



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**ASSESSEMENT OF STORAGE AND RETRIEVAL SYSTEM  
AT APPAREL INDUSTRY**

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Management) with Honors

by

**DORIS TING HUI CHII**

**B051110094**

**910215135790**

FACULTY OF MANUFACTURING ENGINEERING

2015

**BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA**

**TAJUK: Assessment of Storage and Retrieval System at Apparel Industry**

**SESI PENGAJIAN: 2014/15 Semester 2**

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\_\_\_\_\_  
Pujut 2C, 98000 Miri,

\_\_\_\_\_  
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I hereby, declared this report entitled “Assessment of Storage and Retrieval System at Apparel Industry” is the results of my own research except as cited in the references.

Signature : .....

Author's Name : Doris Ting Hui Chii

Date : 26<sup>th</sup> June 2015

## **APPROVAL**

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Management) (Hons.). The member of the supervisory is as follow:

.....

(Professor Dr. Adi Saptari)

## ABSTRAK

Sistem penyimpanan dan perolehan yang cekap membantu dalam mengurangkan kos operasi industri. Permintaan, susun atur gudang, lokasi barangan dan kaedah perolehan merupakan faktor yang memberi kesan kepada kecekapan sistem. Tujuan kajian ini adalah untuk menilai sistem penyimpanan dan perolehan sedia ada di industri pembuatan yang menghasilkan aksesori pakaian. Cara pekerja menjalankan tugas dan susun atur kemudahan diperhatikan. Temu duga digunakan untuk menyemak sama ada prosedur kerja digunakan. Ruang rak yang ada dan ruang rak yang diduduki diukur untuk menentukan penggunaan ruang rak. Masa dan kajian gerakan telah dijalankan untuk menilai unsur-unsur nilai tambah (VA) dan bukan nilai tambah (NVA) beroperasi. Kajian ini mendapati bahawa hanya 22.5% daripada ruang rak telah digunakan. Kecekapan perolehan untuk satu item adalah 72.4% manakala 75.1% bagi dua item. Masa tertinggi VA adalah “tie and weigh item” yang menduduki sehingga 31.4% manakala masa paling tinggi jatuh pada pengangkutan iaitu sehingga 67.2% untuk NVA. Temuduga dan pemerhatian juga mendedahkan bahawa Standard Prosedur Operasi (SOP) tidak digunakan dalam sistem penyimpanan dan perolehan. Oleh itu, SOP telah dicadangkan untuk meningkatkan kecekapan sistem. Pelaksanaan SOP untuk operasi perolehan dengan satu item menunjukkan pengurangan masa VA dengan 31.4% manakala 62.1% untuk masa NVA. Jumlah masa telah menurun sebanyak 42.4%. Untuk operasi perolehan dengan dua item, jumlah masa VA telah menurun sebanyak 41.7% manakala 43.7% untuk masa NVA. Penyusutan sebanyak 42.4% didapati dalam jumlah masa perolehan.

## **ABSTRACT**

An efficient storage and retrieval system helps in reducing the cost of operation of the industry. Demand, warehouse layout, location of items and picking methods are factors that affect to the system efficiency. The aim of this research is to assess the storage and retrieval system at Bulk Storage Area (BSA) of a manufacturing industry which produces apparel accessories. The way operators carried out their tasks and the facilities layout were observed and working procedure was examined through interview. The available rack space and occupied rack space were measured to determine the storage utilization. Time and motion study was carried out to evaluate value added (VA) and non-value added (NVA) elements in retrieving operation. The study found out that only 22.5% of storage was utilized. The average retrieving efficiency for one item was 72.4% while 75.1% for two items. The highest VA time was untie and weigh item which occupied up to 41.7% whereas highest NVA time fell on transportation with up to 67.2%. The interview and observation also revealed that Standard Operating Procedure (SOP) was not available for storing and retrieving process. Thus, SOP was proposed for major activities in BSA to increase the system efficiency. Implementation of SOP for retrieving operation with one item showed reduction of VA time by 31.4% while 62.1% for NVA time. The total time was decreased by 42.4%. For retrieving operation with two items, the total VA time was decreased by 41.7% while 43.7% for NVA time. Decrement of 42.4% was found in total retrieving time.

# **DEDICATION**

Dedicated to my beloved family

## **ACKNOWLEDGEMENT**

I would like to express the deepest appreciation to my supervisor, Professor Adi Saptari for his advice and guidance throughout the study. Without his support and supervision, the study would not have been possible to complete.

I acknowledge my deep sense of gratitude and sincere thanks to Mr. Goh, the planning executive of the industry for providing essential information that critical in the completion of the study. His support and useful suggestions are also sincerely appreciated.

I would also like to extend my deepest gratitude to the operators at Bulk Storage Area (BSA) of the industry for their assistance and participation in data collection of this study.

In addition, a thank you to my family and friends for their endless support and help either morally, financially and physically throughout this study.



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# LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURES

|       |   |   |
|-------|---|---|
| AGV   | - | Automated Guided Vehicles                 |
| AICD  | - | Automatic Identification and Data Capture |
| AS/RS | - | Automated Storage and Retrieval System    |
| BSA   | - | Bulk Storage Area                         |
| DPSS  | - | Dispatch and Path-Planning System         |
| I/O   | - | Input/Output                              |
| MPVI  | - | Motor Vehicles Periodic Inspection        |
| NVA   | - | Non-Value Added                           |
| QC    | - | Quality Control                           |
| RFID  | - | Radio Frequency Identification            |
| SME   | - | Small Medium Enterprise                   |
| SOP   | - | Standard Operating Procedure              |
| TMS   | - | Time and Motion Study                     |
| UTeM  | - | Universiti Teknikal Malaysia Melaka       |
| VA    | - | Value Added                               |

# CHAPTER 1

## INTRODUCTION

This chapter elaborates on the background of study that focuses on storage and retrieval system. The company background is described. The problem statement is then stated and followed by the objectives, scope and significance of the study. The organization of the study will be clearly shown by the end of this chapter.

### 1.1 Background of Study

Nowadays, the competition among the industry sector is getting intense. It is crucial that an industry able to manufacture high quality products in low cost and at the shortest processing time in order to increase the customer satisfaction and survive in competition among the industries.

In the manufacturing industry, storing and retrieving are the significant activities influencing the productivity. According to Tompkins *et al.* (2010), order picking is a costly process in the storage area which occupied 55% of total operating cost of the warehouse. Thus, it is necessary to increase the retrieving efficiency in order to reduce the operating cost.

The order picking efficiency is influenced by the storage assignment (Chan and Chan, 2011). If the items are not stored efficiently, more travel distance will incur and increases the time taken to complete the task during order picking. Efficiency of order picking will determine the customer satisfaction. The faster an order is retrieved, the sooner it can be shipped to customers. Customers are more satisfied when their orders

can be received in shorter time. To increase the efficiency of order picking, Manzini (2012) pointed out that redesign the process, new equipment, layout or automation, computerization of process and use operational policies are required.

This study is about to assess the storage and retrieval system in Bulk Storage Area (BSA) of an apparel industry and come up with an alternative that can increase the system efficiency. The apparel industry is located in Melaka and is a multinational manufacturing company with worldwide operation. It is a subsidiary company of Germany and engaged in manufacturing and distribution of sewing notions, garments accessories and craft accessories.

The company manufactures a variety of clothing accessories such as safety pin, straight pin, sew-on press fasteners, pearl headed pins, ball pins, concorder pins, bra back extenders and braided elastics for snap fasteners tape. The accessories are usually supplied in mixed batch and large volume. It also supplies sewing notions, needlecraft and knitting accessories for garment industry and household use.

In manufacturing and processing steps, the highest standards are set and only high quality material is used to ensure long lasting functioning of each product. The company compliances with all products and environmental regulatory requirement that includes the content of hazardous substances, packing and labelling requirements, protection on risk for children or even eco-design requirements for energy-using products.

In the apparel industry, Bulk Storage Area (BSA) is an area for temporarily storing the accessories manufactured. When the order is requested by the customer, the operators will follow the order list and retrieve all the required accessories for sending to the dispatching area.



## 1.2 Problem Statement

In Bulk Storage Area (BSA), the activities carried out are receiving the incoming accessories, storing the accessories to specified rack and retrieving the accessories when order requested by the customer. Preliminary interview with planning executive and warehouse supervisor of the apparel industry revealed that the company is currently facing the problem of low efficiency of the storage and retrieval system in BSA.

In the current system, the operators are not guided by any procedure during storing and retrieving process. Strategies that reduce the travel distance during storing and retrieving are not adopted. The operators only follow the sequence in order list without sorting first. Thus, they were observed to back and forth during storing and retrieving process. Workers also found to retrieve wrong items at least once per week as they do not verify the retrieved items before sending to dispatching area.

According to the planning executive, the current system is unable to record the amount of items received and issued effectively. Thus, missing items are common in BSA. Some of the customers also complained that the quantity of items received was incorrect. Since the information of issued items could not be tracked effectively, the missing quantity was replaced by the company and thus lost was incurred.

From observation of the current rack system in BSA, it was found that more than 50% of the rack was empty without storing any item. The warehouse supervisor pointed out that it is due to fast moving items and unfilled items. The fast moving items are being retrieved within 6 hours after sending to BSA. Due to high demand of the items, their dedicated locations are empty. Some items are not refilled or restocked even the reordering point is reached. Since the items are not available, the order cannot be completed

### **1.3 Objectives of Study**

The objectives of this study are:

- a) To identify problems of current storage and retrieval system in Bulk Storage Area (BSA).
- b) To evaluate the efficiency of current storage and retrieval system.
- c) To propose an alternative storage and retrieval system that increases efficiency.

### **1.4 Scope of Study**

This study was carried out in Bulk Storage Area (BSA) of the apparel industry to assess the storage and retrieval system. Only activities that involved in BSA which are receiving incoming accessories, storing accessories on the racks and retrieving accessories were investigated in this study. The analysis of the system efficiency was based on the current storage and retrieval system.

In evaluating storage utilization, only rack system was considered. Measurements of available and occupied space were taken for all racks in BSA. For evaluating the retrieving efficiency, classification of value added (VA) and non-value added (NVA) elements was performed.

The alternative storage and retrieval system proposed was focused on reducing the highest VA and NVA time. The storage layout principle and order picking policies were studied in order to select effective storing, picking and routing method.

## **1.5 Significance of Study**

There are some potential benefits that can be gained by the company after the completion of this study.

- a) The storage assignment in Bulk Storage Area (BSA) of the apparel industry will be based on order characteristics.
- b) The efficiency of storage and retrieval system in Bulk Storage Area (BSA) will be increased.

Overall, the operating cost of the company will be lowered as manpower required in BSA can be reduced through increasing the efficiency of the storage and retrieval system. The workers can perform storing and retrieving in shorter time by minimizing the travel distance through planned storage assignment and effective work procedure.

## **1.6 Organization of Study**

- a) Chapter 1: Introduction

This chapter discusses the background of the study and company background. Problems are identified through interview and observation by using checklist and questionnaires. This is followed by objectives to be achieved throughout the study and scope which narrows down the area of the study. The impact of the study to the company is also revealed.

- b) Chapter 2: Literature Review

This chapter covers the basic theories regarding the research topic and the previous studies from journal, book and internet. The current material handling equipment is explained. The principle for storage design and policies of order picking are also comprised. Lastly, the methods for evaluating system and proposing alternative are described.

c) Chapter 3: Methodology

This chapter discusses the methods employed for the completion of the research. Problems regarding current storage and retrieval system are identified. Measurements of available and occupied rack space are taken to evaluate the storage utilization. To compute the retrieving efficiency, the time and motion study is carried out. Related policies and principle are applied in proposing alternative storage and retrieval system.

d) Chapter 4: Results and Discussion

In this chapter, the data are collected based on observation and interview by using checklist and questionnaires. Analysis and interpretation are carried out for problems identification and efficiency evaluation. The Standard Operating Policies (SOPs) are developed for major activities in BSA.

e) Chapter 5: Conclusion and Recommendation

In this chapter, the summary of the findings and recommendations of the study is made based on the results and discussion from previous chapters.

## **CHAPTER 2**

### **LITERATURE REVIEW**

This chapter includes the summary of the journal, articles or book related to the study of storage and retrieval system. It comprises of significant of storage and retrieval system to the operation of the company. Besides, this chapter will explain about material handling equipment includes material transport equipment, storage system, unitizing equipment and identification and tracking system. This chapter also describes the current technology on storage and retrieval system and identification and tracking system. The principles in designing the storage assignment and policies for order picking are elaborated. Lastly, the methods that used to achieve the objectives which are time and motion study and standard work are enlightened.

#### **2.1 Significant of Storage and Retrieval System**

Storage can be defined as the act of storing items or place to store items while retrieval is defined as the act of retrieving or the process of accessing the items at the storage place. Groover (2008) stated that storage and retrieval system is a system that stores the materials for a period of time and provides access to those materials when required. In warehouse, the storage and retrieval system crucial in determining the efficiency of the operation. Storage system involves decision making regarding the location that the inventory should be placed while retrieval system involves order picking process when the order is made by the customer.

Storage assignment is a critical issue in Operations Management and Research (Battista *et al.*, 2011). Chou *et al.* (2012) emphasized it as an important decision making. This is because the decision made will directly impact the productivity of the warehouse operation. An effective storage system is able to maximize the utilization of space, equipment and labor. Besides, maximum accessibility of the material and protection can be achieved through effective storage planning. Battista *et al.* (2011) stated that the performance of storage area depends on the space allocation for material and handling time required. Therefore, when assigning the items to the storage location, certain storage strategies can be used to minimize the travel distance (Dukie and Opetuk, 2008).

Chan and Chan (2011) said that the efficiency of order picking is dependent on the storage assignment. During retrieving process, the items are retrieved from the place stored. If the storage is not properly assigned according to order characteristics such as the demand of the customer and the relationship between the items, the employees have to walk back and forth to retrieve the required items and thus incurs waste in term of travel distance and time. Therefore, the storage system has to be planned carefully as it will directly influence the efficiency of the retrieving process.

Retrieving occupied 55% of the total operating cost of warehouse and thus was a costly activity (Tompkins *et al.*, 2010). By having an effective retrieval system, the operating cost can be reduced thus increases the profit earned by the company. Therefore, the factors that will affect the effectiveness of the retrieval system should be known and identified. Gattorna (1997) pointed out that the demand, warehouse layout, location of the items and picking methods which include routing methods influence the efficiency of the operation. According to Tompkins *et al.* (2010), 50% of the total order picking time is spent on travelling between items. Most of the routes used by the operators are unplanned and unnecessary transportation is involved. By having a good route, the travel distance can be reduced and thus increases the efficiency of order picking.

## **2.2 Material Handling Equipment**

Material handling equipment is complex and involves a wide range of tools, transports, equipment, storage units and appliances in transporting, handling, storing, protecting and tracking of the products. Selection of material handling equipment is critical as it can influence the efficiency of labor usage, system flexibility, productivity, lead times and costs (Kulak, 2005). According to Groover (2008), the material handling equipment was divided into four categories which are material transport equipment, storage system, unitizing equipment and identification and tracking system.

### **2.2.1 Material Transport Equipment**

Material transport equipment is used to transfer the material from one location to another, either within the factory and warehouse or the other site. There are five types of transport equipment pointed out by Garcia-Diaz and Smith (2013) which include industrial truck, automated guided vehicles (AGV), rail guided vehicles, conveyors and hoists and cranes.

#### **2.2.1.1 Industrial Truck**

Industrial truck is the equipment that can move freely in factory or warehouse area to transport the material. Industrial truck can be categorized into non-powered industrial truck and powered industrial truck. Non-powered industrial truck is usually referred as hand truck. Hand truck is a wheeled device that can support load by operating manually (Tompkins and Harmelink, 2004). It is usually more convenient to use the hand truck in narrow aisles. For powered industrial truck, it is self-propelled and worker does not have to move it manually. Sources such as internal combustion engines or electrical motors can be used to power the truck. More advance powered industrial truck had been introduced which is atomic-powered industrial truck that use radioactive material to generate electric power.

Basically, non-powered industrial truck is lighter and cheaper than powered industrial truck. However, it can only use to transport light and limited amount of material. Power and non-powered truck have different usages and selection shall depend on the factory or warehouse condition and task performance.

#### **2.2.1.2 Conveyors**

Conveyors are mechanical equipment that used to move especially heavy and bulky material on the fixed path or between different workstations. Conveyors can be divided into power and non-powered. Powered conveyors use chains, belt or rotating rolls to operate while non-powered conveyors require human operator or gravity to push the load.

Conveyors are commonly being applied in manual assembly line. They are used to move the parts to the human operators for assembling and move the parts away when the assembly process is done. They are also widely used in the sortation of items in distribution center. By using conveyors, the operators can save their time for transporting the material manually in long distance and the damage to the material during the transportation can be minimized. However, the declining of the efficiency of the belt conveyor utilization in assembling process was pointed out by Miyake (2006).

In industry, belt conveyors are important in material handling as pointed out by Zhang and Xia (2011) due to their high efficiency of transportation. They believed that the efficiency of the belt conveyors can be increased by reducing the energy consumption and cost of energy. In year 1990, Soavi and Zurla came up with a new type of screw conveyor that used to handle all types of swarf.