PICKING EFFICIENCY IMPROVEMENT THROUGH THE DESIGN OF PICK FACE LOCATION

By
PARAMA TANAKASAMCHAI

A Final Report of the Six-Credit Course
SCM 2202 Graduate Project

Submitted in Partial Fulfillment of the Requirements for the Degree of
MASTER OF SCIENCE IN SUPPLY CHAIN MANAGEMENT

Martin de Tours School of Management
Assumption University
Bangkok, Thailand

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November 2011

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Declaration of Authorship Form

I, Parama Tanakasamchai

declare that this thesis/project and the work presented in it are my own and has been generated by me as the result of my own original research.

PICKING EFFICIENCY IMPROVEMENT THROUGH THE DESIGN OF PICK FACE LOCATION

I confirm that:

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I confirm that this thesis/project has been carried out under my supervision and it represents the original work of the candidate.

Signed ______________

(A.Thanapat Panthanapratez)

Date 20-Dec-2011

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Parama Tanakasamchai
Assumption University
November 2011

ABSTRACT

ABC is a logistics company, providing logistics and distribution services in Thailand. With a high competition in 3PL business, the company must keep up with its service in order to meet customer expectations. Any failure to deliver would cause the customer to stop the service with ABC. A problem with the logistics and distribution is delay delivery. The study has pointed out that major problem was derived from poor picking. There are factors causing efficiency in picking such as traveling time, checking of products and the picking equipment, such as the power pallet truck that the picker used to drive around the warehouse from the starting point to the required pickface location. Further research indicated that poor zoning in the warehouse could consume traveling time unnecessarily.

Using the order transaction data between January-July 2011, the study proposed the zoning of the warehouse by using ABC classification based on frequency of the order to each SKU based on Dekker (2004). The most ordered SKUs were classified into class A which holds up to 71% of the total order hit. The SKUs class B hold up to 20% of the total order hit and the SKUs class C holds 9% of the total order hit respectively. Then each individual SKU got re-assigned into the new pickface location according to its order frequency i.e. SKU ranking 1st most ordered SKU were assigned into the pickface location that has the least traveling time. The same practice was re-applied to the rest of the SKUs accordingly until the result the study could achieve the most appropriate pickface location assigned to each SKU accordingly. The result was successful. From the new pickface location; ABC can reduce the traveling time up to 53% from its original traveling time.

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I, Asst. Prof. Dr. June Bernadette D'Souza, has proofread this Graduate Project entitled

Picking Efficiency Improvement through the Design of Pick Face Location

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and she hereby certifies that the verbiage, spelling and format is commensurate with the quality of internationally acceptable writing standards for a Master Degree in Supply Chain Management.

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(Asst Prof Dr. June Bernadette D'Souza)

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Date: 28th December 2011

CHAPTER I

GENERALITIES OF THE STUDY

There are many third party logistics service providers in the market these days. The high competition forces the logistics industry to be competitive both in pricing and improving the service levels.

One of the services provided by 3PL service is warehousing. The storage service has recently expanded its value by dealing with urgent orders and shorter picking time which results in quicker delivery to the final customer. The operational activities in the warehouse are various and extend from unloading products, putting-away products onto the designated zones and racks, replenishment onto the pickface, order picking, dispatching, inbound value added service (IVAS), outbound value added service (OVAS), and co-packing

Consequently this paper aims to improve the current picking activity within the ABC dedicated warehouse for DH by proposing the storage assignment strategy to its current operation.

1.1 Background of the Company - ABC

ABC has distribution centers in many strategic locations, which could optimize the lead-time in delivery and minimize costs for each customer. As of 2007, ABC expanded the extensive logistics infrastructure in Hong Kong, China, Taiwan, Thailand, Malaysia, Singapore, Philippines, U.S. and U.K. Together with a comprehensive network of more than 85 distribution centers and depots, ABC also invested vastly in technology solutions. It developed a state-of-the-art Automated Storage and Retrieval System facility which was considered to be one of the most advanced and largest logistics hubs in Thailand

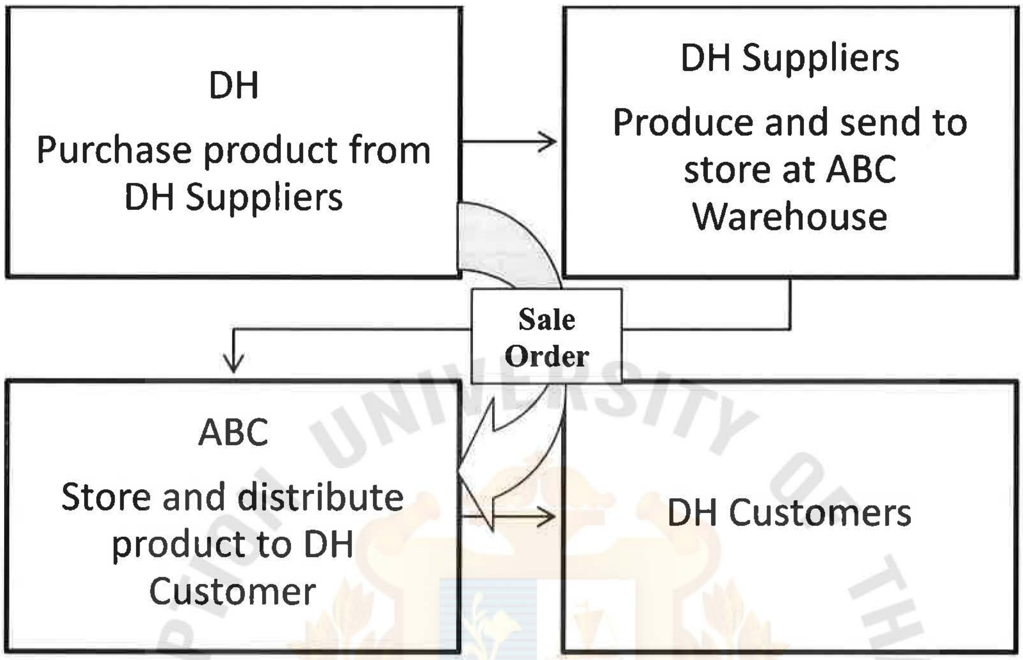
ABC provided customized logistics solutions to help bring finished goods from production lines into the hands of consumers in Thailand. Service fees were charged based on a number of factors, including type of services rendered, nature of the products, and local market conditions.

ABC Menu of Service was vast. It included a service in specialty warehousing, bonded warehousing, cross-docking, export logistics and regional hubs.

For logistics services, the regional competitors were Kerry Logistics, Exel/DHL, Linfox and Toll. However, the competitors that ABC was up against quite frequently were the numerous local logistics providers in each of the countries. The logistics business was highly fragmented in most of Thailand's market, including China where the largest player generally accounted for less than 1-2 percent of the total market. Given that logistics was inherently an asset-intensive business, few players had the resources to build nationwide coverage. As a result, most brand owners needed to work with multiple logistics companies to distribute their goods to various parts of a country. Most of the logistics providers did not have sophisticated technology, and did not provide additional services beyond warehousing, trucking and delivery.

ABC was taking care of various customers. DH was one of those customers taken care of by ABC. DH is a company that sells cleaning chemicals for heavy industries and hotels. This study is based on the DH operation because the accessibility to the data collection and to the warehouse. Similarly to any 3PL company, ABC services DH could be best explained through the Figure 1.1:-

Figure 1.1 ABC – DH Service flow



Source: ABC

DH Suppliers send finished goods to ABC Warehouse for storage. DH then issues the SO (Sale Order) to ABC. The orders are processed by the order processing administration. The pick slip then is generated and passed to the operation team.

After receiving a pick slip, the pickers will travel by a PPT (Powered Pallet Truck) through each location assigned to each SKU Pickface to pick the ordered SKU(s). After completing all items in the pick slip the pickers will return to the dispatch area with the picked items.

The picking process consists of different activities. Each activity consumes time differently.

1. Driving from the Starting point to the assigned location.
2. Checking SKU to ensure the correct picking.
3. Checking Lots, Batch requested in the picking slip.
4. Checking Expiry Date requested in the picking slip.
5. Picking by requested quantity.
6. Driving to another assigned location for another SKU in the pick slip, unless if finished, to the dispatch area.

Van den Berg (1999) has described that the order picking is the retrieval of a number of items from the warehouse storage locations to satisfy a number of independent customer orders. It is an important link in the supply chain constituting of 65 percent of the total operating costs for a typical warehouse.

Those other activities such as checking SKU, lots, expiry date, will be improved to be faster as time goes by when the picker get used to the product. But the traveling time is the most time consuming and cannot be improved by familiarity of the picker.

1.2 Statement of the Problem

There is a lead time for picked items to be dispatched to a delivery zone. The delivery zone is also known as a dispatch zone where picked items are placed and checked before being loaded into the truck, if the lead time is missed. The product would be delayed for delivery to a customer as scheduled, leading to complains and customer dissatisfaction. Hence the main research question is "How pickface can improve the picking efficiency in the warehouse?"

1.3 Research Objectives

The research objectives are as followed;

1.3.1 To analyze and identify the problem with current pickface location.

1.3.2 To re-assign the picking location to decrease traveling time.

1.3.3 To set a routing policy to optimize the order picking time.

1.4 Scope of the research

This project focuses on only ABC service provided to DH. This project's scope is to find the problems of current pickface layout, increase picking efficiency and reduce labor cost through the design of pickface location through ABC classification and routing method in order to improve customer satisfaction and efficiency in the company. For other problems, the company will be on their own to solve other problems.

1.5 Significance of the study

The study can increase the productivity in order picking for any operation that has a similar situation to ABC by classifying SKUs into ABC Class, and designing the Pickface to match the frequency of the orders in each SKU. This study can benefit the company to increase the picking efficiency.

1.6 Definition of terms

Pickface	The portion of a storage area that is immediately accessible to the order picker. Think of it as the front (face) of your storage. (L.L.C, 2011)
Picker:	The staff that is responsible for picking the product as ordered in the picking slip. (L.L.C, 2011)
Picking Slip	The document that shows the details of the order being requested. The details will usually include the SKU number , quantity, location, customer name, lot number, batch number, product description and delivery date (L.L.C, 2011)
SKU	Stock keeping unit: a specific item in a specific unit of measurement. For example, if you store 10 litres of oil in your warehouse in two packages, in gallons and bottles, then there are 2 SKUs because the both items are the same 10 litres of oil. (L.L.C, 2011)

CHAPTER II

REVIEW OF RELATED LITERATURE

In order to be able to clarify the problem for this project and to learn the solution from previous study, the literature under this chapter includes:

1. Order picking literature, so as to understand more deeply the concerns of order picking activities and efficiency.
2. Storage Assignment, so as to understand the rules that best apply to assign items to the pickface.
3. Class based assignment, so as to understand which type of class-based assignment is most appropriate to this case study since there is no rule to identify a class-based storage assignment strategy
4. Key literature on order picking response time improvement (Dekker, De Koster, Roodbergen, & Van Kalleveen, 2004)

The service level consists of various factors. Such as order accuracy, order integrity, the order delivery time. Nevertheless, the crucial link between order and service level is that the faster the order can be retrieved and dispatched, the sooner it is available for shipping to the customer. (De Koster, Le Duc, & Roodbergen, 2007)

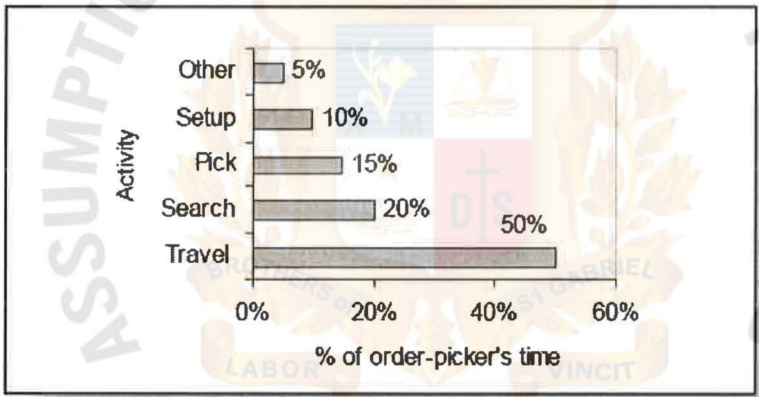
This implies that if the order was not picked on time, then there is a high chance that the order will miss its delivery schedule, hence there is the need to wait for another next delivery, or else ABC might need to use another truck service provider which would have a high cost and poor utilization.

The most common objective of order-picking systems is to maximise the service level subject to resource constraints such as labour, machines, and capital. In this case study, it pointed that ABC does not have an effective order-picking system. (Goetschalckx & Ashaveri, 1989)

Factors influencing order-picking efficiency are operating procedures, changing products' demand, the equipment, the racking and layout of the warehouse. Operating procedures can often improve efficiency without the large capital investments needed to alter racks or equipment.

The time required for picking an order includes the time for traveling between product locations, picking products, and such activities as packaging, dropping off products, and acquiring information for the next order. Of these components, travel time is usually the largest (Tompkins, White, Bozer, Frazelle, & Tanchoco, 2003)

Figure 2.1 Typical Distribution of an Order Picker's Time



Source: Tompkins et al. (2003)

2.1 Order Picking

De Koster et al. (2007) described Order Picking as the most labour intensive and the cost of order picking alone could sum up to 55% of the total cost of the warehouse operating expense. Hence if the performance for order picking is poor it could lead to a very low service satisfaction and high operational cost. Order picking involves the process of clustering and scheduling the customer orders, assigning stock on locations to order lines, releasing orders to the floor, picking the articles from storage locations and the disposal of the picked articles.

The issues in planning and control of order picking can be on either tactical or operational levels. From the organization perspective, common decisions at these levels are:

1. layout design and dimensioning of storage system
2. storage assignment
3. batching and zoning
4. routing
5. order accumulation/sorting

(Rouwenhorst, Reuter, Stockrahm, Van Houtum, Mantel, & Zijm W, 2000)

Since one of the major decision that needs to be made in the operation is storage assignment, the researcher moved on to the next literature review on storage assignment.

2.2 Storage Assignment

Items (or stock keeping units - SKUs) need to be put into storage locations before they can be picked to fill customer orders. A storage assignment method is a set of rules which are used to assign items to storage locations.

De Koster et al. (2007) described 4 types of storage assignment as below:-

a. Random storage assignment

This type of storage assignment assigns items to location randomly over the available storage locations. This type of method is considered widely in the literature; in many studies, it is used as a benchmark for the improvement by using other storage assignment methods.

b. Closest-open-location storage assignment

This type of storage assignment will assign items to the closest and empty location by defining the closeness with the distance from the input/output. It is the simplest method and used under the circumstance where the picker need to pick up the location by themselves. There is no fixed location assigned for each item and as the long run, this may result in items locations scattered all over the picking zone.

c. Dedicated storage assignment

With this storage assignment type, each item has its own storage location. To minimize the travel distance, the closest-to-depot storage locations are commonly reserved for items with a high turnover and little storage space occupation.

d. Full turn over storage assignment

This policy distributes products over the storage area according to their turnover. The products with the highest sales rates are located at the easiest accessible locations, usually near the depot. Slow moving products are located somewhere towards the back of the warehouse.

2.3 Class-based storage assignment

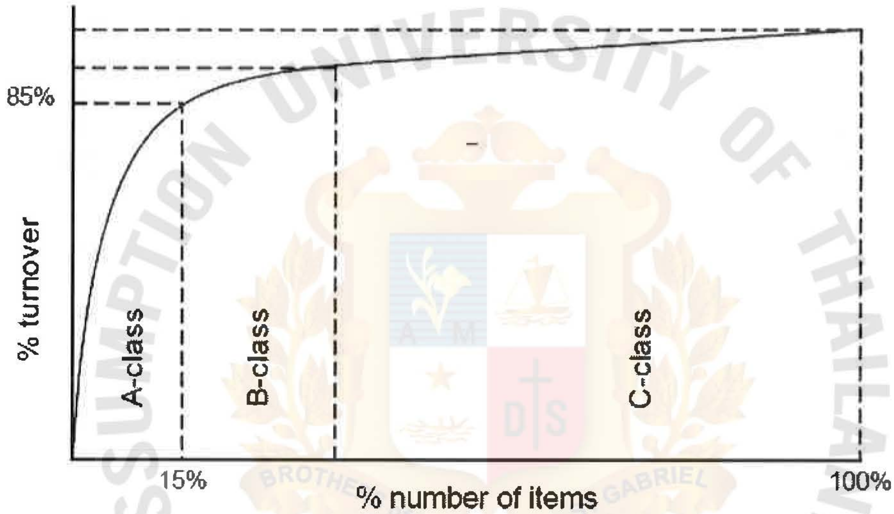
There is no rule to identify a class-based storage assignment strategy. Usually, the number of item classes is restricted to 3 and item classes are named A, B and C (for fastest, medium and slowest moving items), that is why this method is also called the ABC-storage assignment.

A literature suggested that SKU classes are determined by some measure of demand frequency of the products, or pick volume. Fast moving items are generally called A-items. The next fastest moving category of products is called B-items, and so on. Often the number of classes is restricted to three, although in some cases more classes can give additional gains with respect to travel times. (Roodbergen & De Koster, 2001)

Class-based storage assignment (also: ABC-storage, group-based storage) This method assigns items to storage locations on a group basis. It divides both items and storage locations into an identical number of classes. Item classes are based on turnover frequency (like pick lines per time unit, or product units picked per time unit).

ABC storage assignment is also known as a grouped-storage assignment where the products are classified based on type, characteristics, pick frequency and any combination of these three and assign each product group to a certain area of the warehouse (Malmborg, 1995).

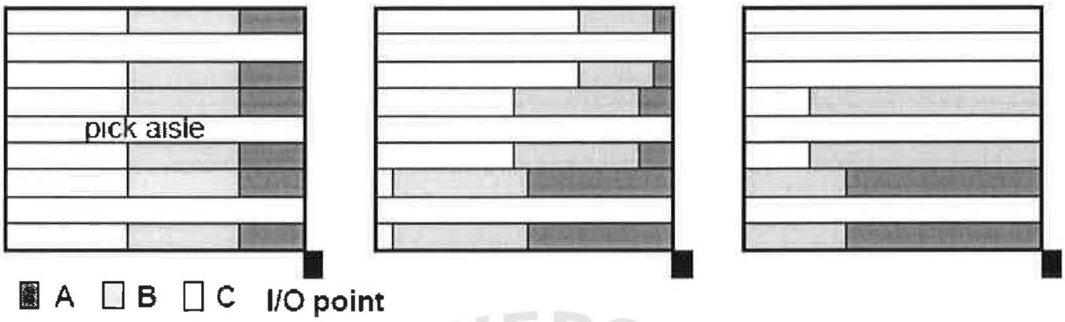
Figure 2.2 Example of the Class Partition Strategy



Source: De Koster et al. (2007)

Figure 2.2 shows an example of a division of the items in three classes. The item classes are sorted on decreasing turnover frequency and the storage location classes on increasing travel distance from the I/O point. Next, the item classes are assigned to the storage location classes (which should be large enough to contain the SKUs) in this sequence.

Figure 2.3 Examples of Locating Item Classes in a Warehouse



Source: De Koster et al. (2007)

Figure 2.3 shows some examples of allocating items in a warehouse by using the class-based storage assignment method.

In class based storage assignment, more classes are also possible and may reduce the travel distance further. For a (low-level) manual-pick OP system, Peterson (1995) recommended that the number of classes should be between 2 and 4. In order to decide the ABC location divisions, the closeness (to the I/O point) can be used. Since usually multiple aisles are present, the closeness depends on the routing method used (Le Duc, 2005).

2.4 Order picking response time improvement

The research on improving the order picking response time by Dekker et al. (2004). This study conducted by first looking at the storage policies that resulted in improving the performance of picking efficiency. By doing so, they defined the ABC Storage policies and also considered several constraints into account before designing of pickface location. These constraints are;

- Product types (tools, hardware, and gardening) must be retrieved separately.
- Breakable products must be retrieved after all unbreakable products.
- Some locations must be empty in all zones (ABC zones plus breakables) in which, for example, to store new products

Dekker et al. (2004) classified each SKUs according to the total pick by Class A contains up to 70 percent and 15 percent of the products. Classes A and B together contain up to 90 percent of the picks and at most 50 percent of the products. Class C contains the rest. The products from the A class are stored into the pickface that is the closest to the starting point, B class next, C class in aisles farthest from the starting point. They filled class A with products first repeated, this is the class with the highest number of picks that is not yet assigned to a class, until the number of picks in class A reaches 70 percent of all picks or until 15 percent of the products are in class A, whichever comes first. Classes B and C are then filled with products consecutively in the same fashion. From this implementation, they reduced the picking time and number of the picker down almost 50% (depending on the peak period). As the result, the company could save up to 140,000 EUR that year.

2.5 Summary

The best tool to apply to ABC is to design the pickface by using ABC classification and to adapt the optimal routing method in order to achieve efficiency in the picking and traveling in the warehouse. In the next chapter, the data will be analyzed of order transaction and current traveling time of each picking location. Together the researcher will use the knowledge gained in the chapter to find the optimal solution for this study.

CHAPTER III

RESEARCH METHODOLOGY

This paper is based on the case study of ABC, which focuses on improving order response picking time in the warehouse. The warehouse that is used in the study is the dedicated ABC warehouse for DH business unit. The methodologies that are used in this chapter consist of raw data, along with case studies and literature that are relevant and supportive to the study. The materials that can provide the best solution for improving order response picking time in the warehouse are considered as well.

This chapter consists of six parts, the first part involves the research method that we use in the data collection process. The data is the raw spreadsheet computer data retrieved from the ABC server. It is the order transaction from January 2010 to July 2010, the assigned location on each SKU, and the number of pickface (Picking location) available within the warehouse, are the layout of the warehouse. The racking length and width information that will be used in finding the traveling time of the picker is also included.

The second part involves the data analysis. Under this part, the data is broken down in spreadsheet to analyze each SKU in detail in order to find out each SKUs characteristics and ordering pattern including number of order hit made to each SKUs for the past 7 months. The third part talks about the results of the findings in the data analysis by reading through the results and matching the results with the current operation. This helps to single out the gap between the order pattern, order picking, current pickface location, and this eventually help finding how to optimize the traveling time for the picker by zoning the SKU. The forth part express the proposed zoning model that will be used to reduce the traveling time of the picker. The zoning model can be done by re-location the current pickface according to the SKUs characters and order hits. The fifth part talks about the benefits of the proposed model and finally the sixth part includes the summary.

3.1 Data collection

The researcher collected historical data of order transaction from January 2010 to July 2010, Picking layout and warehouse layout from the ABC WMS database.

3.1.1 Order transaction

The order transaction data shows the information on:-

- Delivery date, the date that the shipment must be shipped to the customer.
- External Order Key Number, the reference order number assigned to each single order. That means one order per one external order key number. Under this external order key number there is the information on the item being ordered or stock keeping unit.
- Stock keeping unit (SKU) number, in this collected data is an identification number assigned to each single product. The SKU number is usually coupled with a description to describe each SKU again.
- Quantity (QTY), the quantity of SKU that needs to be picked.

Order transaction data is collected because the researcher wanted to find out the ordering frequency of each SKU. The researcher needed to find out the most ordered SKU between January – July 2010. This data helped the researcher to classify SKU ABC Class. Transaction data was collected between January – July 2010 because at the end of year 2009, there was a product write-off and these products expired and no longer available to sell in 2010. So the most appropriate data to collect was between January 2010 – July 2010.

Table 3.1 Example of Order Transaction Data

DeliveryDate	ExternOrderKey	Sku	OriginalQty
4/1/2010 0:00	10000030SO9346157	HH0002650	2
4/1/2010 0:00	10000030SO9346157	HH0000740	1
4/1/2010 0:00	10000030SO9346157	HH0026580	2
4/1/2010 0:00	10000030SO9346157	HH0002720	2
4/1/2010 0:00	10000030SO9346157	HH0089190	5
4/1/2010 0:00	90029949SO9330771	HH0000980	2
4/1/2010 0:00	90028672SO9276632	HH0000980	3
4/1/2010 0:00	90030307SO9340888	7010206	1
4/1/2010 0:00	90030283SO9338033	7010191	24
4/1/2010 0:00	90030283SO9338033	7010194	20
4/1/2010 0:00	90030283SO9338033	7010196	27
4/1/2010 0:00	90029563SO9313318	HH0100730	70

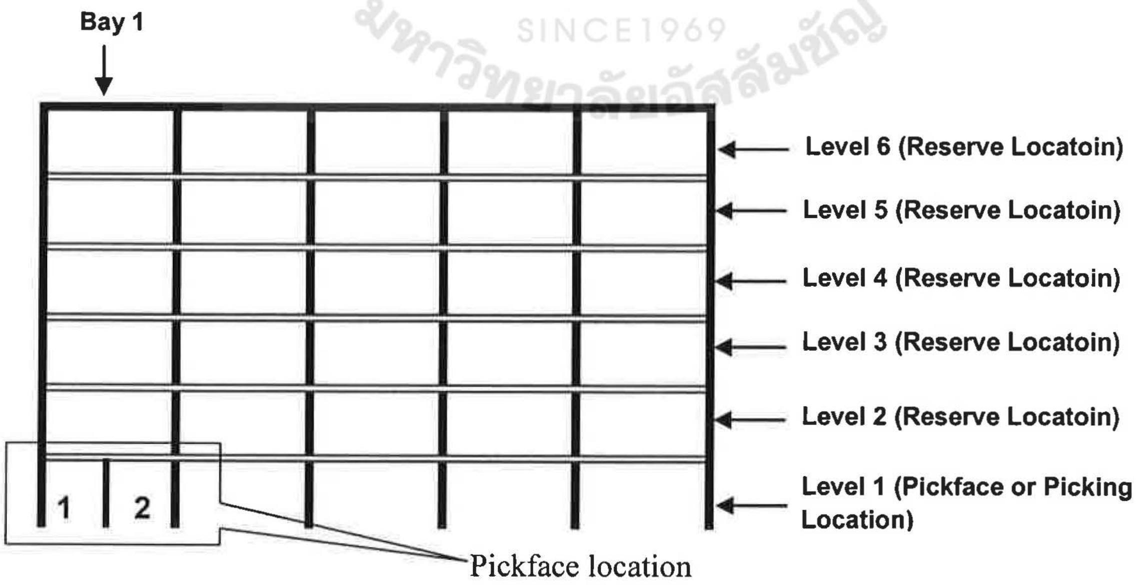
Source: ABC

3.1.2 Current Picking location and warehouse layout

Current Picking location or Pickface:-

It is the location where the picker travels to pick the product as ordered in the picking slip. In ABC, the pickface is at the bottom of the storage rack as shown below;

Figure 3.1 Current Pickface and Rack Drawing

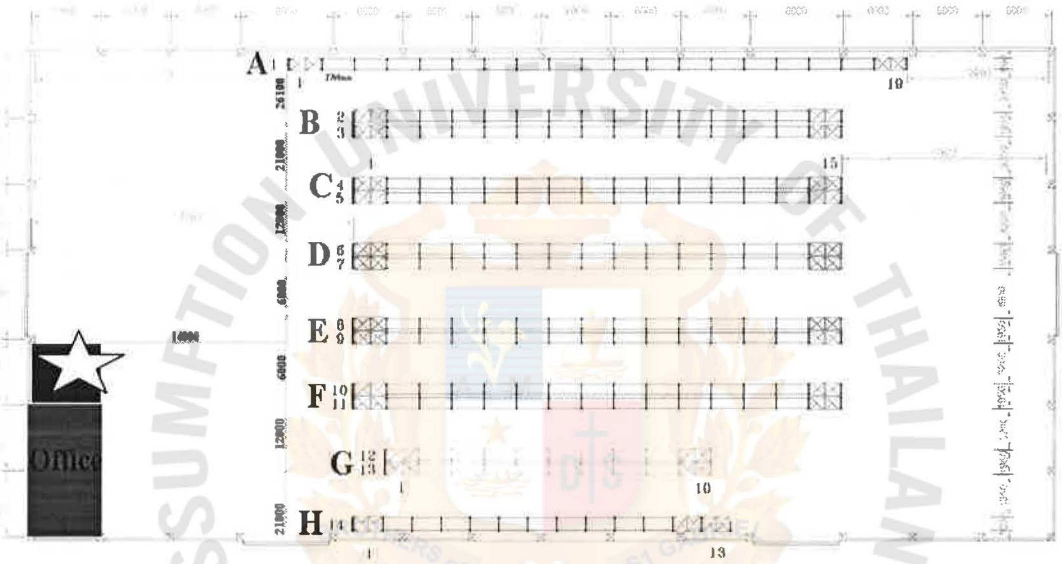


Source: ABC

Warehouse location:-

The original warehouse layout design tells us the distance from the starting point (star) to any destination in the aisle by looking at the length details as shown in the map.

Figure 3.2 Actual Layout of ABC Dedicated Warehouse for DH



Source: ABC

3.2 Data Analysis

The researcher has collected all the information needed for the research. The information will be analyzed by using Microsoft Excel. In this study, The researcher wanted to find out the order frequency of each SKU during the past 7 months because the number of hits can indicate the traveling time spent on each SKU that the picker traveled from between January 10- July 10.

3.2.1 The order transaction analysis

The researcher used the available data to find the frequency of order that hit each SKU. In Table 3.1 indicates the top 20 most hit SKUs result taken from the analysis.

Table 3.2 Top 20 Most Hit SKUs

Sku	Description	Order Hit (Times)	Total QTY	Top
7010190	SUMA ULTRA L2 1X20L	2207	5180	1
7010187	SUMA QUIK DRI A6 1X20L	1783	3456	2
7010097	SUMA STAR D1 4X5L TH	1019	11612	3
7010099	SUMA BREAK UP HD D3.5 4X5L TH	717	2005	4
5156590	20102063Sunlight LemonTurbo20L	615	21733	5
HH0000980	COMPLETE - 1X5GAL	579	2306	6
HH0016990	OPTIMUM 282 OVEN&GRILL 4*4LT	562	2254	7
HH0030060	CREW LIMESCALEREMOVER - 4X4L	473	2240	8
HH0031050	FORWARD DC 20 L.	451	2088	9
HH0016680	OPTIMUM 182 SANITIZER LT -20	423	766	10
4010025	CLAX 100 OB 2AL1 1X20 TH	402	1731	11
5259097	Nobla 25 Kg.	397	4448	12
7010197	SUMA SATURN D4.9 2X5L TH	379	1478	13
4010115	CLAX RUST 6FL1 1X20L TH	377	1644	14
HH0029000	SOFT CARE SANITIZED FIC 4 L.	376	1029	15
HH0030990	FORWARD DC - 4X4 LIT	375	1703	16
HH0087590	CLAX 25 KGS.	367	4113	17
HH0031290	SHINE UP - 4X4L	363	1205	18
4010014	CLAX BETA 1AL2 1X20L TH	344	2623	19
5379224	Comfort Blue 20L	344	5238	20

Source: ABC

Table 3.2, indicates that SKU number 7010190 is the most ordered SKU during the past 7 months. The researcher can use this information to assign each SKU to the closest picking location to optimize the traveling time of picker according to its frequency of orders.

Table 3.3 Summary Table for Order Transaction Analysis

Range of SKU hit	Order hit	Order hit %	Total QTY
1-65	22,662	71%	189,392
66-148	6,476	20%	44,152
149-400	2,761	9%	15,483
Total	31,899	100%	249,027

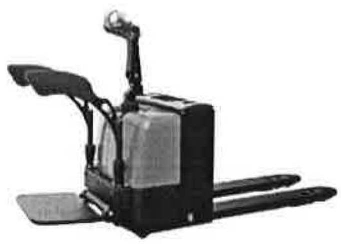
Source: ABC

Table 3.3, indicates that from 400 SKUs, there were 31,899 orders in total. There were 65 SKUs that were ordered most frequently at the rate of 71% of the total number of orders. Consequently these 65 SKUs could be assigned into Class A. There were 83 SKUs that were ordered less frequently at the rate of 20% from the total number of orders. These 83 SKUs could be assigned into Class B. Finally there were 252 SKUs that were least ordered at only 10% from the total number of orders. These 252 SKUs could be assigned into Class C. The next step is to analyze the traveling time for each location.

3.2.2 The Traveling time for each location

For safety sake the speed of a power pallet truck has been configured and fixed at no more than 4.5 km per hour which is 0.8 second per 1 metre.

Figure 3.3 Picture of Power Pallet Truck



Source: ABC

Since the study focuses solely on improving the traveling time by zoning, other activities related to picking such as checking SKU, batch, expiry date, will be excluded. The information on traveling speed was used to the time spent on traveling from starting point to each location in the aisle. The calculation of traveling time is done by using the speed of travel per metre (0.8 sec) multiply by the distance in metre. = 0.80sec x Distance in Metre.

Table 3.4 The Traveling Time for Each Location

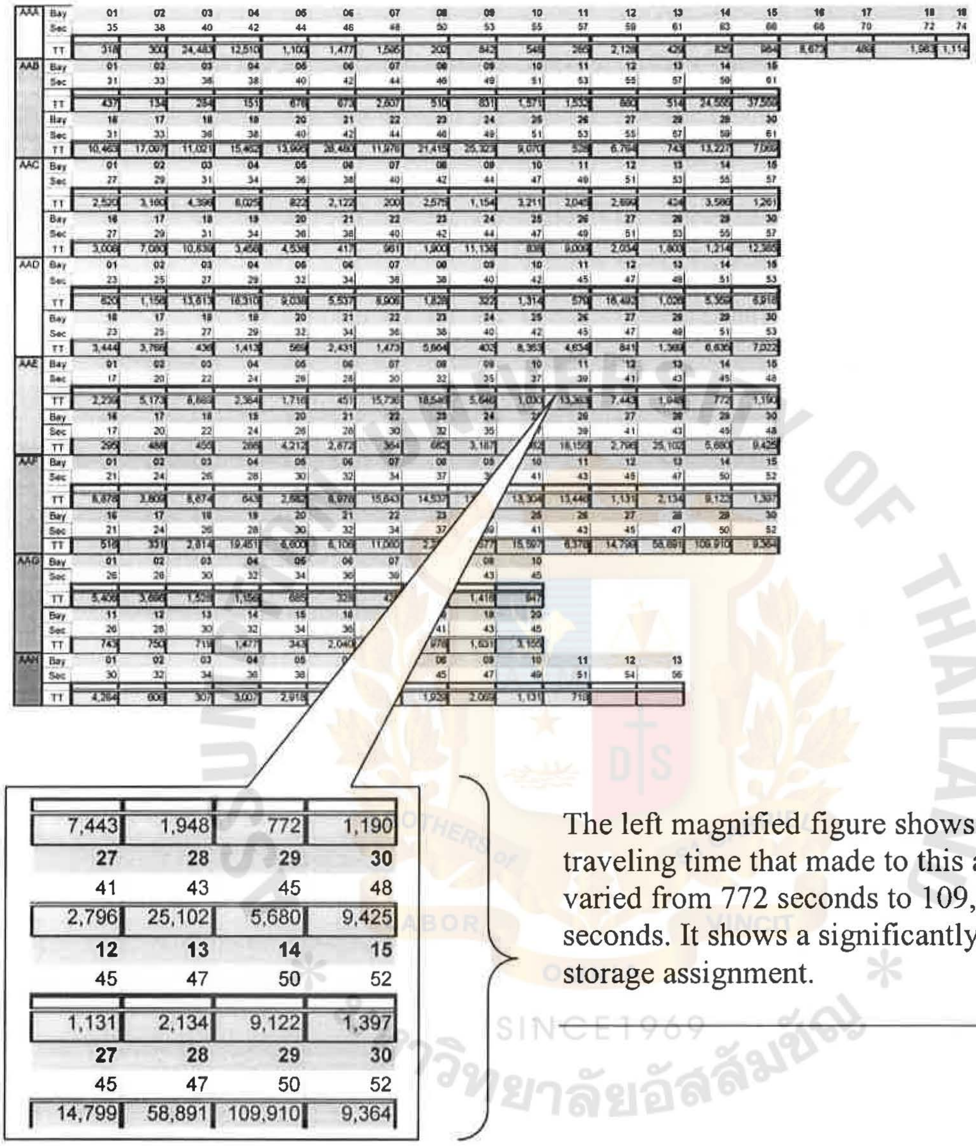
		AA	AB	AC	AD	AE	AF	AG	AH
A	PPT travel time per metre (Sec)	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
B	Travel time to the first bay of each row (Sec)	35	31	27	23	17	21	26	30
C	Length of each location (Metre)	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70
D	Travel time from one bay to the next (Sec)	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16

Source: ABC

Table 3.4 shows the travel time it would take for a picker to travel from the starting point to the first bay of each row. The distance was calculated by taking the length information from the warehouse layout drawing. The total distance to the first bay of the row is calculated by using the actual distance to the first bay of the row + the length of the location which is 2.70metre. Since each beam for the bay has the same length, the calculation for the next second bay used the same method and 2.70 metre were added for each bay consecutively. From this data the researcher was able to identify the traveling time for each row and each bay correctly.

The next step used the order frequency of each SKU and matched it against the location that each SKU belonged to. Then using the available traveling time already calculated, the researcher could come up with the time spent on each location during January 2010 - July 2010.

Figure 3.4 Current picking layout details and Traveling time spent



The left magnified figure shows that the traveling time that made to this area are varied from 772 seconds to 109,910 seconds. It shows a significantly poor storage assignment.

Source: ABC

The information shown in the Figure 3.4 is the current layout for picking location. The "Sec" (Second) information in the Figure 3.4 is the power pallet truck travel time of each location (or each bay) in seconds and the "TT" (Travel Time) is the picker travel time spent to each location from the period of January 2010 – July 2010. From "TT" (Travel Time) information the researcher could obtain information about the problem that with storage assignment inside the warehouse, because the time that the pickers spent in traveling to each picking location varied from all over the warehouse even if the picking locations were close to one another.

3.3 Gap Finding

The researcher has analyzed all the data and the result shows that there was a poor storage assignment. The traveling time spent on each picking location varied all over the warehouse which implies that there was no storage policy and obviously not using the ABC Class storage assignment. Table 3.5 below shows the summary of the results.

Table 3.5 Range of Traveling Time Vs. Actual Number of Location Vs. Order Hits

Range of Traveling Time	Actual Number of location	Number of Order Hits	Percentage
15-30 Sec	86	6,713	21%
31-45 Sec	208	16,167	51%
46-60 Sec	90	8,082	25%
60-75 Sec	16	937	3%
Total	400	31,899	100%

Source: ABC

Table 3.5 displays the relationship between the total numbers of order hits in the specified range of traveling time. The shortest traveling time location has 86 locations. The range of traveling time between 31-45 seconds has the highest number of order hits which is 51% of the total number of order hits. The number of locations (Also represent the number of SKUs since one SKU per 1 location) that required traveling time between 31-45 seconds, also has the highest number of locations which is 208 picking locations.

The analysis tells us that there is more traveling time required for picker to travel to pick the SKUs unnecessarily. The root causes were determined as followings;

- There was a lack of knowledge in picking location assignment to each SKU provided to the staff.
- There was a lack of management supervisory, due to high turnover rate of previous management team.
- There was a lack of training on inventory management and system knowledge.

As the result shown in this section, SKUs that have a high order hits are located at the pickface locations that require a high traveling time. It impacts to unnecessarily traveling time in order picking process that will lead to a high overtime of working hours spent by the pickers and low service level due to delay shipment if the order was not fulfilled.

This study will help the company assign SKUs to the right pickface and to decrease the traveling time in order to reduce the time spent on picking process. The company will save cost on the unnecessary overtime hours, and will prevent the order being delivered to a customer late. This will eventually increase the service level provided to the customer.

3.4 Proposed solution

Referring to Improving order-picking response time at Ankor's warehouse by (Dekker, 2004). In this case study, Ankor Warehouse tried to improve the order picking process by changing its storage policy. They classified their products into ABC-Storage policies,

From this implementation, they reduced the picking time and number of the picker down almost 50% (depending on the peak period). This saved the company around 140,000 EUR.

The researcher has followed the concept by considering the Class A B C which is as follows:

- Class A contains up to 70% of the total picks and at the most 15% of the products.
- Classes A, B contain up to 90% of the picks and at the most 50% of the products.
- Class C contains the remaining products.

To support this theory, Heusman, Schwarz, & Graves (1976) also suggested that the A zone should be very small. Petersen & Schmenner (1999) also suggested this idea, using an A zone of 20 percent of the available picking area and performing experiments with 40, 60 and 80 percent of the picks from the A zone.

From the results of the problem finding it is indicated that there is a poor arrangement on the pickface location for each SKU. The solution to this is to use a spreadsheet to sort out the least travel time required pickface locations match with the most order hits SKU.

Table 3.6 SKU Class Grouping Based on Order Hits Ranking

Range of SKU hit	Order hit	Order hit %	Total QTY	Class
1-65	22,662	71%	189,392	A
66-148	6,476	20%	44,152	B
149-400	2,761	9%	15,483	C
Total	31,899	100%	249,027	

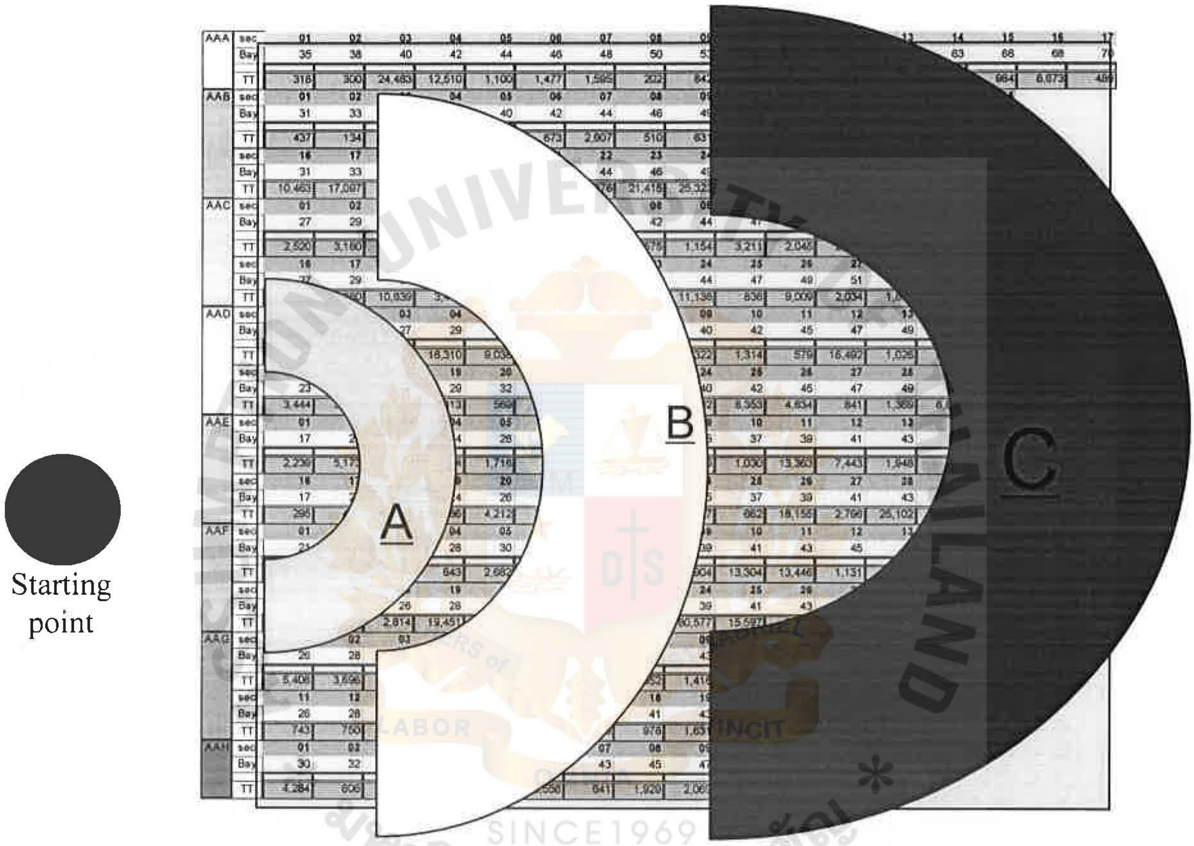
Source: ABC

The researcher used the data analysis results to classify each SKU into ABC Class. The 1-65 top SKUs are classified into A class with the order hit (frequency) of 71%, the 66-148 SKUs are classified into B class with the order hit of 20%, and 149-400 are classified into C class with the order hit of 9%.

From the results that were analyzed previously, the proposed solution to the problem is to re-design picking location by using ABC Class storage assignment.

The researcher found that Le-Duc and De Koster (2005) claimed that the across-aisle storage method can optimize the storage-class positioning. So the researcher proposed the ABC Class storage using the across aisle as below.

Figure 3.5 New Proposed Picking Location



Source: ABC

Figure3.5, indicates that all class A SKU will be grouped near ROW AAE because the location of starting point is closest to AAE. Some of the SKU and B class and C class will share the same row as AAE but at the further distance respectively. The assignment to the new location will be assessed in the traveling time for each picking location.

3.5 Summary

The proposed solution is to re-assign the pickface location to each SKU. This re-assigning process will be managed at the administration level. This means that there will be an involvement in put-away strategy re-adjustment and pickface location assignment strategy under replenishment strategy.

Put-Away strategy is the sub-set function in Exceed 4000. The function involves in setting up the put-away strategy to each assigned SKU to be put-away onto the reserved-locations. Each SKU assigned reserved-location must be close to its pickface location to save time for the replenishing process.

The next chapter will show the full analysis and results of the re-assignment of the pickface location by zoning the SKUs. The results are expected to help the company to set the standard of how to set the pickface location by using the Excel spreadsheet. The cost saving on labour and increasing in service level of order delivery on time can be improved with the proposed solutions.

CHAPTER IV

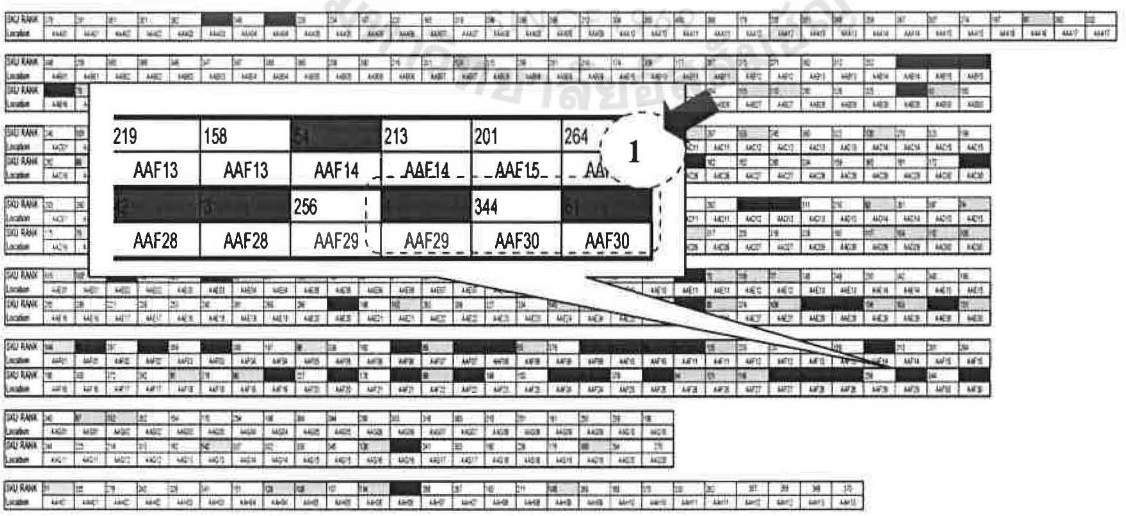
PRESENTATION AND CRITICAL DISCUSSION OF RESULTS

This chapter discusses the results of picking efficiency after redesigning the layout of pickface locations using the ABC Storage classification. This chapter also provides a comparison between the old pickface location and the new pickface location for a better demonstration of the results that supports the key literature from Dekker (2004) and gives a conclusion on the results found from this chapter.

4.1 New design of pickface location

Figure 4.1 indicates that SKUs class A, B and C were located all over the warehouse. This old setting disregarded the frequency required to travel to each location to pick the items. This required a longer traveling time for the picker to travel to pick each item unnecessarily and resulted in a poor efficiency in the picking process. The researcher proposed that the new pickface location were to be re-designed into new zoning using an ABC class based classification from the most picked items to the less picked items.

Figure 4.1: Old Pickface Location for SKU Class A, B and C



Source: ABC

The example on highlighted area number 1, showing most frequently picked SKUs ranking the 1st in location AAF29, 3rd in location AAF28, 51th in location AAF30, and 54th in location AAF14. These four SKUs were located at the end of the aisle of row 'F' and similarly any other SKUs that were spread across the warehouse were disregarded to be used in any strategy.

Figure 4.1 also shows that there were SKU Class A in the beginning of the aisle and at the end of the aisle, the most frequent picked were put at the end of the aisles and had resulted in a poor picking activity. The picker spent time in traveling unnecessarily. The researcher proposed the new layout of pickface location according to Dekker (2004). The SKUs were grouped into classes according to its picking frequency. The most frequent picked SKU was put into the pickface location that was closest to the starting point.

Figure 4.2 Pickface location traveling time in seconds

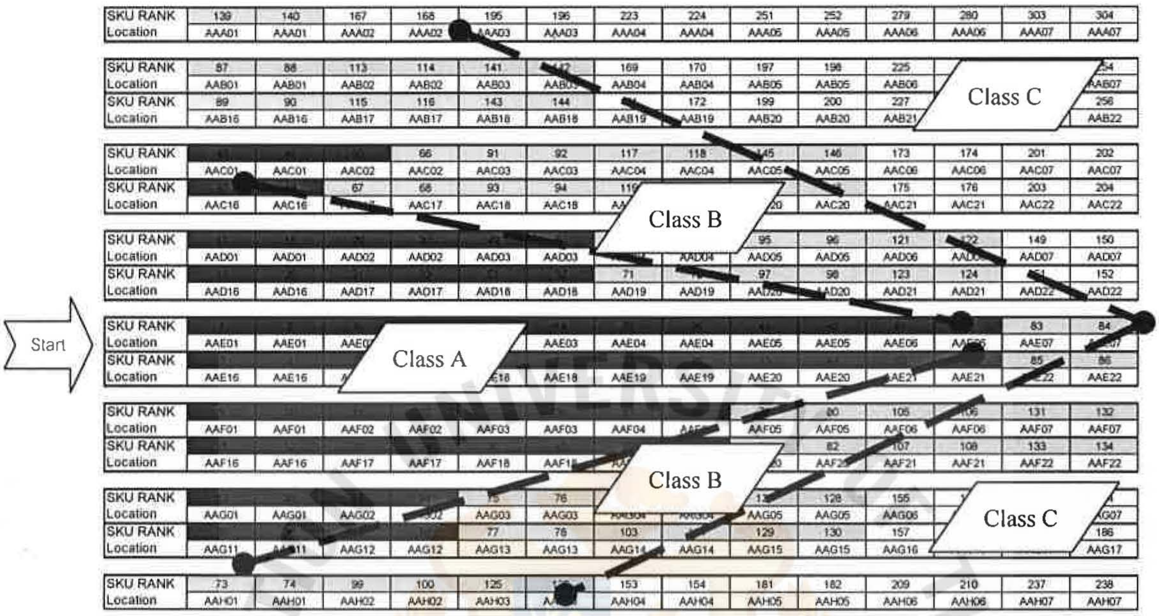
Bay

	AAA	AAB	AAC	AAD	AAE	AAF	AAG	AAH
01	35	31	27	23	17	21	26	30
02	38	31	29	25	20	24	28	32
03	40	31	31	27	22	26	30	34
04	42	31	34	29	24	28	32	36
05	44	31	36	32	26	30	34	38
06	46	31	38	34	28	32	36	41
07	48	31	40	36	30	34	39	43
08	50	31	42	38	32	37	41	45
09	53	31	44	40	35	39	43	47
10	55	31	47	42	37	41	45	49
11	57	31	49	45	39	43	26	51
12	59	31	51	47	41	45	28	54
13	61	31	53	49	43	47	30	56
14	63	31	55	51	45	50	32	
15	66	31	57	53	48	52	34	
16	68	31	27	23	17	21	36	
17	70	33	29	25	20	24	39	
18	72	36	31	27	22	26	41	
19	74	38	34	29	24	28	43	
20		40	36	32	26	30	45	
21		42	38	34	28	32		
22		44	40	36	30	34		
23		46	42	38	32	37		
24		49	44	40	35	39		
25		51	47	42	37	41		
26		53	49	45	39	43		
27		55	51	47	41	45		
28		57	53	49	43	47		
29		59	55	51	45	50		
30		61	57	53	48	52		

Source: ABC

Figure 4.2 indicates the traveling time required to travel to each of location in the warehouse. The researcher used this traveling time information to match against the frequency of picking rank of each SKU and consequently the researcher can assign the new location of pickface to each SKU appropriately. The results of the new pickface location based on ABC class based classification are shown in Figure 4.3.

Figure 4.3: New Pickface Location for SKUs Class A, B and C



Source: ABC

Figure 4.3 shows that each SKUs were now grouped in to 3 classes, A, B and C. The most frequently picked were grouped in to class A. There were 65 SKUs under class A. These 65 SKUs were put in new 65 pickface locations that had the least traveling time. This was to ensure that each time the picker traveled to pick class A SKUs, the picker traveled at the minimum time required to each location. The same practice with class B which had 83 SKUs and class C which had 252 SKUs accordingly. As the result of this, the SKUs that were least to be ordered are put away in the farthest location. The improved traveling time is achieved through this theory.

4.2 Results in Traveling Time of the New Pickface Location

Table 4.1: Total Traveling Time Saved in Seconds

New total traveling time save							
	SKU RANK (a)	Old traveling time (b)	New traveling time (c)	Total save traveling time in percentage (d)	Total save traveling time in seconds (e)	Total save traveling time in hours (f)	Total save traveling per day in minute (g)
Class A SKUs	1 - 65	898,041	505,852	44%	392,190	109	44
Class B SKUs	66 - 148	267,657	224,764	16%	42,892	12	5
Class C SKUs	149 - 400	89,936	95,644	-6%	-5,708	-1.6	-0.6
Total		1,255,634	826,260	53%	429,374	119	48

Source: ABC

Table 4.1 column explains that:

(a) SKU RANK: The rank of each SKU based on the order frequency. The 1st SKU is the most ordered SKU.

(b) Old traveling time: The old traveling time of each class in total.

(c) New traveling time: The new traveling time of each class in total after using ABC classification strategy to re-design a pickface.

(d) Total saved traveling time in percentage: The percentage of the traveling time saved over the new design of the pickface locations.

(e) Total saved traveling time in seconds: The seconds saved in traveling time over the new design of the pickface locations.

(f) Total saved traveling time in hours: The hours saved in traveling time over the new design of the pickface locations.

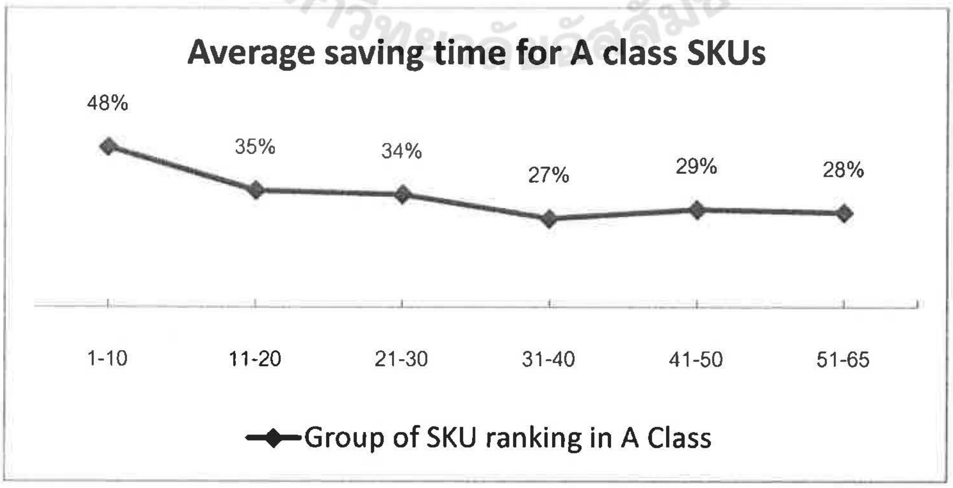
(g) Total saved traveling time per day in minute: The minute saved per day after the new design of the pickface locations.

Table 4.1 it shows the results after implementing ABC Classification strategy to re-design a pickface. The SKUs are grouped into Class A, B and C and re-assigned into new pickface locations.

The results showed that for Class A SKUs the new traveling time is 505,852 seconds reduce from the old traveling time of 898,041 seconds. Class B SKUs new traveling time is 224,764 seconds which reduced from the old traveling time which was 267,657 seconds and the new traveling time for Class C SKUs is 95,644 seconds which increased from the old traveling time which was 89,936 seconds. ABC Classification strategy was used to assign each SKU to new layout reduced the traveling time for a picker to travel to each pickface location. The overall results from total 400 SKUs, showed that Class "A" SKUs could reduce the traveling time to 392,189 seconds, or 109 hours. The result showed that this new design of pickface location could save the operation activity of traveling to pick Class "A" SKU for up to 44 minutes per day.

Class "B" SKUs could reduce the traveling time to 42,892 seconds, or 12 hours. The results show that this new design of pickface location could only benefit the operation activity in traveling to pick Class "B" SKU for up to 5 minutes per day. On the other hand, the result in Class "C" SKUs was different. The new design layout increased the traveling time to picking class "C" SKUs for up to 5,708 seconds, or 1.6 hours or 0.6 minute increase in picking activity for Class "C" SKU per day.

Figure 4.4: Average Saving Time for A class SKUs

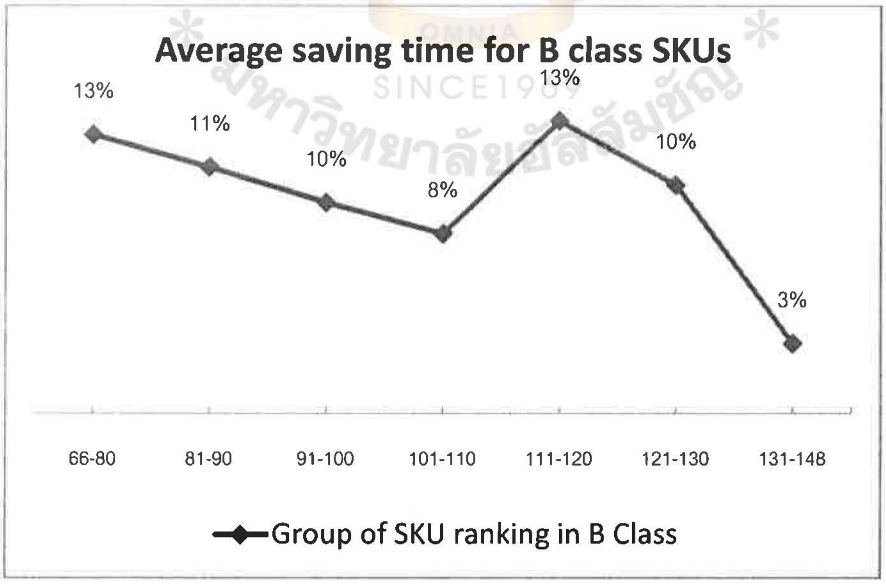


Source: ABC

Figure 4.4, shows clearly that the new traveling time is more utilized than the old traveling time. The most significant changes are in the group of top 1-10 most ordered SKUs. This is because the most frequent ordered SKUs were located in a further location. These locations had been visited more frequency than other locations hence after the re-designing of the pickface, the results show a significant decrease in picking time. The results in Figure 4.4 also show that there is a trend of the average saving time for A class SKUs to decrease as the graph moves toward the less frequent picked SKUs.

Figure 4.5, shows the overall results of the average saving time still can be achieved but nevertheless the graph also shows the average saving time for B class SKUs is continually decreasing as the graph moves toward the less frequent picked SKUs. The explanation to this is the same as what happened in SKU class A. The less frequent ordered SKUs got affected to the new design layout less than the more frequent ordered SKUs.

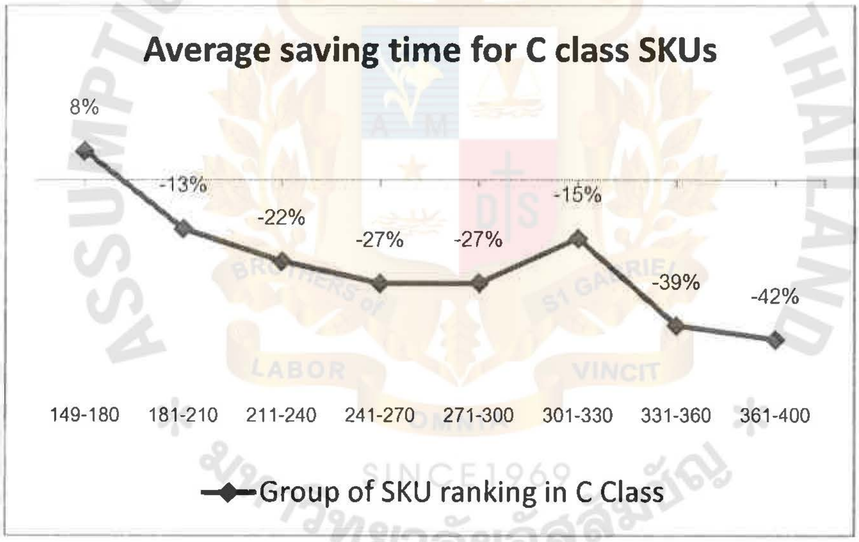
Figure 4.5: Average Saving Time for B class SKUs



Source: ABC

Figure 4.6, shows that the average saving time for C class SKUs decreases continuously. From SKU rank 181-400, the saving stops as the graph shows that these SKUs have am minus saving time, which means the new design of pickface actually gave these SKUs a pickface that required more time to travel. As the results show in Table 4.1, the total saving time between the old and the new design for SKU in C class is only -6%, This figure does impact the operation since these items were less ordered, that means less traveling is required to travel to these pickface locations, hence the new design has a lesser effect to these SKUs.

Figure 4.6: Average Saving Time for C Class SKUs



Source: ABC

4.3 Summary

According to the new design on the pickface location, the new result of traveling time decreases up to 53% from its original traveling time or 119 hours or 48 minutes per day. The company could find way to increase picking efficiency more by using the extra time gained from this implementation. Hence this could enhance the service level of the company to satisfy the customers' expectations.

CHAPTER V

SUMMARY FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This chapter aims to discuss the findings obtained from the research questions, to present the important issues drawn from the findings, and to provide some recommendations for further study. It consists of three main sections: discussion of the research findings, conclusions, and recommendations for further studies to answer the question of how to improve the picking efficiency in the warehouse.

5.1 Summary of the Findings

The picking efficiency in the warehouse can be improved by zoning the SKUs in the warehouse by using the ABC Classification as a tool. The finding shows that the majority of SKUs that were improved regarding the traveling time were mostly in the A class. This is because the significant orders on A class were greatly higher than the B and C class, hence even though C class SKUs did not improve in this study, it did pull back the improvement percentage done by the re-designing of the pickface.

The traveling time in the warehouse depends on many things such as the type of the warehouse, the size, the aisles, the location of the starting and the ending point or the dispatching point, the material handling equipment for picking, the picking list size (number of order line or the item to be picked per one picking list) and the storage assignment rules. In order to benefit from the storage assignment, the company must understand the business nature and its operation. The company must understand clearly the order pattern, they receive from the customer as it would effect how the order picking and operation team operates.

5.2 Conclusions

The study indicated that using an ABC classification to re-design the pickface location could result in more picking efficiency and saving. Nevertheless, there is a potential disadvantage in implementing an ABC classification, in particular in this case. When zoning all high frequent ordered SKUs in the same close area it could lead to traffic congestion.

This congestion could limit an expected picking efficiency though this also depends on the number of pickers and the aisle width, the material handling equipment used in the warehouse. The manager of ABC needs to decide how many power pallet truck and pickers are to be used in each zone in order to best minimal the traffic congestion within the aisles.

In addition, for the seasonal SKUs, this could result in a periodic reassignment to the pickface: It could be timely and costly as well. The manager of ABC needs to study the seasonal SKUs characteristics more carefully and decide whether to put these SKUs into the zoning or separately assign them into one special location.

5.3 Theoretical Implications

This study followed Dekker (2004) case study on Ankor warehouse. The objectives were similar to Dekker (2004), which were to increase the picking efficiency and decrease traveling time in picking process. By doing so, the study conducted the ABC Classification and assigned the pickface according to the order frequency of each SKU. The results of this study could support Dekker (2004) findings because the result of this study decreases the traveling time for 53%, compared to Dekker (2004) which had 50% decreased in traveling time.

5.4 Managerial Implications

The result of this study could help the ABC operation manager to understand and improve the operation productivity. The manager can plan more precisely on the time the operation would spend on the picking process hence the time management and the time allocation needed for the other activity can be achieved successfully. This also could help the company to reduce a number of pickers and increase other activities in the warehouse, such as checking, replenishing and packing if required.

5.5 Limitations and Recommendations for Future Research

There are various ways to improve the picking efficiency because the picking process also consists of various activities that consume time differently.
These activities are:-

- Driving from starting point to assigned location
- Checking SKU to ensure the correct picking
- Checking lots, batch requested in the picking-slip
- Checking expiry date requested in the picking slip
- Picking by requested quantity
- Driving another assigned location for another SKU in the pick slip, unless if finished, to the dispatch area.

Even though the new design is conducted under this study based on the ABC Classification assigned to each SKU, the researcher also saw the opportunity to increase the efficiency of picking. If the study went further more into grouping SKUs by the frequency it is more likely that it can be ordered together. This would benefit the order where there are multiple items to be picked. The various items under the same order, can help to predict if they are meant to be ordered together. These items can be re-designed to be right next together in order to reduce the distance between these items. Sometimes the most frequent ordered SKUs are to be complimented with less ordered SKUs which might not be in the next closest location.

The checking process at the pickface is also important. A further study into how to reduce the checking time at the pickface location would also increase the picking efficiency. The time of the picking, and the prevention of additional time wasted by wrong pick can be checked.

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