Faculty of Manufacturing Engineering

INVESTMENT ANALYSIS OF A NEW PAINT SHOP IN AUTOMOTIVE INDUSTRY

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INVESTMENT ANALYSIS OF A NEW PAINT SHOP IN AUTOMOTIVE INDUSTRY

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DECLARATION

I declare that this thesis entitled "Investment Analysis of a New Paint Shop in Automotive Industry" is the result of my own research except as cited in the references, referred process layout, and equipment pictures. This thesis has not been accepted for any degrees and is no concurrently submitted in candidature of any other degree.

Signature : ………………………………….

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APPROVAL

I hereby declare that I have read this thesis and in my opinion, this thesis is sufficient in terms of scope and quality for the award of Master of Science in Manufacturing Engineering.

Signature   : …………………………………

Supervisor Name : ………………………………….

Date   : …………………………………

ABSTRACT

National Automotive Policy stated by year 2020, the automotive industry will provide 550,000 employment opportunities with involvement of 430 local vendors. In NAP 2014, government has given special emphasis on export of local production cars and increase localisation of automotive component. With the annual export target of 250,000 units, the quality of painting job in the manufacturing process must be at global standard and able to withstand the extended warranty of minimum 5 years. Paint shop, one of the important components in automotive industries is an essential process in automotive manufacturing. Comparable to Germans' marque car, painting shop in Malaysia is not able to match with the quality standard and process specification due to inferior technology. It demands high quality result which may lead to adverse impact to environment and human safety. As such the selections of process and technology level are crucial to determine the level of quality, environment, and safety to workforce. All these aspects will directly give an impact to initial capital investment of the company. This thesis examines two alternatives faced by decision maker whether to maintain the current technology or to pursue new technology (challenger). Two approaches of study were employed i.e. the first one was a combination of team assessor where experts were invited to provide opinion, and benchmarking of available facilities. The second approach used is Investment Analysis (IA). IA test the robustness of the results of an intended investment in the presence of uncertainty. It was a combination of feasibility study where the challenger was assessed through financial analysis such as Net Present Value (NPV), Internal Rate of Return (IRR), and Pay-Back Period (PBP) .Value Analysis and Value Engineering (VA/VE) were used to justify the selection of technology of painting used. In the investment analysis, assessment factors such as sales of the car, manufacturing cost, time to deliver and level of investment were included. The results show that the challenger was preferable based on team assessor due to its technical superior over the current technology in terms of quality and safety. However, when it tested for feasibility study, the results were not encouraging. Then VA/VE method was used to investigate whether the challenger can fit financially to the requirement set at the beginning by the owner of the project. The final results approved that the challenger was selected.

ABSTRAK

Dasar Automotif Nasional menjelang tahun 2020, industri automotif akan menyediakan 550,000 peluang pekerjaan dengan penglibatan 430 pembekal tempatan. Dalam NAP 2014, kerajaan telah memberi penekanan kepada eksport kereta tempatan dan meningkatkan keperluan kandungan komponen automotif tempatan. Dengan sasaran eksport tahunan sebanyak 250,000 unit, kualiti kerja mengecat kereta dalam proses pembuatan mesti menepati piawaian global antaranya untuk bertahan waranti lanjutan minimum 5 tahun. Bahagian mengecat kereta adalah aktiviti mengecat rangka kereta yang paling penting dalam pembuatan kereta. Jika dibandingkan dengan kereta jenama buatan Jerman, kilang mengecat di Malaysia tidak dapat menandingi piawaian produk berkualiti dan spesifikasi proses dari segi tahap teknologi. Ia memerlukan pencapaian hasil yang berkualiti tinggi yang juga boleh membawa kepada kesan sebaliknya kepada alam sekitar dan keselamatan manusia. Pemilihan proses dan tahap teknologi adalah penting untuk menentukan hasil yang berkualiti, persekitaran yang baik dan kawasan kerja yang selamat. Semua ini secara langsung akan memberi impak awal pelaburan modal syarikat. Tesis ini menilai dua pilihan yang perlu dibuat oleh pembuat keputusan samaada mengekalkan teknologi semasa atau untuk menggunakan teknologi baru yang dinamakan pencabar (challenger). Dua kaedah kajian telah digunakan iaitu yang pertama adalah gabungan tenaga mahir di mana pakar-pakar industri dijemput untuk memberikan pendapat, dan membuat penanda arasan peralatan pada mesin yang sedia ada. Kaedah kedua yang dicadangkan dalam kertas kerja ini adalah Analisis Pelaburan (IA). Ianya adalah alat untuk menguji keteguhan keputusan pelaburan pada situasi yang ketidakpastian. Ianya adalah gabungan kajian kemungkinan di mana pencabar dinilai melalui analisis kewangan seperti Nilai Terkini Bersih (NPV), Kadar Pulangan Dalaman (IRR) dan Tempoh Pulangan Balik (PBP). Analisis Nilai Dan Kejuruteraan Nilai (VA/VE) telah digunakan untuk menilai pemilihan teknologi pengecatan yang digunakan. Dalam analisa pelaburan, faktor-faktor seperti jualan kereta, kos pengeluaran, masa penghantaran dan tahap pelaburan digunakan. Keputusan menunjukkan bahawa pencabar adalah lebih baik berdasarkan penilaian pakar industri dari segi tahap teknologi , kualiti dan keselamatan. Walau bagaimanapun, apabila ianya diuji untuk kajian kemungkinan, keputusan analisis kewangan tidak menggalakkan. Kaedah VA / VE telah digunakan untuk mengesahkan sama ada pencabar boleh menepati keperluan kewangan yang ditetapkan pada cadangan awal oleh pemilik projek. Keputusan akhir yang diluluskan memilih teknologi baru pencabar.

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LIST OF ABBREVIATIONS

BOM   : Bill of Material

CKD   : Complete Knock Down

ED   : Electrophoretic Deposition

FY   : Financial Year

HAMM   : Hicom Automotive Manufacturing Malaysia

IA   : Investment Analysis

IRR   : Internal Rate of Return

IETS   : Industrial Effluence Treatment System

MIDF   : Malaysian Industrial Development Finance Berhad

NAP   : National Automotive Policy

NPV   : Net Present Value

OEM   : Original Equipment & Manufacturer

PPE   : Personal Protective Equipment

PVC   : Polyvinyl Chloride

PW   : Present Worth

RHB   : RHB Bank Berhad

SA   : Sensitivity Analysis

SGA   : Small Group Activities

TIV   : Total Industrial Volume

VA   : Value Analysis

VE   : Value Engineering

VOC   : Volatile Organic Compound

WACE   : Weighted Average Cumulative

CHAPTER 1

INTRODUCTION

1.1   Background

Automotive industry is one of the major economic sectors in the world. It has a wide range of companies involved in designing, manufacturing, marketing and selling of motor vehicles. Moreover, it has also become the main cause for its derivative business i.e. automotive repair shops, spare parts and even vehicle petrol stations (Ahmad, 2015).

In the United States of America, as reported by Booz & Company Report of U.S. Automotive Survey and Confidence Index in 2012, a considerable improvement of automotive sales had been achieved in 2012, nearly twice of the previous year, and surprisingly, it occurred after the global crisis in 2009. In the United Kingdom, automotive industry contributes up to 4 per cent of its country GDP and provides employment for more than seven hundred thousand people, recently. This makes United Kingdom currently as the second largest vehicle market and the fourth largest vehicle manufacturer in Europe (Zubir et al.,2013).

This shows that the automotive market is still showing its high potential in the future and leading to growing optimism among the automotive manufacturers.

Meanwhile in Malaysia, automotive industry arises as the most steadily growing market and one of the main pillars for Malaysia economy (MIDA, 2010). This has placed Malaysia ranked in the third among South-East Asian automakers with its renowned status as passenger cars producer. In the National Automotive Policy (NAP), it was underlined

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that by year 2020, the automotive industry in Malaysia is expected to provide 550,000 employment opportunities with the involvement of 430 vendors (MAA, 2014).

According to the Malaysian Automotive Association (MAA, 2014) report, the total vehicle sales in Malaysia showed an increase of 1.6 per cent in 2014 with the total units sold of 666,465 compared to 655,793 units from the previous year (Malaysian Automotive Outlook, 2014. Total Industry Volume (TIV) is to ease at 650,000 units. Meanwhile, Malaysian Industrial Development Finance Berhad (MIDF) expects a growth of 0.3 per cent to 701,000 units from its 2014 target of 668,200 units (MAA, 2014).

Figure 1.1 indicates that the number of vehicles produced since 2011 showed an increment of 17 per cent (70,000 units) over the period of four years. Only 14 per cent of TIV was on the commercial vehicles' production.
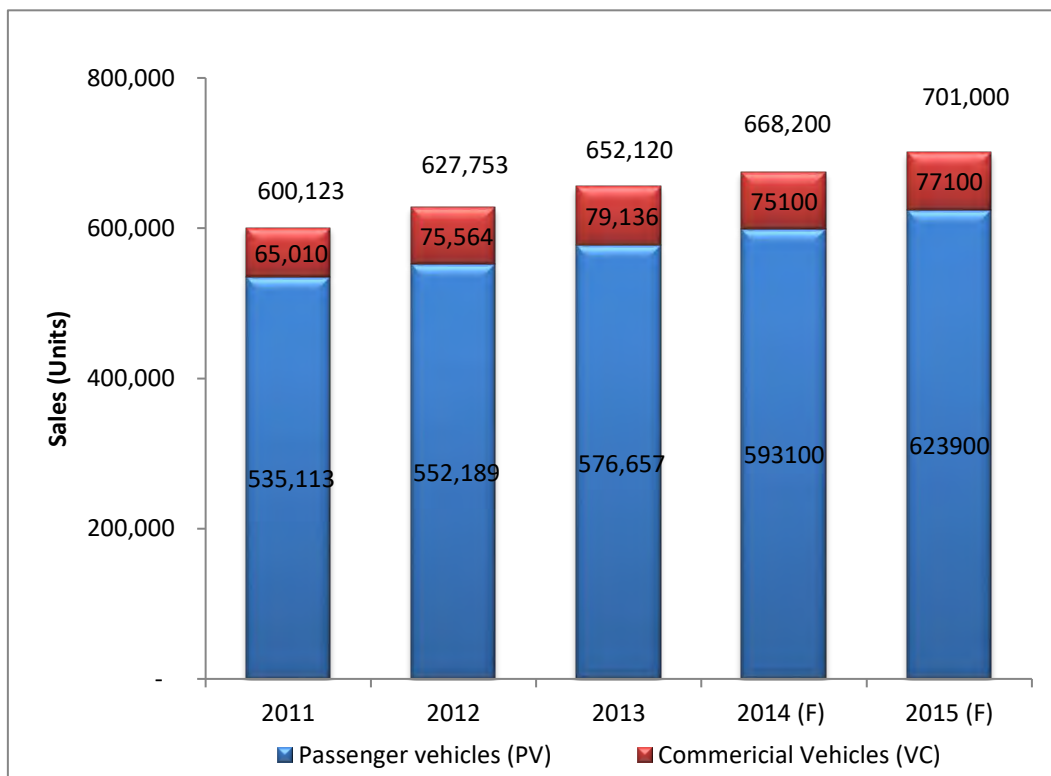

Figure 1.1: Total Industry Volume (TIV) in Malaysia

(Malaysia Automotive Market, 2014)

Our next four year's indicative forecast of the TIV from 2017 up to 2020 will grow steadily at the range of 2.2 % to 3.0% yearly (Ahmad, 2015). Apparently, this number of sales has attracted researchers to explore and gain more information about current automotive business in Malaysia. Studied by Wad and Govindaraju (2006) who have suggested that the expansion of automotive sales and employment should be aligned with international competitiveness. Zubir et.al, (2012) studied the performance sustainability of Malaysian automotive industry subjected to environmental, economic and social factors. The research even provides some useful models of sustainable manufacturing practices for automotive manufacturers.

Based on the studies above, needless to say, automotive industry in Malaysia will apparently still be a long lasting business in the future. Investment is a must for a company to expand to the market expectation. Management with the support of experts has to make the right investment decision. In order to do that, the company must do a series of group activities such as comparative technology benchmarking, benchmarking of the available facilities, evaluation of the required technology, study on local authority requirement on the environment and safety, building a factory with the right equipment to produce the right product at the right cost, and cash flow analysis. Thus, this thesis will explain the above scenario by providing an investment analysis as the decision tools and value analysis and value engineering as the secondary tools to support management in making the right decision.

1.2   Paint Shop in Automotive Industry

In general, automotive manufacturing process in the plant mainly consists of four stages: the press shop, body shop, paint shop, and assembly shop (arranged in a sequence). The press shop stage performs the formation of metal panels for the vehicle body and the

process of dies mounting and adjusting. In the body shop stage, the metal panels are welded to join different parts of metals. While at the paint shop stage, the vehicle parts are coated and painted to different colours accordingly. The vehicle bodies are then trimmed and all the components, such as engine and transmission are assembled in the assembly shop.

Paint shop or automotive painting is therefore one of the very critical processes in the automotive industry as it provides high level of appearance standard and covers all specific areas of car body surface. The paint shop process must ensure excellent quality, easy maintenance, and good delivery. It should also be cost-effective, ergonomic, user-friendly, and environment-friendly. Figure 1.2 illustrates the paint shop stages where paint shop is positioned in the middle between the welding and final assemblies.

| Stamping and Welding Assembly | → | Paint Shop | → | Final Assembly |

Figure 1.2: Paint Shop Stages

For Malaysian local car manufacturers, this paint job process becomes a critical factor as the foreign manufacturers competing for the market share offer cars with high quality paint. It is essential for the local manufacturers to ascertain that the quality of painting job in the automotive process is at par with the global standard to withstand the minimum of 5 years of extended warranty. Hence, the need for a new technology in automotive painting is essential, at least to maintain the existing market share in the era of high competitiveness of car selling.

At present, local car manufacturers have to purchase painted body parts from foreign car manufacturers due to the absence of the paint technology that is capable of

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producing the colours of demand. This leads to the increased cost of car production, and eventually increase the needs to adopt the new technology in automotive painting which will enable local car manufacturers not only able to produce cars of better look and performance, but also to produce cars of lower production cost in the long run.

There are three major considerations for any automotive manufacturers in selecting an appropriate technology for the paint shop. The first consideration is to choose a technology that provides better competitive advantages in terms of quality. Quality in this context covers the features such as durability, aesthetic value and long lasting appearance.

The second consideration is the safety and health issue. For instance, whether the technology complies with the standard set with respect of human health either during the process of painting or after the product being shipped to customer. So, complying with the environmental standard is a must as prescribed in government regulations on environment and safety. Furthermore, the product must also fulfil the international standard as set and endorsed by foreign country if it is to be exported.

The third major consideration is on the cost effectiveness of investment, whether it is worthy to have such a paint technology (Roelant, 2004). This is the utmost concern for any industries before they decide whether the project to be undertaken or not.

Therefore, before the crucial investment in paint shop is made, a robust feasibility study is obviously needed since the investment involves large capital requirement, compliance with various standards and environmental protection issue (Redlich, 2006).

1.3   Problem statement

The complexity of the paint shop process is mainly to ensure high quality of painting finishing without compromising issues pertaining to safety and environmental protection. In order to increase the product quality and the process efficiency of the paint

shop, the painting process is equipped with the automatic machineries, better scheduling works, adherence to safety and regulations for personnel in this process, as well as conservation of the environment.

Today, the car manufacturing trend focuses on the production of the energy-efficient vehicles which emphasizes on reducing the car weight. This initiated many car manufacturers to start producing vehicles using aluminium, magnesium and super high tensile materials (Arenas and Claudia, 2010). Thus, to uphold this latest requirement, the painting shop needs to be upgraded to meet this advanced technical specification requirement.

Unfortunately, Malaysian companies do not have the paint shop to carry out this requirement. In fact, they are even far from giving the five years warranty on harsh usage condition. It is crucial that all car manufacturers put a concerted effort in ensuring the quality of their car paint meets acceptable standard as required by Global OEM standard. For instance, German car makers have raised their car body material standard and paint quality specification which local companies in Malaysia are not able to undertake. Mercedes Benz confirmed that the aluminium body of its cars requires special processes that force the company to import from overseas. The process of automotive painting is important to provide corrosion protection, mechanical protection such as anti-scratch protection, atmospheric and weather protection, and maintain its aesthetical appearance. Due to this extreme standard, European car assemblers i.e. BMW, Mercedes Benz, Citroen and Peugeot in Malaysia have imported painted body shells from their origin plant in Europe in order to comply with this standard.

However, the selection of this advanced technology has to be in tandem with the rate of return on investment (ROI). Companies in Malaysia need to determine the amount of investment to be put forth to enable them to opt for the acceptable level of technology

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that suits to their business needs. Thus, Investment Analysis (IA) will act as the important tool that can be used to stimulate the financial ratio for the company and shareholders to make a complex decision.

1.4   Objectives

The main objectives of this study are:

a)   To explore alternative technology and investment in establishing the paint shop.

b)   To examine the alternative paint shop technologies using the investment analysis.

c)   To recommend competitive alternative via Value Analysis/Value Engineering (VA/VE) in decision making.

1.5   Scope of the Study

The study focuses on the local company, an automotive assembler and its Paint Shop project. It will examine the state of affairs within the company, between the company and its customers, and the state of competition in the automotive industry in Malaysia. The models of the vehicles under study are Japanese and European brands with each passenger car having a five-year life cycle. Also, this feasibility study will only focus on the financial viability of the proposal and environmental impact due to the delivery expectation. The need to have the new paint shop is limited to the capacity and capability constraint resulting from a production volume, failure to meet the new requirements from OEM for higher aluminium content, high painting quality defect and aging equipment that require extensive level of repair and maintenance.

1.6   Significance of the Study

It is of great hope that this study will:

a) raise awareness of the contribution of the automotive assembly companies in the automotive industry market.

b) initiate understanding towards the function of Paint Shop in the automotive industry and the related issues in the automotive market.

c) increase business success and sustainability of local automotive companies.

d) act as a source of information for companies involved in automotive assembly and Paint Shop in the automotive industry.

1.7   Organisation of the Thesis

The thesis includes the following chapters:

Chapter 1   Introduction

This chapter provides a brief introduction on the background of automotive industry and the description on paint shop processes. The problem statement is proposed. The main objectives and significance of this study are also discussed.

Chapter 2   Literature Review

This chapter focuses on the literature pertaining to the variables involved in this research. The literature review outlines the variables or parameters in automotive painting shop which influence management decision in capital investment. These variables include multiple energy system, environmental impact, and financial sensitivity analysis. The literatures on the level of technology and investment applied by other automotive industries are also included.

Chapter 3   Methodology

This chapter describes the element in financial modelling methods used to conduct this research. The evolution of technology in paint shop in Malaysia context will also be explained, besides the cost reduction and sensitivity analysis application. The case study which was conducted in real-life industry will be mentioned and the results obtained will be compared with the management financial policy.

Chapter 4   Results and Discussion

This chapter presents the results and discussion of the statistical data analyses. An industrial case study conducted in an automotive company in Malaysia will be shared. The data collected and the effects of capital investment are analysed. Economic measurement in terms of volume, net present value, payback period and internal rate of return will be tabled in three levels of cases. The value added and value engineering methodologies will be used to reduce the initial investment without jeopardising the principle requirement in terms of quality, output and environmental impact.

Chapter 5   Conclusion

This chapter gives the main conclusion from the results of the study by providing results of selected technologies, and investment. Implications of the sales volume changes are also explained in this chapter.