UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND FABRICATION OF SEMI-AUTOMATED PARTS SUPPLY SYSTEM FOR AUTOMOTIVE INDUSTRY

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Mechanical Engineering Technology (Automotive Technology)(Hons.)

by

AZRIF FARIS BIN ABDUL JALIL ALWI

B071110346

910902085043

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A thesis submitted in fulfillment of the requirements for the degree of Bachelor of Mechanical Engineering Technology.

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2015

DECLARATION

I declare that this thesis entitled "Design And Fabrication Of Semi-Automated Parts Supply System For Automotive Industry" is the result of my own research except as cited in the references.

Signature : ....

Author's Name: Azrif Faris Bin Abdul Jalil Alwi

Date : ....

APPROVAL

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

………………………………

(Project Supervisor)

ABSTRACT

In recent years and ongoing, the national car maker had to compete in the global automotive industry that force them to offer lower price. Through lean manufacturing system, waste can be eliminated in order to reduce cost and avoid inefficiency in the manufacturing process. This can be achieved by improving the automated part supply system and designing the conveyor segments based on consideration of manufacturing ergonomics. Besides that, in current conventional for part loading and unloading system, human need to pick and transfer back (manually) in the part supply system. The purpose of this study to design an automated part supply system that support production with supply system. Second, to reduce single operator workload by designing a semi automated part racking. Based on product benchmarking on the market, the sketch is generated and design will be produced by using SpaceClaim software. The software is also use to analyze the design produce. The prototype is fabricate using selected material and is test to support the AGV polybox transfer.

ABSTRAK

Dalam tahun-tahun kebelakangan ini dan berterusan, syarikat kereta nasional terpaksa bersaing dalam industri automotif global yang memaksa mereka untuk menawarkan harga yang lebih rendah . Melalui sistem pembuatan kemas, sisa boleh dihapuskan untuk mengurangkan kos dan mengelakkan ketidakcekapan dalam proses pembuatan . Ini boleh dicapai dengan menambah baik sistem bekalan bahagian automatik dan mereka bentuk segmen penghantar berasaskan pertimbangan ergonomik pembuatan. Selain itu, dalam sistem memunggah dan untuk memuatkan bahagian semasa, manusia perlu memilih dan memindahkan semula dalam sistem bekalan bahagian secara manual. Tujuan kajian ini untuk mereka bentuk suatu sistem bekalan sebahagian automatik yang menyokong pengeluaran dengan sistem pembekalan. Kedua, untuk mengurangkan beban seorang pekerja pengendali dengan mereka bentuk rak semi automatik. Berdasarkan produk penanda aras di pasaran, lakaran dihasilkan dan reka bentuk akan dibina dengan menggunakan perisian SpaceClaim . Perisian ini juga adalah digunakan untuk menganalisis hasil reka bentuk. Prototaip akan dibina menggunakan bahan terpilih dan ujian untuk menyokong pemindahan polybox AGV dilakukan.

DEDICATION

Dedicated to my father, Abdul Jalil Alwi bin Idris and my mother, Norakmar binti Manap. To my supervisor, Ir. Mazlan bin Ahmad Mansor, co-supervisor, Mr. Mohd Suffian bin Ab Razak, lecturers and friends for all of their support and help.

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Thanks to my family, who has been the loveliest advisor to give constant support and inspiration from the day I came here. Their supports are meant so much to me in finishing this project.Last but not least, I thank everyone who involved directly and indirectly in this project.

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LIST OF ABBREVIATION, SYMBOLS AND NOMENCLATURE

AGV	-	Automated Guided Vehicle
AMS	-	Advanced Mechatronis Solutions
BOM	-	Bill of Materials
CATIA-	Computer Aided Three-dimensional Interactive Application	
FIFO	-	First in, First out
KPI	-	Key Performance Index
MH	-	Material Handling
MHS	-	Material Handling System
SOP	-	Standardization and Operation Control

CHAPTER 1

INTRODUCTION

1.1 Background

Nowadays, automotive industry had become highly competitive in few recent years and ongoing. The foreign car brands in Malaysia that offer lowered prices and high quality can cause a negative effect to the national automotive industry. The national car brands had to offer lower price so that they can compete in the local market.

In order to reduce the national car prices, thereby car maker is focusing on eliminating waste to reduce cost, increase efficiency of production and shorten the manufacturing time by the adopting lean manufacturing system. Through lean manufacturing, it is the best way to accomplish aims for a better output in shorter time, lower the human effort, decrease in machinery, less material waste and lower cost without compromising quality.

However, by increasing the production output may lead to fast work pace, work shift or extended production hours that a higher probability of getting fatigue on workers. This protracted repetitive task performance without sufficient recovery and rest may cause an injury problem. In the automotive industry, most of the component is heavy and repeated material lifting would cause problems for workers' health.

The purpose of this research is to design an automated part supply system that improves the existing system by increase production output, lower the risk of injury and worker's compensation claims, and improve line reliability as well as the employees' morale. This can be achieved by improving the automated part supply system by designing the conveyor segments based on consideration of manufacturing ergonomics.

1.2 Project Title

Design and Fabrication of Semi-Automated Parts Supply System for Automotive Industry

1.3 Problem Statement

In high-volume production, conveyors are the main material transfer mechanism. By providing buffer space and easier motion control, conveyors can transfer a large quantity of material. Using First-In-First-Out (FIFO) operating principle is important in the conveyor working system. A simple conveyor system cannot change the arrangement of material by itself. In making automation in a conveyor system, there needs to use a special mechanism such as spur, bypass and transfer. To minimize the use of special mechanism and to maximize utilization in operation, especially when transporting large quantity of material need consideration of manufacturing ergonomics, floor space and cost are important. Increasing production output lead to fast work pace that cause higher probability of getting fatigued and stress on workers.

In the automotive industry, there are heavy components such as engines and transmissions. The engine parts are produced in the automotive industry like intake manifold, camshaft, crankshaft and cylinder block are heavy. These materials handled by workers may force them to physical risk factors. This can lead to fatigue and injury as the tasks of heavy material handling are repeating for a long time. So it's important to avoid injury risk that cause by repetitive motions, awkward postures, high pressure exertion and static postures.

Besides that, in current conventional parts transfer system, operator manually needs to pick polyboxes and transfer back empty polyboxes into the system. To assist the worker in part handling for part loading and unloading, automated part supply system is proposed. The part supply system should be using first in, first out (FIFO) concept and designed with semi-automated operation by mechanism. This research aims to develop an ergonomic, first in, first out (FIFO) rack design.

1.4 Project Objective

The objectives of this project are:

i. To design automated part transfer mechanism for polyboxes supply.
ii. Improve ergonomics by design and fabrication of semi-automated part racking.

1.5 Project Scope

The scopes of this project are:

i. Benchmark the current design on market and design the automated part supply system using SpaceClaim software.
ii. Analyze the part supply design using Dynamics for Spaceclaim module.
iii. Prototype fabrication and experimentation.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this section, information from by referring from article form websites, reference books and research journals has been done in order to identify the important knowledge that related with this project. The analytical summary and synthesis of the information gained are discussed before designing a part supply system mechanism for automatic part loading and unloading of an automated guided vehicle

2.2 Material Handling (MH)

Material handling involves material handling (MH) involves “short-distance movement that usually takes place within the confines of a building such as a plant or a warehouse and between a building and a transportation agency.” It can be used to create “time and place utility” through the handling, storage, and control of material, as distinct from manufacturing such as fabrication and assembly operations, which creates “form utility” by changing the shape, form, and makeup of material. (G.Kay, 2012)

2.2.1 Material Handling Systems (MHS)

A common approach to the design of material handling systems (MHS) is to consider MH as a cost to be minimized. This approach may be the most appropriate in many situations because, while MH can add real value to a product, it is usually difficult to identify and quantify the benefits associated with MH; it is much easier to identify and quantify the costs of MH such as the cost of MH equipment and the cost of indirect MH labor. Once the design of a production process is completed, alternate MHS designs are generated, each of which satisfies the MH requirements of the production process. The least cost MHS design is then selected. (G.Kay, 2012)

The appropriateness of the use of MHS cost as the sole criterion to select an MHS design depends on the degree to which the other aspects of the production process are able to be changed. If a completely new facility and production process is being designed, then the total cost of production is the most appropriate criterion to use in selecting an MHS and the lowest cost MHS may not result in the lowest total cost of production. If it is too costly to even consider changing the basic layout of a facility and the production process, then MHS cost is the only criterion that need be considered. In practice, it is difficult to consider all of the components of total production cost simultaneously, even if a new facility and the production process is being designed. Aspects of the design that have the largest impact on total cost are fixed at some point and become constraints with respect to the remaining aspects of the design.(G.Kay, 2012)

2.2.2 The Unit Load Concept

A unit load is either a single unit of an item, or multiple units so arranged or restricted that they can be handled as a single unit and maintain their integrity. Advantages of unit loads are more items can be handled at the same time, thereby reducing the number of trips required and, potentially, reducing handling costs, loading and unloading times, and product damage. Secondly, enables the use of standardized material handling equipment. Figure 2.1 show example of material handling load comparison. (G.Kay, 2012)

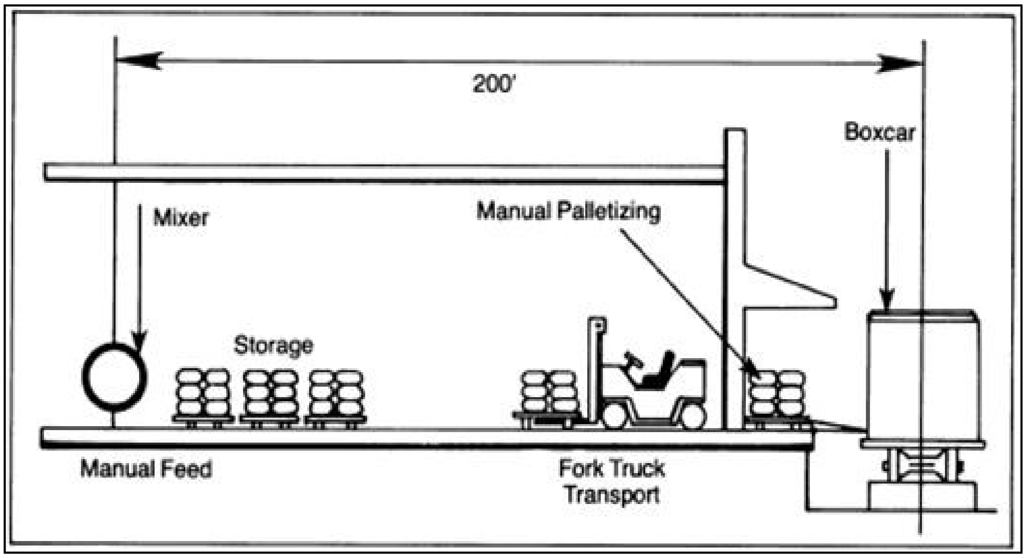

Figure 2.1: Unit vs. bulk handling of material (source: http://www.ise.ncsu.edu)

Disadvantages of unit loads are time spent forming and breaking down the unit load. Next, cost of containers or pallets and other load restraining materials used in the unit load. Lastly empty containers or pallets may need to be returned to their point of origin. There are basic ways of moving a unit load by use of a lifting device under the mass of the load (a pallet and fork truck), inserting a lifting element into the body of the load (a coil of steel), squeezing the load between two lifting surfaces (lifting a light carton between your hands, or the use of carton clamps on a lift truck) and suspending the load (hoist and crane). (G.Kay, 2012)

2.2.3 Unit Load Design

Unit loads can be used both for in-process handling and for distribution (receiving, storing, and shipping). Unit load design involves by determining the type, size, weight, and configuration of the load. Next, equipment is identified and method used to handle the load. Lastly, create methods of forming (or building) and breaking down the load. Figure 2.2 and Figure 2.3 show example of unit load design.

Figure 2.2: Pallet (source: www.my.all.biz)

Figure 2.3: Polybox (source: www.tmeh.com.my)

For process in handling, unit load size needs to be selected. Unit loads should not be larger than the production batch size of parts in process. If the unit load size is larger, then a delay would occur if the load is forced to wait until the next batch of the part is scheduled to start production which might be days or weeks before it can be transported.

Secondly, large production batches used to increase the utilization of bottleneck operations can be split into smaller transfer batches for handling purposes, where each transfer batch contains one or more unit load, and small unit loads can be combined into a larger transfer batch to allow more efficient transport such as several cartons at a time can be transported on a hand truck, although each carton is itself a unit load and could be transported separately. (G.Kay, 2012)

2.3 Material Handling Equipment

Transport equipment is used to move material from one location to another, such as between workplaces or between a loading dock and a storage area. The major subcategories of transport equipment are conveyors, cranes, and industrial trucks. Material can also be transported manually using no equipment. (G.Kay, 2012)

2.3.1 Conveyors