SELECTION OF CONVEYOR SYSTEM USING FUZZY ANALYTICAL HIERARCHY PROCESS

This report is submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for Bachelor Degree of Manufacturing Engineering (Robotics & Automation) (Hons.)

by

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Sesi Pengajian: **2016/2017 Semester 2**

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I hereby, declared this report entitled “Selection of conveyor system using Fuzzy Analytical Hierarchy Process” is the results of my own research except as cited in reference.

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of Universiti Teknikal Malaysia Melaka as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Robotics and Automation) (Hons.).

The members of the supervisory committee is as follow:

…..…….

(IR. DR. LOKMAN BIN ABDULLAH)

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ABSTRAK

Objektif projek ini adalah untuk memilih konsep reka bentuk sistem penghantar dengan menggunakan teknik Fuzzy Proses Analisis Hierarki. Menurut (Zadeh, 1965), teori set Fuzzy boleh menyelesaikan ketidaksempurnaan penilaian. Manakala, menurut (Fulvio et al., 2004), Fuzzy AHP adalah satu kaedah yang berguna untuk berurusan dengan maklumat yang tidak tepat, tidak menentu dan samar-samar. Terdapat tiga kaedah yang digunakan dalam memilih sistem penghantar yang terbaik, iaitu AHP asas, Trapezoid Fuzzy AHP dan segi tiga Fuzzy AHP. Reka bentuk konsep penghantar yang telah dibincangkan dalam projek ini adalah rantaian penghantar, tali pinggang penghantar, penghantar roller dan roda penghantar. Beberapa kriteria dalam memilih konsep reka bentuk yang terbaik juga telah dibincangkan dan dibandingkan prestasinya. Terdapat tujuh kriteria yang dibincangkan dalam projek ini iaitu kos, fleksibiliti talisawat, kelajuan penghantar, lebar item dan berat item yang boleh dipindahkan oleh penghantar, keselamatan dan ergonomik penghantar. Tradisional AHP dan segi tiga Fuzzy AHP menunjukkan susunan perintah yang sama penghantar manakala Trapezoid Fuzzy AHP menunjukkan sedikit berbeza dalam kedudukan perintah penghantar yang dipilih. Kriteria yang paling penting dalam memilih konsep reka bentuk yang terbaik sistem penghantar adalah kos. Pengesahan keputusan dengan menggunakan Expert Choice Software menunjukkan bahawa rantaian penghantar adalah konsep terbaik reka bentuk penghantar dalam memindahkan kotak dalam industri kertas dengan wajaran 0,5400, diikuti oleh penghantar tali pinggang dengan wajaran 0,2760, penghantar roller dengan wajaran 0,1230 dan roda penghantar dengan wajaran 0,0610. Kesimpulan daripada keseluruhan projek ialah reka bentuk penghantar akhir dipilih adalah wajar dan ketiga-tiga objektif tercapai. Beberapa cadangan untuk kerja-kerja masa depan juga termasuk untuk penambahbaikan.

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ABSTRACT

The objective of this project is to select the design concept of conveyor system by using Fuzzy Analytical Hierarchy Process. According to (Zadeh, 1965), Fuzzy set theory can solve the impreciseness of the judgments. Then, according to (Fulvio et al., 2004), Fuzzy AHP is a method that is useful to deal with imprecise, uncertain and ambiguous information. There are three methods used in selecting the best conveyor system, which are Traditional AHP, Trapezoidal Fuzzy AHP and Triangular Fuzzy AHP. The design concept of conveyor that have been discussed in this project are chain conveyor, belt conveyor, roller conveyor and wheel conveyor. Several criteria in selecting the best design concept also have been discussed and compared. There are seven criteria discussed in this project which are cost, flexibility of the conveyor, speed of conveyor, item width and item weight that is transferred by the conveyor, safety and ergonomics of the conveyor. Traditional AHP and Triangular Fuzzy AHP showed the same ranking order of the conveyor while Trapezoidal Fuzzy AHP showed slightly different in ranking order of the conveyor selected. The most important criteria in selecting the best design concept of conveyor system is cost. The validation of the result by using Expert Choice Software showed that chain conveyor is the best design concept of conveyor in transferring the boxes in paper industry with the weightage of 0.5400, followed by belt conveyor with the weightage of 0.2760, roller conveyor with the weightage of 0.1230 and wheel conveyor with the weightage of 0.0610. The conclusion also has been drawn out from overall project where final conveyor design selected is justified and all the three objectives are achieved. Several suggestion and recommendations for future work also included for improvement.

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DEDICATION

To my beloved parents

Suhaimi bin Ya and Nik Ashikin Bt Nawi

My appreciated siblings

Nur Athirah Shazwani Bt Suhami, Mohd Aliff Shazwan Bin Suhaimi

Mohd Azim Shaffri Bin Suhaimi and Nur Adlin Shaziera Bt Suhaimi

My friends and my Supervisor

Thank You So Much

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Last but not least, I would like to express my gratitude to my parents, Suhaimi Bin Ya and Nik Ashikin Bt Nawi and my siblings, for always supporting me throughout the project. Their support, care and prayers are very meaningful for me.

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LIST OF ABBREVIATIONS

AHP	-	Analytical Hierarchy Process
ANC	-	Average Normalized Column
CR	-	Consistency Ratio
CI	-	Consistency Index
DC	-	Design Concept
FIA	-	Fuzzy Information Axiom
FUMAHES	-	Fuzzy Multi-Attribute Material Handling Equipment Selection
HRST	-	Human Resource in Science Technology
LFPP	-	Logarithm Fuzzy Preference Programming
MHESA	-	Material Handling Equipment Selection Advisor
MCDM	-	Multi-Criteria Decision Making
RI	-	Random Index
PSO	-	Particle Swarm Optimization

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LIST OF SYMBOLS

α	-	Alpha
β	-	Beta
γ	-	Gamma
δ	-	Delta

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CHAPTER 1

INTRODUCTION

This chapter includes the background of the project, problem statement, objective and scope of the project.

1.1 Background

Material handling involves the movement of a building or between a building and a transportation vehicle. It uses a wide range of manual, semi-automated, and automated equipment and includes application of the storage and movement control of the materials throughout the manufacturing. Material handling system is used in moving and controlling the goods throughout the process. By using the material handling system, the material that is transferred is in the right amount and can be reached the destination on time with minimum cost. The effective material handling can minimum the cost of operation, cycle time and decrease the damage. It helps to maximum the flexibility and higher automation and material flow in handling.

Material handling is an important component in any production process. It is a process that goes on in every plant every time. It is simply pick up, lie down and moving the material through manufacture.

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In this project, the Fuzzy Analytic Hierarchy Process (AHP) is applied for the selection of the best design concept of material handling system that integrates the qualitative and quantitative of each criterion in the decision structure. AHP is widely used as multi-criteria decision analysis which decomposes the decision problem in a hierarchy structure and derives priorities from the value judgments of individual or in a group of decision making. Despite, the traditional method of AHP has a limitation in addressing the ambiguousness of subjective judgment. Variant of fuzzy AHP was thus developed and applied to model the ambiguousness of judgment by representing the verbal scale in terms of fuzzy number.

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1.2 Problem Statement

Currently, there are several types of conveyor used in the industry, however, the best type of conveyor that the most suitable to use for purpose of transferring the boxes in paper industry is not known. As there are also several methods that well known for the multi-criteria decision making, but the suitability of method used need to be identified. To know the accuracy of final answer in selecting the best conveyor system, the best software is needed.

1.3 Objective

i) To select the best conveyor system using Fuzzy-AHP method.

ii) To identify and compare the final decision made using Traditional AHP, Trapezoidal Fuzzy AHP and Triangular Fuzzy AHP.

iii) To validate the result of Fuzzy-AHP using Expert Choice software.

1.4 Scope

The scope of the project are as follows:

i. Focusing on the conveyor used for the purpose of transferring the boxes in paper industry.

ii. Determination of the best design concept of conveyor system using Traditional AHP, Trapezoidal Fuzzy AHP and Triangular Fuzzy AHP.

iii. Validation of the result by using the Expert Choice Software.

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1.5 Structure of Report

This report contains 5 chapters that will explain briefly about this research. The first chapter is about the introduction of this research which contains background, problem statement, objectives, and scope of this project. The second chapter explains about the literature review which review about the previous research about the material handling system, Analytical Hierarchy Process (AHP), Fuzzy Logic and Fuzzy-AHP. Next, chapter 3 is about the methodology and steps that have been taken during conducting this research. Chapter 4 explains about the different design of material handling system, the hierarchy framework for AHP and the analysis of the result by using the Expert Choice software. Then chapter 5 is about conclusion and outcome of this research and the recommendation for future improvement also included.

In Introduction, there are five subtopics that will be presented. The first part is the study about the material handling and the Fuzzy Analytic Hierarchy Process (Fuzzy-AHP). From the background, the problem statements are summarized and explained in detail. A few objectives of this project also have been set. However, a few scopes of this project also will be set so the project study will only cover the specific portion only.

The second chapter is literature review which covers the previous founding regarding the project research. The journals are studied thoroughly based on the objective and scope that has been stated.

In the third chapter, explains about the method to carry out the project. The ways in conducting the project is determined in a flow chart. The correlation of the concept used and the step in conducting the project should be simultaneous.

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Chapter 4 is the most crucial. This chapter explains the result and the outcome after the research is carried out. The research is carried out based on the step that have been stated in chapter 3.

The last chapter concludes about the overall project. Conclusion must be declared either the project fulfilled the objectives from the first chapter. Several recommendations also must be stated to improve for better result accuracy.

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