



## **Faculty of Manufacturing Engineering**

### **Inventory Management Via Topsis Analytical Hierarchy Process (AHP) Method Embedded with Economic Order Quantity (EOQ)**

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**INVENTORY MANAGEMENT VIA TOPSIS ANALYTICAL HIERARCHY  
PROCESS (AHP) METHOD EMBEDDED WITH ECONOMIC ORDER  
QUANTITY (EOQ)**

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in fulfilment of the requirements for the degree of Master of Manufacturing  
Engineering (Quality System Engineering)**

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**2020**

## DECLARATION

I am hereby to declared this report entitled “Inventory Management Via Topsis Analytical Hierarchy Process (AHP) Method Embedded with Economic Order Quantity (EOQ)” is the result of my own research except as cited in references.

Signature : .....

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## **APPROVAL**

I am hereby declared that I have read this dissertation/report and in my opinion, this dissertation/report is sufficient in terms of scope and quality as partial fulfilment of Master of Manufacturing Engineering (Quality System Engineering).

Signature: .....

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Date: 11th September 2020

## ABSTRACT

Inventory management is the process of keeping track of all the material on the manufacturing industry has in its industry stock. Effective inventory management aligns all inventory types to the efficient creation of the production process to finished products and delivery to the customer's satisfaction. Ineffective inventory management either beyond having too much inventory or too little inventory, poor inventory management causes inefficiencies of production activity. This will be having reordering inventory from suppliers at last minute or increase risk of mistakes non-fulfilled customer orders on time. The consequence of poor inventory management can cause customers to withdraw orders or industry pay compensation due to order delivery date not achieve as agreement. Due to the poor inventory management problem, this project purpose to use economic order quantity (EOQ) application in a rubber manufacturing company and optimization of the economic order quantity (EOQ) with Technique for Order Preference by Similarity to Ideal Solution Analytic Hierarchy Process (TOPSIS-AHP). Nowadays, the choice of suppliers and the supplier material performance assessment are very important. This become the major challenges in the manufacturing industry which mainly faced by supply chain managers or purchaser. The progress to evaluating each supplier and selecting the best supplier are become complicated tasks. In the decision-making process, there are different criteria and alternatives must take into consideration. The objective is to determine and select the best supplier of inventory by using the Analytic Hierarchy Process (AHP) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method. The economic order quantity (EOQ) model was used to calculate the best quantity of the material. Therefore, at the end of this project concluded the best supplier is supplier A with its material. The result is consistent in all methodologies. The economic order quantity (EOQ) to order upon purchasing of new inventory is 2847 kg.

# **PENGURUSAN INVENTORI MELALUI KAEDAH HIERARKI ANALITIK TOPSIS (AHP) YANG DILEKATKAN DENGAN KUANTITI PESANAN EKONOMI (EOQ)**

## **ABSTRAK**

Pengurusan inventori adalah proses mengawasi semua bahan yang dimiliki industri pembuatan dalam stok industri. Pengurusan inventori yang berkesan menyelaraskan semua jenis inventori dengan pembuatan proses pengeluaran yang cekap hingga produk siap dan penghantaran sehingga memuaskan pelanggan. Pengurusan inventori yang tidak berkesan sama ada di luar mempunyai terlalu banyak inventori atau terlalu sedikit inventori, pengurusan inventori yang buruk menyebabkan ketidakcekapan aktiviti pengeluaran. Ini akan mempunyai penyusunan semula inventori dari pembekal pada saat-saat akhir atau meningkatkan risiko kesalahan pesanan pelanggan yang tidak dipenuhi tepat pada waktunya. Akibat daripada pengurusan inventori yang buruk dapat menyebabkan pelanggan menarik pesanan atau membayar pampasan industri kerana tarikh penghantaran pesanan tidak dapat dicapai sebagai persetujuan. Oleh kerana masalah pengurusan inventori yang lemah, projek ini menyiasat aplikasi kuantiti pesanan ekonomi (EOQ) di sebuah syarikat pembuatan getah dan pengoptimuman kuantiti pesanan ekonomi (EOQ) dengan Teknik Pemilihan Pesanan dengan Kesamaan dengan Proses Hierarki Analitik Penyelesaian Ideal (TOPSIS-AHP). Pada masa kini, pilihan pembekal dan penilaian prestasi bahan pembekal sangat penting. Ini menjadi cabaran utama dalam industri perkilangan yang terutama dihadapi oleh pengurus atau pengarah rangkaian bekalan. Kemajuan dalam menilai setiap pembekal dan memilih pembekal terbaik menjadi tugas yang rumit, kerana terdapat pelbagai kriteria dan objektif yang harus dipertimbangkan dalam proses membuat keputusan. Dalam projek ini akan dicadangkan model analisis pemilihan pembekal menggunakan kaedah Analisis Hierarki Analitik (AHP) dan kaedah untuk Kaedah Pilihan berdasarkan Kesamaan dengan Penyelesaian Ideal (TOPSIS). Objektifnya adalah untuk menentukan dan memilih pembekal inventori terbaik menggunakan kaedah Teknik untuk Kaedah Pilihan berdasarkan Kesamaan dengan Penyelesaian Ideal (TOPSIS) kaedah hierarki analitik (AHP). Model kuantiti pesanan ekonomi (EOQ) digunakan untuk mengira kuantiti bahan yang terbaik. Oleh itu, pada akhir projek ini disimpulkan bahawa pembekal terbaik adalah pembekal A dengan bahannya. Hasilnya konsisten dalam semua metodologi. Kuantiti pesanan ekonomi (EOQ) untuk dipesan semasa pembelian inventori baru ialah 2847 kg.

# **DEDICATION**

My Only  
beloved father,  
appreciated mother,  
for giving me love, understandings, moral support, cooperation,  
and also  
encouragement,

I Love You All Forever  
&  
Thank You Vey Much

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## TABLE OF CONTENTS

	<b>PAGE</b>
<b>DECLARATION</b>	
<b>DEDICATION</b>	
<b>ABSTRAK</b>	<b>i</b>
<b>ABSTRACT</b>	<b>ii</b>
<b>DEDICATION</b>	<b>iii</b>
<b>ACKNOWLEDGEMENT</b>	<b>iv</b>
<b>TABLE OF CONTENTS</b>	<b>v</b>
<b>LIST OF TABLES</b>	<b>viii</b>
<b>LIST OF FIGURES</b>	<b>x</b>
<b>LIST OF APPENDICES</b>	<b>xi</b>
<b>LIST OF ABBREVIATIONS</b>	<b>xii</b>
<b>LIST OF SYMBOLS</b>	<b>xiii</b>
<b>CHAPTER</b>	
<b>1: INTRODUCTION</b>	
1.1 Introduction of the Study	1
1.2 Problem Statement	3
1.3 Objectives	4
1.4 Scope	5
1.5 Structure of the report	5
1.6 Project planning overview	6
<b>2: LITERATURE REVIEW</b>	
2.1 Introduction	7
2.2 Inventory management for the manufacturing industry	7
2.2.1 Importance aspect of Inventory Management	9
2.3 Multi-Criteria Decision Making (MCDM) Method	10
2.4 Analytic hierarchy process (AHP)	12

2.4.1	Advantage and disadvantage of Analytic hierarchy process	16
2.5	Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) Analytic hierarchy process (AHP)	16
2.6	Advantages of using Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) Analytic hierarchy process (AHP)	17
2.7	Economic order quantity (EOQ)	18
2.7.1	Ordering Cost	19
2.7.2	Holding Cost	20
2.7.3	Limitations of the Economic Order Quantity (EOQ)	21
2.8	Summary	21

### **3: METHODOLOGY**

3.1	Project planning	22
3.2	Project Flow Chart	22
3.3	Process explanation	24
3.3.1	Formulation of the Problem	24
3.3.2	Literature Review	24
3.3.3	Data collection from industry	24
3.3.4	Data Analysis	24
3.3.5	Traditional Analytic Hierarchy Process (AHP) Method	25
3.3.6	Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) Method	29
3.3.7	Validation of Result	31
3.3.8	EOQ Analysis Method	31
3.3.9	Discussion and Conclusion	32

### **4: RESULTS AND DISCUSSION**

4.1	Analysis method	33
4.2	Product Description	33
4.3	Traditional Analytic Hierarchy Process (AHP)	33
4.3.1	Hierarchy Model	33
4.3.1.1	Level I Goal	34
4.3.1.2	Level II Criteria	34

4.3.1.3	Level III Sub-Criteria	34
4.3.1.4	Level IV Alternatives	36
4.3.2	Pair-Wise Comparison Matrix	37
4.3.3	Synthesizing the Pairwise Comparison	37
4.3.4	Eigenvalue, $\lambda_{max}$	38
4.3.5	Consistency Index (CI) and Consistency Ratio (CR)	40
4.3.5.1	Consistency Index (CI)	40
4.3.5.1	Consistency Ratio (CR)	40
4.3.6	Repetition the step for all levels in the hierarchy	41
4.3.7	Overall Priority Ranking	43
4.3.8	The Best Supplier Selection	45
4.4	Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) Method	46
4.4.1	Decision Matrix for The Ranking	46
4.4.2	Normalize the Decision Matrix	46
4.4.3	Weighted Normalized Decision Matrix	47
4.4.4	Positive Ideal Solution ( $A^*$ ) and Negative Ideal Solution ( $A^-$ )	50
4.4.5	Separation Distance of Each Alternative	50
4.4.6	Closeness to Ideal Solution	51
4.4.7	Optimal Selection by Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) Method	52
4.4.8	Final Decision Making	52
4.4.9	EOQ Analysis Method	53
4.5	Summary of Result	55
<b>5. CONCLUSION AND RECOMMENDATIONS</b>		
5.1	Conclusion	56
5.2	Sustainable Design and Development	57
5.3	Recommendation for future work	57
<b>REFERENCES</b>		58
<b>APPENDICES</b>		64

## LIST OF TABLES

TABLE	TITLE	PAGE
2.1	Example of goal, criteria, and alternatives.	11
2.2	The fundamental scale of the absolute number	14
3.1	Scale of pair-wise comparison for AHP	26
3.2	Random Index Table	28
4.1	Requirement on Product Tensile Test	35
4.2	Pair-wise comparison matrix of criteria Level 1	37
4.3	Synthesizing the Pairwise Comparison for criteria Level 1	38
4.4	New Vector (NV) and Priority Vector (PV)	39
4.5	Summary of Criteria Level 1 Consistency Test	41
4.6	Summary of Sub-criteria SC1 until SC3 Consistency Test	42
4.7	Summary of Sub-criteria SC4 and SC5 Consistency Test	42
4.8	Summary of Sub-criteria SC6 and SC7 Consistency Test	42
4.9	Summary of Sub-criteria SC8 Consistency Test	42
4.10	Summary of Sub-criteria SC9 Consistency Test	43
4.11	Summary of Alternatives Consistency Test	43
4.12	Summary of All priority vector (PV) for criteria, sub-criteria, and alternatives	44
4.13	Overall Priority Vector for Five (5) Supplier Alternatives with Respect to the Sub-Criteria.	44
4.14	Overall Priority Vector for Five (5) Supplier Alternatives	45
4.15	Result of Best selection	45
4.16	Decision Matrix of Alternatives relative to Sub-criteria.	46
4.17	Normalized Decision Matrix.	48
4.18	Global weights	48

4.19	Global weights with Normalized Decision Matrix.	49
4.20	Weighted Decision Matrix.	49
4.21	Positive Ideal Solution (A*) and Negative Ideal Solution (A -)	50
4.22	Separation Distances	51
4.23	Closeness Coefficient of All Alternatives	51
4.24	Result of Best selection	52
4.25	Final weightage best solution	52
4.26	Summary of EOQ variables	54

## LIST OF FIGURES

<b>FIGURE</b>	<b>TITLE</b>	<b>PAGE</b>
2.1	Decision Making with the Analytic Hierarchy Process	13
2.2	Simple decision with criteria and alternative	15
2.3	Ordering Cost	19
2.4	Holding Cost	20
2.5	Economic order quantity (EOQ)	21
3.1	Project Flow Chart	23
3.2	Hierarchy model for the selection of best supplier selection	25
3.3	Visual model of EOQ, inventory versus time	31
4.1	Hierarchy model	34
4.2	Level 3 sub-criteria	35
4.3	EOQ in single cycle	54
4.4	EOQ in one-year cycle	55

## LIST OF APPENDICES

APPENDIX	TITLE	PAGE
A	Master Project 1	64
B	Master Project 2	65
C	Industrial Data Analysis	66
D	AHP- Criteria Consistency Test	70
E	AHP- Sub-criteria Consistency Test	76
F	TOPSIS -Normalize the Decision Matrix	94

## **LIST OF ABBREVIATIONS**

AHP	-	Analytic Hierarchy Process
BOCR	-	Benefits, Opportunities, Costs, and Risks
C	-	Criteria
EOQ	-	Economic order quantity
MCDM	-	Multi-Criteria Decision Making
MP	-	Master Project
SC	-	Sub-criteria
SOP	-	Standard Operation Procedures
SWOT	-	Strengths, Weaknesses, Opportunities, and Threats
TOPSIS	-	Technique for Order Preference by Similarity to Ideal Solution
WIP	-	Work In Process
WCM	-	World Class Manufacturing



## LIST OF SYMBOLS

%	-	Percent
min	-	Minute
RM	-	Ringgit Malaysia
sec	-	Second
phr	-	Part per Hundred Rubber

# CHAPTER 1

## INTRODUCTION

In this chapter are explaining the overall introduction in this project. Main introduction of an inventory management as a main role in a manufacturing industry environment. The introduction of study, problem statement, objectives, and scope of the project will be clarifying in detail in this chapter.

### 1.1 Introduction of the study

First of all, inventory management is the process of keeping track of all the material on the manufacturing industry has in its industry stock. Effective inventory management aligns all inventory types to the efficient creation of the production process to finished products and delivery to the customer's satisfaction. Ineffective inventory management either beyond having too much inventory or too little inventory, poor inventory management causes inefficiencies of production activity. This will be having reordering inventory from suppliers at last minute or increase risk of mistakes non-fulfilled customer orders on time. The consequence of poor inventory management can cause customers to withdraw orders or industry pay compensation due to order delivery date no achieve as agreement.

Inventory management can be considered as the most important department in every manufacturing industry. There is some inventory management method often used in the manufacturing industry. The most common is perpetual inventory is to update inventory stock at fixed time intervals. For example, the manufacturing industry will conduct a stock take day to check and physically count inventory in the stock room at the end of every month.

Nowadays, the choice of suppliers and the supplier material performance assessment are very important. This become the major challenges in the manufacturing industry which mainly faced by supply chain managers, purchaser or directors. The progress to evaluating each supplier and selecting the best supplier are become complicated tasks. In the decision-making process, there are different criteria and alternatives must take into consideration The supplier selection process needs to determine and evaluation because each supplier have different criteria and features. The process was including both quantitative and qualitative

factor. The supplier selection process can be considered as a multi-criterion decision-making problem (MCDM) which is well known in the manufacturing field. In this project will proposed a multi-criterion decision-making problem using both the Analytic Hierarchy Process (AHP) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method.

According to Shahroudi and Rouydel (2012), supplier selection was classified into two types, which is single sourcing and multiple sourcing. For the supplier classify as single sourcing is when one of the suppliers can support or provide all of the buyer requirements for example the buyer require two lots of material and supplier able supply two or more lots material to the buyer. In this case, the buyer only makes one decision in this type among the supplier to determine which supplier is the best. For the second type of supplier selection is multiple sourcing is happened when one supplier cannot support or provide the total requirements of the buyer. For instance, the buyer requires two lots of material and supplier only able to supply less than two lots material to the buyer. As a result, the buyer has to purchase the total requirement quantity from several suppliers. In this case the supplier selection become more complicate, because its need to determine the best criteria and objectives among the supplier and best amount to purchase from each supplier. In this project, the rubber manufacturing industry supplier selection is classified as single sourcing.

According to Panigrahi (2019) states that mainly manufacturing industries in China and India in top competition on facing the appropriate level of inventory. The inventory level should maintain by manufacturing industries towards the customer requirement as well as their own industry production process. In recent years, there many researches papers purpose is to observe and inspect the production performances (PP) with the impact of inventory management practices (IMP). The performance of inventory management of the manufacturing industry base on the various external factors and internal factors. For instance, the common factor was inventory costs volatile, this will create scarcity mindset due to the requirement of inventory and unexpected supply and demands.

Nowadays, the global competition happened in the manufacturing industry are apply to different management strategies related to different inventory management practices for example ABC model, VMI Model, EOQ model, and etc. According to Mohamad (Mohamad et al., 2009), in the process of identification the research problems the different statistical tools were apply in the manufacturing industry. Production performances have a strong

relationship in selection of techniques in inventory management practices. Just-in-Time inventory is a common manufacturing inventory tool to implies manufacturing to fill demand exactly, such as ABC inventory is a widely used method of categorizing your product inventory. The study from Mohamad (Mohamad et al., 2009) concludes that the effective inventory management of manufacturing industry enable to get great advantages in the competitive and become the top in the market.

Fundamentally, there was many mathematical models had been developed for manage inventory level. Some of the effective techniques that being applied in the past research paper depend on the inventory management problem. They have used eight inventory management techniques recommended to solve the problem related to inventory management.

- i. ABC analysis or selective inventory control
- ii. HML (High, Medium or Lost Cost item)
- iii. VED (Vital, Essential, Desirable)
- iv. SED (Scarce, Easily, Difficult)
- v. GOLF (Government, Ordinary, Local and Foreign)
- vi. FSN (Fast, Slow or Non-Moving)
- vii. SOS (Seasonal, Off Seasonal)
- viii. XYZ (High, Medium and Low Value)

## **1.2 Problem statement**

This case study focuses on identifying the current process and problem in the compounding department of a rubber manufacturing company. Therefore, it aims to select the best supplier by using the technique for order preference by similarity to ideal solution (TOPSIS) analytical hierarchy process (AHP) method embedded with economic order quantity (EOQ).

The main problem of the compounding department is always have last minute order from supplier. This might cause the production line stop due to shortage of raw material from the compounding department. Consequence is increasing the production downtime and not enough production output. In additional, there are too many suppliers able to provide the same material with various of criteria. This is difficult to choose the best supplier among

them. In this project, the focus will be on a highest usage material in compounding department use in rubber compounding process.

The technique for order preference by similarity to ideal solution (TOPSIS) analytical hierarchy process (AHP) method is use to analyse the parameter for economic order quantity (EOQ). The project also requires to analyse the criterion, with the use of the economic order quantity (EOQ). To ensure that the optimum amount of inventory is ordered per times so the manufacturing industry does not have to make orders frequently and there is not must of excess inventory holding.

For economic order quantity (EOQ) is an inventory technique to analyse the optimal quantity that to be order every time in the inventory. This order quantity should minimize the holding costs and ordering costs of the inventory. By using economic order quantity (EOQ), the manufacturing industry able to minimize the costs a with the ordering constant holding cost. On the manufacturing organization, the high consumption material will serve as a base model to order from the same amount of source, as the source will reflect into one of its variables. The results from the same variables will repeat in order and can be visualise by using consumption curve of graph. Based on the criterion of the sources of the material and supplier differs and various production activities, the selection for the economic order quantity (EOQ) variable is expected to change. As a result of the highest usage material, it is more compatible to apply economic order quantity (EOQ) with a visual consumption curve is for this case study.

### **1.3 Objectives**

The objectives of this project are:

- i. To identify the current process and problem in the compounding department of the rubber manufacturing company
- ii. To analyse the criteria and select the best supplier of inventory using the technique for order preference by similarity to ideal solution (TOPSIS) analytical hierarchy process (AHP) method.
- iii. To determine the optimum quantity of material via economic order quantity (EOQ).

## 1.4 Scope of study

The scope of the project are as follows:

- i. The inventory management of suppliers and material according to the compounding department of rubber manufacturing company only.
- ii. The highest usage material used only for the compounding process in the compounding department of a rubber manufacturing company.
- iii. Multi-criteria decision-making analysis (MCDM) will be limited to using the technique for order preference by similarity to ideal solution (TOPSIS) analytical hierarchy process (AHP) method.

## 1.5 Structure of the report

This report was containing five chapters which are:

Chapter 1: Introduction

Chapter 2: Literature Review

Chapter 3: Methodology

Chapter 4: Result and Discussion

Chapter 5: Conclusion and Recommendation

Next, **Chapter 2** is about the literature review of inventory management. Furthermore, detail calculation on the analytical hierarchy process (AHP) method and technique for order preference by similarity to ideal solution (TOPSIS). Conspectus of the concept, theory, calculation and the previous studies made from various sources such as journals, books, paper and materials are studied. All the material study was based on the objective and scope that has been stated in the introduction.

**Chapter 3** illustrated the flow chart of the methodology of the entire project that will conduct and how it conducts with some explanation.

**Chapter 4** was the compile of results through the whole case study and analyses the result. A highest consumption material is chosen in the compounding department and the function of material in the compounding process with have a brief explanation. Analysis of selection of supplier is by using analytical hierarchy process (AHP) method and technique

for order preference by similarity to ideal solution (TOPSIS). In addition, economic order quantity (EOQ) method will be determined and discussed in this chapter.

Finally, **Chapter 5** will conclude all the results and discussions that conduct in this report. Some recommendations and suggestions are provided for the industry to help them further project references.

## **1.6 Project planning overview**

The project is divided into two semesters, which is Master Project 1 and Master Project 2. A slight overview of the project planning is represented as a Gantt Chart (Appendix A and B).

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Introduction

A few subtopics will be discussed in this chapter. First subtopic is inventory management. The introduction of inventory management will be discussed with the importance of the inventory management. The second subtopic study about analytical hierarchy process (AHP) method and technique for order preference by similarity to ideal solution (TOPSIS) method. The calculation and the applied method will explain clearly in this chapter. Lat but not least, the final subtopic is economic order quantity (EOQ). The idea of apply economic order quantity (EOQ) for inventory management is to calculate the optimum quantity of material and minimize the holding and ordering cost for every order.

#### 2.2 Inventory management for the manufacturing industry

Inventory management can be explained as a single process of ordering, storing in the manufacturing industry. This includes the management of raw materials, equipment of maintenance, utilities, work in process components and finished products. Inventory management can be considered as the most important and major investment in every manufacturing industry. The inventory management able to influences the internal flexibility of a company for instance compounding process able to allow the production to change product. In vice versa the inventory management also influences the external flexibility of a company, for example by improve or change earlier delivery date to deliver product customer. The inventory management is always related to the working capital and inventory space. Large inventory store will be having risk from shrinkage, obsolescence, theft or deterioration due to the inventory environment. Inventory must be taken care carefully, if it is not sold in time the inventory may have to be disposed or destroyed at certain time.

Nowadays, mainly in the manufacturing industry has focuses on a concept of inventory is waste. There are well known to applied as just in time (JIT) manufacturing, which derived by the consumer demand-driven systems. In the year 1960s and 1970s this method was originated in Japan by Toyota Motor (TM). The method helps the company to