

**THE CHALLENGES OF TECHNOLOGY ADOPTION IN OIL AND GAS
INDUSTRY**

THE CASE STUDY OF SOLAR ALERT SDN BHD

EIDIL HARZEQ BIN ZAINUDIN

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

‘I hereby declare that I have read this thesis and in my opinion this thesis is sufficient
in term of scope and quality for the award of the degree of Bachelor of
Technopreneurship’

Signature :
Name of Supervisor : DATIN SURAYA AHMAD
Date : 7 JUNE 2016



Signature :
Name of Panel Supervisor : DR ISMI RAJIANI
Tarikh : 7 JUNE 2016

THE CHALLENGES OF TECHNOLOGY ADOPTION IN OIL AND GAS
INDUSTRY:

THE CASE STUDY OF SOLAR ALERT SDN BHD

EIDIL HARZEQ BIN ZAINUDIN

This report is submitted in
fulfilment of the requirement for the
Bachelor of Technopreneurship

Faculty of Technology Management & Technopreneurship
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

JUNE 2016

VERIFICATION

“I admit that this report is the result of my own except summaries and citations that each of them has explained the source”

Signature :

Name : EIDIL HARZEQ BIN ZAINUDIN

Date : 7 JUNE 2016

DEDICATION

I would like to dedicate the appreciation to my family, lecturer and friends

ACKNOWLEDGMENT

I was deeply grateful and wish to express my sincere thanks to Datin Suraya Binti Ahmad for her guidance throughout this final year project. Her passion and patience to teach me to finished this research. Besides that, I would like to thanks to Dr. Ismi Rajiani for his beneficial comment, advice as well as guidance for a quality final year project.

I also want to express my thanks and appreciate all of those members who involved direct or indirectly towards this final year project. Last but not least, I also very want to appreciate to the respondent who spends their valuable time to answer the questionnaires especially to Solar Alert Sdn Bhd production team that willing to share knowledge about the current situation in oil and gas industry.

ABSTRACT

Technology is the backbone for large industrial on fulfilling the market demand. Technology adoptions also determine the level of innovation for a particular country which reflects with nation Gross Domestic Product (GDP). Every technology provider firm must cope and adopt with the technology revolutionary. This will ensure firm to sustain and growth in the competitive market. For a country like Malaysia which prioritise in oil and gas energy as the key economics area, all player in oil and gas industry must complement with advanced technology in order to achieve an international standard for this industry. The purpose of this study was to identify the challenge of technology adoption in oil and gas industry. It is not easy for firms to adopt new innovation or technology. Through depth study and identify the challenge of technology adoption, it can reduce the time require to adopt new technology. This study will focus on CNC technology at Solar Alert Sdn Bhd and investigate the main challenge such like the organisation factor, compatibility and technical capabilities. This research used a quantitative method which is survey / questionnaire to analyse the data from production line staff at Solar Alert Sdn Bhd (Oil and Gas Division). There were 59 questionnaires that have been distributed. According to the research finding, it has been identified that the compatibility of technology was the dominant challenge. It is concluded that the challenge such as organisation factor, compatibility and technical capabilities influenced the technology adoption in oil and gas industry. Eventually, this research would help all technology providers in oil and gas industry to produce a quality product through advanced technology.

ABSTRACT

Teknologi merupakan tulang belakang bagi industri-industri besar memenuhi keperluan pasaran. Penggunaan teknologi juga turut menentukan aras inovasi bagi sesebuah Negara dimana ia berkait dengan GDP Negara. Setiap pembekal teknologi haruslah mengikuti revolusi teknologi. Ini bagi memastikan kestabilan serta perkembangan sesebuah syarikat di dalam pasaran yang bersaing. Bagi Malaysia yang mengkhususkan sektor gas dan minyak sebagai kunci ekonomi. Oleh itu, semua pemain di dalam sektor gas dan minyak mestilah selaras dengan teknologi tercanggih bagi memenuhi standard antarabangsa di dalam industri ini. Tujuan utama kajian ini adalah untuk mengenalpasti cabaran dalam penggunaan teknologi bagi industry gas dan minyak. Ia bukanlah perkara mudah bagi firma mengguna pakai inovasi atau teknologi. Melalui kajian yang mendalam untuk mengenalpasti cabaran dalam penggunaan teknologi, ia membolehkan sesebuah firma mengguna teknologi dalam masa yang singkat. Kajian ini akan fokus terhadap teknologi CNC di Solar Alert Sdn Bhd and mengkaji cabaran utama seperti faktor organisasi, kesesuaian dan keupayaan teknikal. Kajian ini menggunakan kaedah kuantitatif iaitu kajian soal selidik untuk menganalisa data dari pekerja di Solar Alert Sdn Bhd (Oil and Gas Division). Sebanyak 59 soal kaji selidik telah di edar. Berdasarkan hasil kajian, ia telah mengenalpasti bahawa kesesuaian teknologi merupakan cabaran utama. Kesimpulannya, faktor organisasi, kesesuaian dan keupayaan teknikal mempengaruhi dalam penggunaan teknologi di dalam industri gas dan minyak. Akhir sekali, kajian ini dapat membantu semua pembekal teknologi di dalam industri gas dan minyak untuk menghasilkan produk yang berkualiti melalui penggunaan teknologi canggih.

TABLE OF CONTENT

CHAPTER	CONTENT	PAGE
	VERIFICATION	ii
	DEDICATION	iii
	ACKNOWLEDGEMENT	iv
	ABSTRACT	v
	ABSTRAK	vi
	TABLE OF CONTENT	vii
	LIST OF FIGURE	x
	LIST OF TABLES	xi
CHAPTER 1	INTRODUCTION	
	1.1 Background of study	1
	1.2 Problem statement	4
	1.3 Research question	5
	1.4 Research objective	5
	1.5 Scope of study	6
	1.6 Importance of research	6
	1.7 Summary	7
CHAPTER 2	LITERATURE REVIEW	
	2.1 Introduction	8
	2.2 Technology Adoption	9
	2.3 Individual Innovativeness Theory	10
	2.4 Technology Adoption Lifecycle	11
	2.5 Oil and natural gas	14

2.6	Advanced Manufacturing Technologies (AMT)	15
2.7	Production technologies	16
2.8	Diffusion of innovation theory	19
2.9	Compatibility	20
2.10	Organisation Factor	21
2.11	Capabilities	23
2.12	Theoretical Framework	25
2.13	Summary	27
CHAPTER 3	RESEARCH METHODOLOGY	
3.1	Introduction	28
3.2	Research Design	28
3.3	Methodological Choices of data collection	29
3.4	Primary and Secondary sources	30
	3.4.1 Questionnaire	31
	3.4.2 Using SPSS software	31
	3.4.3 Comparison by journal or article	31
3.5	Location of Research	32
3.6	Questionnaire Design	32
3.7	Research Strategy	33
	3.7.1 Survey	33
3.8	Sampling Design	35
3.9	Reliability and Validity Test	37
3.10	Correlation Analysis	38
3.11	Regression Analysis	38
3.12	Summary	39
CHAPTER 4	DATA ANALYSIS AND DISCUSSION	
4.1	Introduction	40

4.2	Demographic	41
4.2.1	Gender	41
4.2.2	Age	42
4.2.3	Type of technology	43
4.2.4	Position	44
4.2.5	Working Experience	45
4.2.6	Opinion	46
4.3	Descriptive Analysis	47
4.4	Reliability Analysis	48
4.5	Correlation Analysis	49
4.6	Simple Regression Analysis	50
4.6.1	Objective and Hypothesis 1	50
4.6.2	Objective and Hypothesis 2	52
4.6.3	Objective and Hypothesis 3	54
4.7	Summary	57
CHAPTER 5	CONCLUSION AND RECOMMENDATION	
5.1	Introduction	58
5.2	Discussion	58
5.2.1	Objective 1	59
5.2.2	Objective 2	60
5.2.3	Objective 3	61
5.3	Limitation of Study	62
5.4	Recommendation for future research	63
5.5	Conclusion	63
REFERENCE		64
APPENDICES		67

LIST OF FIGURES

NO	TITLE	PAGE
2.1	Categories of Adopters	10
2.2	Technology Adoption Lifecycle	12
2.3	Dynamic Interaction of Technology System	16
2.4	Input and Output manufacturing system	22
2.5	Theoretical Framework	25
4.1	Age	42
4.2	Type of technology	43
4.3	Position	44
4.4	Working Experience	45
4.5	Opinion toward technology adoption	46

LIST OF TABLE

NO	TITLE	PAGE
2.1	Categories of Adopters	10
2.2	Shows the strategic flexibility of production.	18
3.1	Likert Scale	34
3.2	Sample Size	36
3.3	Cronbach Coefficient Alpha	37
4.1	Gender	41
4.2	Age	42
4.3	Type of technology use	43
4.4	Position	44
4.5	Working Experience	45
4.6	Opinion on the technology adoption	46
4.7	Descriptive Analysis	47
4.8	Reliability Analysis	48
4.9	Correlation Analysis	49
4.10	Simple Regression for Hypothesis 1	51
4.11	Simple Regression for Hypothesis 2	52
4.12	Simple Regression for Hypothesis 3	54

CHAPTER 1

INTRODUCTION

1.1 Background Study

Technology is the purposeful application of information in the design production, and utilisation of goods and services, and in the organisation of human activities. According to Galbraith (1974), technology means the systematic application of scientific or other organised knowledge to a practical task. Basically, technology is use for problem solving. This includes a process which through an explicit or implicit phase of research and development allows for the commercial production of goods and services (Dussauge, Hart and Ramanantsoa 1992, 13). The better technology is used within the organisation, the better output that the organisation will receive. For competitive market such like manufacturing industry, technology plays an important role which includes a specific method, materials, and devices used to solve a practical problem in order to increase the production rate. 21st century global market trends force many industries to use high technology as well as innovation in order to meet demand internationally.

Innovation is the process of translating an idea or invention into a good or service that creates values or for which customers will pay. Innovation contributes in several ways. For example, research evidence suggests a strong correlation between market performance and new product (Christensen and Raynor, 2003; Foster and Kaplan, 2002).

Technology adoption means different things to different people. Viewing technology adoption as a consistent process is the key to enabling hesitant users to successfully adopt and use technology. As developing country, there is a force driving technological development which required the country to implement technology transfer. In order to successfully bringing the new technology, it needed to be adopted so it can be fully utilised in selected industry. Thus, accelerating technology adoption into system and routines generates manufacturing flexibility by upgrading the operational competitiveness from the existing level to the required level by giving a barrier to competitors (Kotha, 1995).

According to Department of Statistic Malaysia (Feb, 2015), industries in the manufacture of refined petroleum products contribute 23.3% in manufacturing industries. Compare with manufacturing of other natural products such as rubber, unvulcanised, vulcanised or hardened which contribute 32.9%. This proves that oil and gas industries are on the second higher demand in the manufacturing sector. In order to meet the demand, the concurrent development of industry and technology is the important factor that needs to take into consideration. The role of the future usage of oil and natural gas depends on the available resources, the production technologies, on the future demand, on the development of alternative energy sources and the existence of reliable energy supply routers (Doukas et al., 2011). However, oil and natural gas resources are limited and a technology shift reducing the dependency on these resources is necessary in order to enter into a more sustainable era (Flamos and Begg, 2010).

During SME MASTERPLAN (2012-2020), it emphasises on accelerating the performance of SMEs to the next level. The aim is to understand the force that drives SME performance. According to the World Bank Productivity and Investment Climate Analysis state that there are six factors which influence the performance of Malaysian SMEs. To achieve nation with highly competitive in the global market, growth of employment and productivity, the SME performance levers analysis found that adoption of innovation and technology was the most important factors. Because of that, The Malaysian Innovation Agency Act 2010 was enacted to enable SMEs to embrace the new phenomenon. Furthermore, the Special Innovation Unit (UNIK)

was established under the Prime Minister's Department to assist SMEs in innovating for their businesses. UNIK aims to introduce new technologies to SMEs. Already, UNIK has searched universities and research institutes and identified technologies suitable for adoption by SMEs. The complex growth markets will need SMEs to involve the inadequate adoption of technology (Preedeban, 2013). According to the chief executive officer of SME Corp, Datuk Hafsah Hashim, this has been a significant distraction for SME operations in Malaysia

"The utilisation of technology which is still relatively low poses another problem or serves as a constraint for entrepreneurs to move forward," she explained.

SME MASTERPLAN (2012-2020) also explained that SMEs have limited diffusion of technological innovation due to lack of participation in the national innovation system. Other than that, technology upgrading is also viewed as a cost rather than an investment resulting in poor technology adoption by SMEs. In addition, the access of unskilled labour has created a disincentive for SMEs to adopt new technologies and move into higher value-added activities. In RMK10, it highlighted that SME as the strong support for the large firm to be able to compete in the higher market.

This research is focused on production technology in Oil and Gas division at Solar Alert Sdn Bhd. The company are capable to producing a range of Wellhead equipment, Christmas trees and oilfield related equipment. The product already enters international market such as Turkmenistan, Bahrain, Sudan, Uzbekistan Vietnam and etc. To be more responsive to market needs and reduce costs which align with the concept of manufacturing flexibility, Advance Manufacturing Technology (AMT) was applied in the production line.

1.2 Problem Statement

Technology adoption is increasingly becoming an important issue for both small and large manufacturing firm due to the latest manufacturing trend. A case at Solar Alert Sdn Bhd the use of the computer numerical controller (CNC) machine in their oil and gas division is a basic requirement when firm decide to transform their traditional manufacturing plant to advance manufacturing technology (AMT). These changes are the force by demand condition where the consumer wants a variety of high-quality similar product. Using of technology such like CNC, CAD/CAM, ERP, RFID CRM and others that not mentioned before can help the firm to be more competitive. According to manufacturing global (Feb 5, 2015), the manufacturing trend 2015 is slightly transformed into Internet of Things (IoT) to align with smart industry concept which is greener. Internet of Things (IoT) will use complex software where it allows all devices to communicate with one another. Despite it provide benefit to the industry, but lack of ICT skill will slow down the process.

Drastically changes in technology also as the challenges for Solar Alert whereby every update on the CNC programme needs to be utilised by the production line. Organisation should also aware on every changing of technology or else they will fail in the competitive market. Some research needs to be done before decide to adopt it because it need to ensure that the changes will fit with the local infrastructure, as well as manufacturing facilities. Other than that, World Bank Knowledge Assessment Methodology Innovation Index (2009), state that Malaysia is on 5th ranking for the firm-level innovation in Asia. The rate of nation innovation is influenced by the level of technology adoption. For example, the adoption of internet technology leads to innovation in online business, mobile application and etc. As an intern at Solar Alert Sdn Bhd, some of the issues were identified during the training period. Successfully adopt new technology can achieve competitive advantage over competitor (Porter, 1980).

1.3 Research Question

This study is focuses on the barriers of technology adoption. There are several adoption process models in order to identify the process of how technology is adopted. Most people adopt a technology by first being aware of the existence of a technology and forming attitudes towards a technology, following by decision-making process whether to adopt or reject a technology. After the adoption decision is made, adopters will use a technology and eventually reach the final stage by confirming the adoption decision if a technology could function as expected (Rogers, 1995). There are barriers between the processes of technology adoption. This research was guided by the following question:

1. What is the organisation factor affecting technology adoption?
2. What is the compatibility of having the new technology for adoption?
3. What are the technical capabilities require for technology adoption?

1.4 Research Objective

The research was basically to study the relationship between the challenges and technology adoption that can increase production rate of Solar Alert Sdn Bhd. It has been highlighted into the three (3) main objectives:

1. To study the organisation factor toward technology adoption
2. To study the compatibility of new technology through technology adoption
3. To study the technical capabilities require for technology adoption

1.5 Scope of study

In this study, researcher focuses on Solar Alert Sdn Bhd Oil and Gas division. Through this, it can identify the type of technology uses in production line. It can also study the challenges faced by production line to adopt new technology in order to increase production rate so researcher can know the important of technology adoption. In Solar Alert production line, researcher will focus on ICT and production line technology such as CNC, CAD/CAM to identify the challenges of adopting new similar technology. By understanding the concept of technology adoption lifecycle can help researcher to know the challenges of technology adoption. Further discussion will be explained in Chapter 2 of the research.

1.6 Importance of Study

According to this study, adoption of new technology plays important role in creating nation economic prosperity. This is because manufacturing industry that involving high technology, technical capabilities, and innovation can lead to better production output as a result can increase the nation economically.

This research can become guidance for another researcher. Besides that, this research also can make to other manufacturer know why diffusion of technology can help the growth of their company. Through process of technology adoption, there is challenge that other manufacturer can identify and overcome it to successfully adopt the technology. In another hand, small industry can know the different perspective about the importance of technology in business.

Technology adoption acts as the key for developing country to sustain in the global market force. As for that, this research will provide further information about the actual time to obtain the technology based on demand changing as well as another driven factor that force company to do innovation and diffusion of innovation.

1.7 Summary

This chapter I was briefly explained about the research study. It explained about the aim of the study through specific question from identified problem as well as the issues involved. It was also included some of the basic information about Oil and Gas division in Solar Alert Sdn Bhd which included type of technology used, specialised skills, and dynamic interaction in Solar Alert Sdn Bhd.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The 21st century natural gas and oil industry are forced by innovation and technology. It has dramatically altered the manner in which oil and gas reserve are identified, developed and produced. Advancements in technology have also improved environmental protection and conservation of natural resources. Due to a rapid growth of manufacturing technology, most of the large manufacturing firm are shifting to Advance Manufacturing Technology (AMT) in order to compete in the global market. The technology will focus on the computer numerical controller (CNC) machine.

This research examines the challenge of technology adoption in Oil and Gas industry: The case study of Solar Alert Sdn Bhd. This study will seek the four challenges toward the adoption of CNC technology in oil and gas industry. The literature review will demonstrate the theory related to the adoption of new technology. There are four significances of challenges that carrying the important role which are compatibility, organisation factor, capabilities as well as a dominant factor. However, by knowing the challenges of technology adoption in oil and gas industry are importance to increase the national trade for oil and natural gas which give impact toward our nation GDP.

2.2 Technology adoption

Technology means the systematic application of scientific or other organised knowledge to practical tasks (Galbraith 1974, 31) where a process through an explicit or implicit phase of research and development allows for the commercial production of goods and services (Dussauge, Hart, Ramanantsoa, 1992).

Technology adoption is important because it is the vehicle that allows most people to participate in a rapidly changing world where technology has become central to our lives. The firm who won't or can't adopt will increasingly limit their ability to participate fully in the competitive market and convenience benefits associated with technology.

Understanding the factor influencing technology adoption helps researcher predict and manage who adopts, when, and under what conditions. For some people technology adoption is synonymous with computer and internet usage. But people adopt a wide range of technologies that are not obviously computer based.

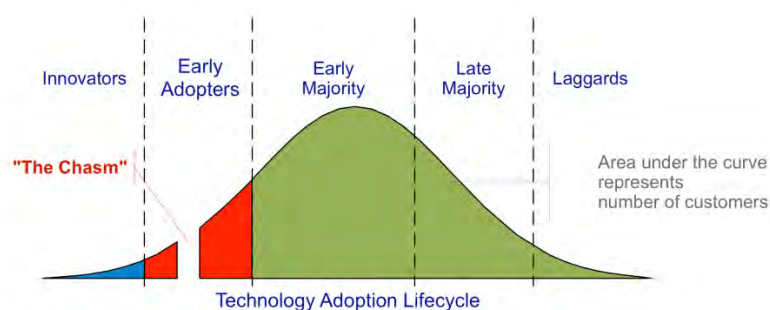
Technology users differ widely in their attitudes toward technology and in their skills, ranging from early adopters who will master even the most difficult technology through to people who will never adopt. Technology adoption comprises of two processes, acquisition and adaptation (Juhaini et al, 2014 :-

- Acquisition: The significance of technology as a source of competitive advantage has become so widely accepted. In addition, acquisition of external technologies is an essential mean by which established firms add to their technical capabilities and products enhance their market power and achieve strategic renewal. Lastly, the idea of acquisition will bring technology to the firm, organisation and nation in order to be adapted to the local environment.
- Adaptation: The process of transfer is not costless during operational stage because it requires the allocation of resources and it is a continuous process in the entire life cycle of the project orientation. For adaptation, there is several factor need to be seriously considered:

- Local preferences might be different
- Imported technology needs special adaptation mechanism to fit with local values.
- For developing country like Malaysia, it is more difficult to adapt fast moving high-end technology because it is too specialised and,
- To anticipate difficulties in transferring know-how when technical and organization-managerial change happens.

2.3 Individual Innovativeness Theory

The individual innovativeness theory is based on who and when to adopt the innovation. A bell-shaped curve as shown in figure 2.1 and table 2.1 below is to illustrate the percentage of an individual who adopts an innovation. According to Rogers (1995), there are five categories of adopters



Figures 2.1: Shows the categories of adopters

Table 2.1: Categories of Adopters

Categories	Innovators	Early Adopters	Early Majority	Late Majority	Laggards
Number of Adopters	2.5%	13.5%	34%	34%	16%

(Source: Brychan, T. (2003), A Model of Diffusion of Technology)

Categories of adopters:

1. Innovators. These are the risk-takers and pioneers who lead the way. They are able to adopt despite a high degree of uncertainty about the innovation at the time of adoption and are willing to accept an occasional setback when a new idea proves unsuccessful.
2. Early adopters. They climb aboard the train early and help spread the word about the innovation to others.
3. Early majority. They are persuaded to adopt by the innovators and early adopters, and may deliberate for some time before completely adopting the new idea. Their innovation-decision period is relatively longer than that of the innovators and early adopters.
4. Late majority. They approach innovation cautiously and wait to make sure that adoption is in their best interests. As a result, they do not adopt until most others have done so.
5. The laggards. These are the individuals who are highly sceptical and resist adopting until absolutely necessary.

2.4 Technology Adoption Lifecycle

According to MaRS library (2009), the technology adoption life cycle (TALC) describes how a market develops for a new product category. By understanding TALC helps business managers focus product management, develop future marketing strategies and allocate resources to a thoroughly innovative product.

The figure below shows the bell curve has long served as an illustration of the market development process for the new product category, Geoffrey Moore introduced the notion of a “chasm” in the market development process for thoroughly innovative products in his 1991 book, *Crossing the chasm*. Given MaRS focus on assisting technology entrepreneurs, the researcher will use Moore’s version of the TALC. Figure 2.2 below shows the technology adoption lifecycle.