



**AUTOMATED SYSTEM – APPLICATION OF AHP  
AND TOPSIS ANALYSIS FOR PRODUCTIVITY  
IMPROVEMENT**

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FOR PRODUCTIVITY IMPROVEMENT**

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## DECLARATION

I declare that this thesis entitled “An Effect of Surface Roughness to Colour Sensor Detection Range in Ambient Temperature” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : .....

Name : .....

Date : .....

## APPROVAL

I hereby declare that I have read this dissertation/report and in my opinion this dissertation/report is sufficient in terms of scope and quality as a partial fulfilment of Master of Manufacturing Engineering (Industrial Engineering).

Signature : .....

Supervisor Name : .....

Date : .....

## **DEDICATION**

To my beloved family.

## ABSTRACT

Productivity improvement in manufacturing industry is always the key focus to strengthen an enterprise cost position to stay ahead of competition. Increase in productivity can reduce the cost of work on the production unit or an increase in output. This study emphasises on enhancing the work method in food industry by proposing an automated practice that is imposed to eliminate waste activities for continuous improvement. Additionally, this study focuses at *lekor* shaping process in Zazihan Enterprise. The production report showed that the company is having a shortage for cheesy *lekor* ball due to low production rate compared to targeted demand. The objective of this study is to analyse the current method by using work study and identify all activities related to the shaping process for cheesy *lekor* ball. Apparently, based on multiple-criteria requirement, AHP and TOPSIS analysis were used to determine the best automated machine for the shaping process of replacing a manual method. Finally, the proposed method was evaluated, and the results indicated that the productivity improvement rate is increased by 860% which is from 45 to 432 bulk per week. Moreover, the number of worker has been reduced as the proposed method only requires a single person to operate while other workers can focus on producing different types of products at the same time.

## ABSTRAK

Peningkatan produktiviti dalam industri perkilangan selalu menjadi tumpuan utama untuk mengukuhkan kedudukan kos perusahaan untuk berada di hadapan persaingan. Peningkatan produktiviti dapat mengurangkan kos kerja pada unit pengeluaran atau peningkatan output. Kajian ini memberi penekanan untuk meningkatkan kaedah kerja dalam industri makanan dengan mencadangkan suatu amalan automatik yang dikenakan untuk menghapuskan aktiviti sisa untuk penambahbaikan yang berterusan. Kajian ini memberi tumpuan kepada proses pembentukan lekor di Zazihan Enterprise. Laporan pengeluaran menunjukkan bahawa syarikat mengalami kekurangan untuk bola lekor berkeju disebabkan oleh kadar pengeluaran yang rendah berbanding dengan permintaan yang disasarkan. Objektif kajian ini adalah untuk menganalisis kaedah semasa dengan menggunakan kajian kerja dan mengenal pasti semua aktiviti yang berkaitan dengan proses pembentukan bola lekor berkeju. Kemudian, berdasarkan pelbagai kriteria yang diperlukan, analisis AHP dan TOPSIS digunakan untuk menentukan mesin automatik yang terbaik untuk dicadangkan pada proses pembentukan untuk menggantikan kaedah manual. Akhir sekali, kaedah yang dicadangkan dinilai dan membuktikan bahawa kadar peningkatan produktiviti meningkat sebanyak 860% iaitu dari 45 hingga 432 kotak setiap minggu. Selain itu, bilangan pekerja dikurangkan kerana kaedah yang dicadangkan hanya memerlukan seorang untuk beroperasi manakala pekerja lain boleh memberi tumpuan kepada menghasilkan pelbagai jenis produk pada masa yang sama.



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## LIST OF ABBREVIATIONS

AHP	Analytic Hierarchy Process
CI	Consistency Index
CR	Consistency Ratio
DMA	Decision Matrix Analysis
HACCP	Hazard Analysis and Critical Control Points
ISO	International Standard Organisation
MIDA	Malaysian Investment Development Authority
NIS	Negative Ideal Solution
NT	Normal Time
PIS	Positive Ideal Solution
PFD	Personal Fatigue and Delay
PMA	Pugh Matrix Analysis
RI	Random Index
SDW	Standardized Work
SIRIM	Scientific and Industrial Research Institute of Malaysia
SME	Small Medium Enterprise
SS	Stainless Steel
ST	Standard Time
STR	Time Reduction
TOPSIS	Technique for Order Preference by Similarity to Ideal Solution



# CHAPTER 1

## INTRODUCTION

This chapter discusses an overview of the background, objectives and scope of the study. It includes the primary focus of the reason and impact by conducting this study. Additionally, a description of conducting this project and explanation of the results is discussed.

### 1.1 Background of Study

Manufacturing can be defined as the transformation of materials and information into goods for the satisfaction of human needs, Chrysolouris (2006). In the current highly competitive business environment, the manufacturing industry is facing constant challenges of producing innovative products at shortened time-to-market.

Nee et. al. (2012) agreed that this situation leads the product development processes are increasingly more complex as products become more versatile, intricate and inherently complicated, and as product variations multiply to address to the needs of mass customisation. The core of improving manufacturing productivity can be summed up essentially as precisely capture information that finds the losses, use that information to identify the priorities, take thoughtful, thorough, and sustained action.

According to Amal and Gopinadhan (2016), productivity depends on various factors like labour, machinery, capital, temperature, raw materials, quality etc. so each factor has its own contribution. Optimizing the output is a big challenge; to achieve this goal the role of every worker regarding the production department has a great importance. In this

environment, the problems regarding men and machines need to be concentrating to improve the productivity and operational efficiency of the system.

Therefore, this study of productivity improvement is conducted in manufacturing sector to produce lekor in various type, namely crispy lekor, cheesy crispy lekor and cheesy lekor ball. Combination between lekor (originally made from fish and flour) and cheese shows promising sales in market. However, the entrepreneur has to be creative and innovative in producing special and unique lekor compared to ordinary one. On the other hand, an automated system should be developed to sustain the quantity and the quality of the product to meet uprising demand nowadays.

In conclusion, the successful achievement of an organization is based on their productivity. Tara (2017) stated that by implementing improvement of productivity, companies bring products to market more quickly, ensure customer satisfaction and maintain their market share. Improving manufacturing productivity involves collecting and analysing data and making effective decisions. Ensuring the success of these operational excellence initiatives often depends on divisions working together to share data and interpret it appropriately.

## 1.2 Problem Statement

Process utilisation that ensures all workstations are balanced is essential factor for factory productivity. In short, increasing productivity means that the workers/machine produce products more quickly or completing services at a more rapid rate than before. Currently, the shaping operation for producing cheesy lekor ball is done manually by four workers. Moreover, due to limited number of worker, they cannot produce the cheesy lekor ball on daily basis because of constraint of time to produce different types of products with shape and size of crispy lekor. Currently, the factory is able to produce the cheesy lekor ball once in a week with limited operation time and thus result in low productivity. The company has planned to expand their business to provide their product to super or hypermarket apart of the daily market. Table 1 shows the average monthly output from April to October 2017 which is considered low compared to monthly supermarket's demand. Therefore, a necessary improvement of working procedure should be considered to increase the productivity of lekor product in the Zazihan Enterprise to meet the increasing demand.

Table 1.1: An average of monthly output of cheesy lekor ball from April to October 2017 (Zazihan, 2017).

<i>Product</i>	<i>Cheesy Lekor Ball</i>	
<i>Month (2017)</i>	<b>Output (Bulk)</b>	<b>Demand (Bulk)</b>
<i>Apr</i>	42	400
<i>May</i>	40	400
<i>Jun</i>	45	400
<i>Jul</i>	45	400
<i>Aug</i>	40	400
<i>Sep</i>	42	400
<i>Oct</i>	40	400

### **1.3 Objective of Study**

Objective of this study are:

- i. To identify the current activities in shaping process by using process work study.
- ii. To propose a new automated approach by AHP and TOPSIS analysis.
- iii. To differentiate the productivity between conventional and propose method.

### **1.4 Scope of Study**

This study will be conducted at Zazihan Enterprise, located at No 34 Jalan Suria 68, Bandar Seri Alam 81750 Masai Johor and focusing in Production Area at Shaping Process. Even though there are various products produced by Zazihan Enterprise, this study only emphasises on the improvement of productivity in producing cheesy lekor ball. Design consideration of this study is based on company requirement and mutual-agreement between both parties which are from the researcher and the company.

### **1.5 Significance of Study**

Process utilisation that ensures all workstations are balanced is essential factor for company productivity. The main current problem which productivity is not achievable might due to several contributing issues such as unsuitable work method procedure, lack of machinery and equipment usage. Upon the development of this study, several achievements might be yield such as targeted productivity of selected area can be achieved successfully by reducing or eliminating bottleneck process and improve the conventional method to automated system.

## **1.6 Research Planning**

Activity planning of this research is outlined in a Gantt chart as in Appendix A.

## **1.7 Outline of Thesis**

This thesis is presented in four chapters as detailed below:

- Chapter 1 introduces the background of productivity improvement, factors and impacts of the study.
- Chapter 2 describes the literature review by various researchers in the field of productivity improvement and automated practice in food manufacturing industry.
- Chapter 3 describes the details of scheme planned in conducting the study.
- Chapter 4 describes the result and discussion based on collected data and several analyses is made to determine the feasibility of proposed approach compared to conventional method.
- Chapter 5 concludes the study thoroughly and proposes some recommendations for future enhancement of the study.

## **CHAPTER 2**

### **LITERATURE REVIEW**

This chapter reviews the precious literatures which have been carried out by various researches that related to the scope of the study. It covers elements that are important in this project such as productivity, type of waste and productivity that contribute to manufacturing industry efficiency. Sources of information were obtained from journals, books, case studies, and reports been collected and compiled together.

#### **2.1 Manufacturing**

Manufacturing has been practiced for several thousand years, beginning with the production of stone, ceramic, and metallic articles. Much of manufacturing remained for centuries as essentially individual activity, practiced by artisan and their apprentices. The ingenuity of successive generations of artisan led to the development of many process and great variety of product, but the scale of production is limited by the available power (Schey, 2012). Manufacturing is an industrial activity that changes the form of raw materials to create products by adding value. To be profitable, an enterprise establishes and nurtures a manufacturing system that facilitates the flow of information to coordinate inputs, process and output. Development of modern manufacturing, for example, is dependent on research materials that may require a variety of new production processes (Ostwald and Munoz, 2008).

According to Quirk (1999) in manufacturing, there are four basic elements that represent the manufacturing resources required to produce, namely:

- i. Labour
- ii. Methods
- iii. Machines
- iv. Materials

These elements are the building blocks of a process and together create an infrastructure that supports manufacturing both directly and indirectly. On one hand, understanding these different elements can help to simplify the manufacturing concept. The elements represent the specific aspects of manufacturing that should be used efficiency in aspects of less labour, less equipment, less time and material required. This efficiency increases the value in the product, which helps to meet the goal for competitive manufacturing. In this study, it focuses on the effectiveness shaping process in order to improve current productivity.

## **2.2 Productivity in Manufacturing**

Most organizations would like to find the recipe for the ultimate productivity improvement strategy. Most organizations that are searching for this improvement are likely unable to take full advantage of the methodologies and techniques they had tried so far. Part of this is because many of them simply do not understand what productivity really means. Productivity can be defined as the application of the various resources (inputs) of an organization, industry or country, in order to achieve certain planned and desired results (outputs). Productivity measurement entails a comparison of outputs to inputs normally by calculation of a productivity index (output/input ratio). Productivity improvement thus becomes the establishment of approaches to improve this productivity index (Baines 1997).

According to Stevenson (2007), productivity is an index that measures output (good and services) relative to the input (labour, materials, energy, and other resources) used to produce them. It is usually expressed as the ratio of output to input:

$$\text{Productivity} = \text{Output} / \text{Input} \quad (2.1)$$

A productivity ratio can be computed for a single operation, a department, an organisation, or an entire country. In business organisation, productivity ratios are used for planning workforce requirements, scheduling equipment, financial analysis and another important task. In the same way, Mukherjee (2006) stated that productivity is defined as the ratio of output to input within a defined time with due consideration for quality.

Nevertheless, according to Kendrick and Frankel (2017), productivity is outcome of several interrelated factors, which can broadly be divided into two main categories where human factors and technological factors. Human factors are a human nature and human behaviour is the most significant determinants of productivity. Human factors include both their ability as well as their willingness to work. Meanwhile, technology factors are the factors that exert significant influence on the level of productivity. There also another factor that contributes the efficiency of productivity is managerial, natural environment, sociological, political and economic.

### **2.3 Productivity Improvement**

Productivity improvement in manufacturing is always the key focus to strengthen an enterprise cost position to stay ahead of competition. In manufacturing sector, improve the cost position through faster machine speed, reduce man to machine ratio, utilization of material efficiently, and increase the through output per fix process cycle are the common