Faculty of Mechanical and Manufacturing Engineering Technology

INTEGRATION OF TIME DRIVEN ACTIVITY BASED COSTING (TDABC) AND SIMULATION FOR DECISION MAKING IN ASSEMBLY PROCESS

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Specially dedicated to my beloved parents

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ABSTRACT

The manufacturing industries are currently moving to the new industrial paradigm – Industry 4.0 which geared towards increasingly specialized production processes. Therefore, it is crucial to manufacturing companies to be cost-effective during their production cycle. This paper focuses on the analysis of existing costing method used by an automotive part manufacturing company in Melaka and the implementation of Time Driven Activity Based Costing (TDABC) in their production line namely assembly process. Since the company has been established since 1994 and their costing has never been updated since then. As a consequence, Time Driven Activity-Based Costing (TDABC) method is suggested to obtain the costing of an assembly production line. Comparison of TDABC method and current costing method shown that TDABC is more accurate in terms of practical capacity of production line using time equation, cost drivers with affecting parameters and apportioned of busy time and idle time of resources. The total assembly production cost for line T9AX per month using TDABC is RM25783.68. ARENA modelling predicted the cost reduction of the production line by eliminating unnecessary resources by 42.71% accounting to RM5053.50. Therefore, ARENA simulation act as a Decision Support System in this case study.

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ABSTRAK

Industri pembuatan sedang bergerak ke paradigma perindustrian yang baru – Industri 4.0 yang ditujukan kepada proses pengeluaran yang lebih khusus. Hal ini membawa kepada peningkatan persaingan di kalangan syarikat pembuatan Malaysia. Oleh sebab itu, syarikat pembuatan haruslah menitikberatkan kitaran pengeluaran mereka supaya menjadi kos efektif. Demi mendapat kos pengeluaran yang tepat, sistem kos yang memperuntukkan dengan tepat semua kos produk menggunakan darjat pembahagian haruslah diperkenalkan. Makalah ini memberi tumpuan kepada analisis kaedah kos sedia ada yang digunakan oleh Peps JV Sdn Bhd, Melaka, dan pelaksanaan Time Driven Activity Based Costing (TDABC) dalam barisan pengeluaran khasnya proses pemasangan. Syarikat tersebut ditubuhkan sejka 1994 dan model kos mereka tidak pernah dikemas kini sejak itu. Perbandingan kaedah TDABC dan kaedah kos semasa menunjukkan bahawa TDABC adalah lebih tepat dari segi kapasiti praktikal pengeluaran menggunakan masa, parameter yang mempengaruhi pemandu kos dan membahagikan masa sibuk dan masa yang tidak produktif. Jumlah kos pengeluaran pemasangan untuk barisan pengeluaran T9AX sebulan dengan menggunakan kaedah TDABC ialah RM25783.68. Pemodelan ARENA meramalkan pengurangan kos barisan pengeluaran sebanyak 42.71% sesama RM5053.50 dengan kurangkan sumber tenaga manusia. Oleh itu, simulasi ARENA bertindak sebagai sistem sokongan keputusan dalam kajian kes ini.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

TDABC	-	Time Driven Activity Based Costing
ABC	-	Activity Based Costing
CPS	-	Cyber Physical System
CPPS	-	Cyber Physical Production System
2D	-	2 Dimensional
3D	-	3 Dimensional
IoT	-	Internet of Things
IT	-	Information Technology
AR	-	Augmented Reality
HVAC	-	Heating, Ventilation and Air Conditioning
ASQ	-	American Society for Quality
RM	-	Ringgit Malaysia
FYP	-	Final Year Project
EPMB	-	EP Manufacturing Berhad
OEM	-	Original Equipment Manufacturer

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CHAPTER 1

INTRODUCTION

1.0 Introduction

The industry is now in the midst of a fourth wave of technology advancement, known as Industry 4.0 which connects digital system production technologies and production process through streaming of data. Under the concept of Industry 4.0, the pressure of changing mass production to customized productions leads manufacturing industry to a new challenge. Therefore it is crucial to manufacturing companies to be cost-effective during their production cycle.

In this context, an accurate costing method is essential to estimate the cost of the production line namely the assembly process. Many companies have established their own costing methods which usually involves material, labor and overhead cost or based on past experience of costing strategy. In addition, most costing method established by companies uses only estimation and assumption to decide the cost of their product. There is no measure to determine whether the cost is too high or too low for the manufacturing cost. Neither way can cause problem such as overcharging or undercharging customers for their product. Hence, Time Driven Activity Based Costing (TDABC) an alternative costing method is used in this paper.

Since many manufacturing companies have enter the paradigm of Industrial 4.0 therefore utilising of the pillars of technology of Industrial 4.0 is an advantage and it brings many more benefits for the company. Simulation is one of the tool to help the management of a company to make decisions. The existing costing method and TDABC method will be

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evaluated. Consequently, this paper combines TDABC and ARENA simulation to study costing of production line and provide Decision Support System (DSS) to the company. This paper presents the aid of ARENA simulation for decision making on a cost effective perspective.

1.1 Background

Time Driven Activity Based Costing (TDABC) was first developed in 2004 by Kaplan and Anderson as a cost allocation methodology to derive a more reliable information to set pre-dominance for multi-products, price allocating and process improvement. TDABC is an improvised version of ABC due to its complexity and neglect of the actual capacity of resources are working (idle time).

As mentioned earlier in the introduction, the two key parameters of TDABC are cost rate of capacity and resources estimated for related cost object. To obtain the first parameter, the total cost of resource capacity supplied is divided by the actual capacity. The cost of all the resources supplied to a particular department or any process which can be equipment, technology or infrastructure sums up together as the total cost. Whilst, estimated resource employed are derived from time equation to justify the time required to carry out each task (Siguenza-Guzman, 2014).

Along with that, Wouters et al. (2015) found that the most innovative outlook of TDABC is the use machine times based on real time data, in the context of a large number and routinely alternating products which complies with Industry 4.0 concept. On top of that, the digital industrial technology in Industry 4.0 leading production process to achieve great efficiency, more autonomous and versatile. TDABC methodology is also used in the flexible production not only for costing estimations but also capacity optimization in operations and production systems (Santana et al. 2017).

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1.2 Problem Statement

Malaysia manufacturing companies today face the increasing competition on global market. These companies should react rapidly and produce low cost product to be competitive in this latest of environment. In this case study, the company chosen is Peps-JV (M) Sdn Bhd also known as EP Manufacturing Bhd (EPMB) which is located in Alor Gajah, Melaka. Peps-JV (M) Sdn Bhd Melaka mainly manufactures and supplies automotive modular components to Honda Malaysia Sdn Bhd (HMSB). Their product range includes body parts, suspensions, engine parts, modular assemblies and engineering plastic parts of automobile.

The current practice costing model of PEP-JV consist of only estimation and assumption of the labor cost and capital cost. Estimation of these elements are not precise enough to help in decision making and certainly not accurate enough to charge the customers. Thus, the company faced problems such as undercharging or overcharging their customers. As an example, if the company undercharge their customer for their products, the company may loss profit. In contrast to that, if the company overcharge their customers, they will suffer from loss of customer as the price of product is high. Therefore, as effective control measurements, there must be a cost system that accurately allocate all the product cost using apportionments standard and comprising of allocation errors.

The management should have accurate and up to date costing information. The reason behind a new costing system have to be introduced so that the true cost of a certain product can be revealed and lead to right decision making. Therefore, Time Driven Activity-Based Costing (TDABC) will be implemented to estimate the accurate costing of a product's production line. This costing method hopes to provide the management reliable cost of product complies with Industry 4.0 using ARENA simulation as a Decision Support System (DSS).

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1.3 Objectives

Several objectives are established to achieve the goal of study indicated as below:

i. To calculate costing of the assembly line using Time Driven Activity-Based Costing (TDABC) Method.

ii. To compare the accuracy of existing costing method and Time Driven Activity-Based Costing Method.

iii. To predict the changes in cost structure of the assembly line by using ARENA Software.

1.4 Scope

This project will be based on case study on a selected company which is PEPS-JV Sdn Bhd. This project focus on selecting one entire assembly line of the family product. In this case, line T9AX is selected which assemblies Left Wheel House Comp (LH), Right Wheel House Comp (RH) and Cross Member (C/MR) for Honda City car model. These three products are running in the same assembly production line. This study will be focusing on the existing costing method implied by the company and analysis will be made. TDABC will be carried out to evaluate the cost of assembly line of the product selected. The accuracy of existing costing system and TDABC will be review thoroughly. However, costing model is considered private and confidential documents of a company. Hence, the company will not reveal the complete steps in obtaining the cost of production. In conjunction to that, interview session is made with the plant manager to get rough information on their costing model. Simulation of cost structure in ARENA Software will be included in this project.

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1.5 Expected Result

The project aims to provide analytical evaluation on existing costing system in assembly production line in contrast with Time Driven Activity-Based Costing (TDABC). Together with other complementary results of the case study, TDABC will come out as a more accurate costing method by using the practical capacity of the resources supplied to drive cost rates. Simulation will act as a good Decision Support System (DSS) to support and enable managers to make a decision on the entities, attributes and cost of the production line.

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CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter mainly discuss about the background study of the project. Literature review is the solid backbone to ensure success of any study and it also helps to identify current problem occurred in the field of study. Moreover, it also reviews various approach to achieve project goal based on the study. This chapter focuses on the current trend – Industry 4.0 in Manufacturing System and the technologies revolving the evolution. Costing methods from Traditional Costing method to Time Driven Activity-Based Costing (TDABC) method are also reviewed as the main objective is to calculate costing of the assembly line using TDABC method. Besides, types of assembly process is discussed as part of the case study. Study on Simulation Model is also included in this this chapter.

2.1 Introduction to Industry 4.0

According to Lasi et al. (2014), the beginning of industrial evolutions has taken a leap to a new paradigm in digital technology. The first industrial revolution was in the field of mechanization where machine is introduced in Britain by the end of 18th century (1760-1840) with the water as source of power to generate steam powered engines. The intensive use of electrical energy is the symbol of the beginning of second industrial revolution (1870-1914). The electrification of factories contributes to mass production in the industry. Nevertheless, the reason such revolution come to an end is due to World War I. This marks

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up the beginning of wide spread digitalization in the industry which so-called the third industrial revolution which uncover between 1950 and 1970. In another words, it was also called information age where a direct result of massive development in computers, information and communication technology.

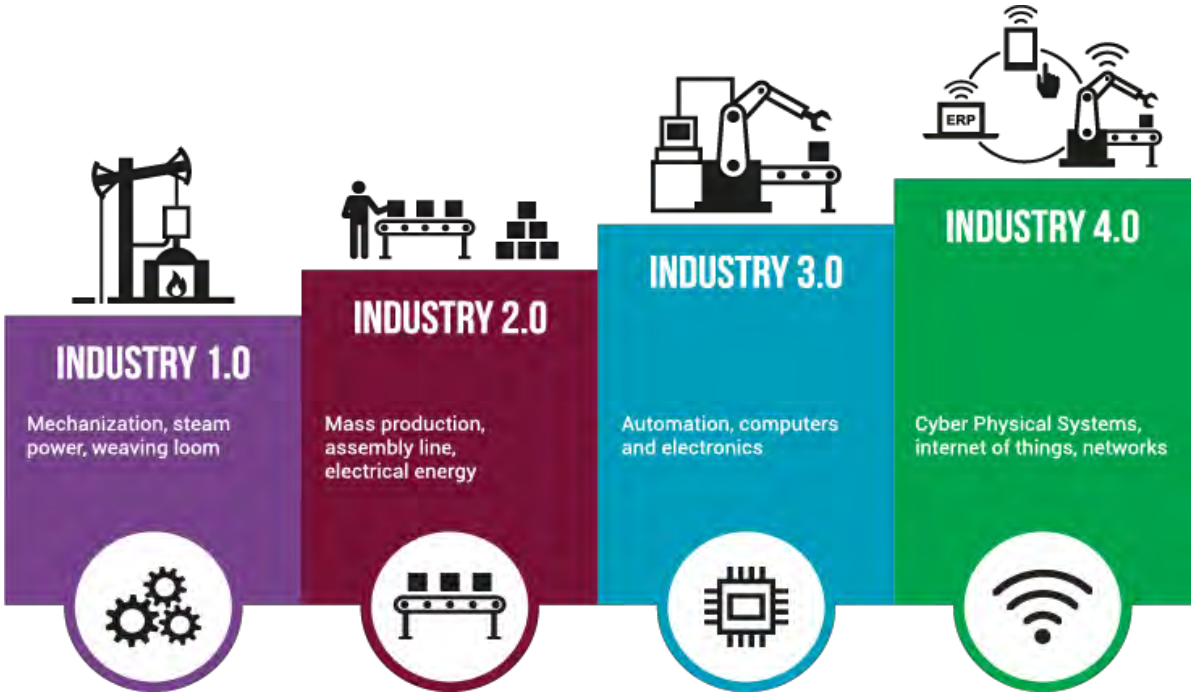

Figure 2.1: Revolution of Industry 4.0 (Simio LLC, 2017)

Today, the fourth industrial revolution emerges as an advanced digitalization within factories, the combination of Internet technologies and future-oriented technologies in the field of smart objects (machines and products) seems to result in a new fundamental paradigm shift in industrial production. Zhou et al. (2014) stated that "Industrial 4.0" concept is surfaced by the German government in November 2011. Over the past few years, "Industrial 4.0" has been broadly deliberated for most global industries which will yield remarkable influence on international industries. The concept of Industry 4.0 is depending on a Cyber Physical System (CPS) based on the streaming of data and communication technologies and industrial technology coming together to form a smart factory, leading manufacturing environment to become more flexible and customized. The objective of

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