system for the real-time stock movement for monitoring and controlling in addition to provide finished goods inventory or stock report.

6. Conclusion

In the development phase (Phase 2) of this research, there are three main steps thus ABC classification by each customer name for determine minimum quantity, maximum quantity and numbers of location by SKUs of each customer name after that design new storage strategy as "Random Location under Fixed Zone" Finally, design and develop initial program for support all activities in finished goods warehouse The results after implementation which can decrease picking process time by 3.93 minutes per order and increase location utilization by 23.21%. In addition to can increase space worthiness ratio which compare between warehouse rental cost (rental cost per year in Thai Baht) and actual active locations by 27.47%.

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Biography

Pikchaya K. works as a Lecturer in Industrial Management of Faculty of Business Administration at Thai-Nichi Institute of Technology, Thailand. She graduated in a Bachelor's Degree of Engineering in Management Engineering and Logistics from Silpakorn University, Nakhon Pathom, Thailand and earned Master's Degree of Science in Logistics Management from King Mongkut's University of Technology Thonburi, Bangkok, Thailand. Her interesting research field is about Industrial Management Engineering, Operations Management, Supply Chain and Logistics Management. She has published journal and represented her research in international conference.