

THE APPLICATION OF NANOTECHNOLOGY IN THE SEMICONDUCTOR
INDUSTRY: THE CASE OF ADVANCED MICRO DEVICES (AMD) GLOBAL
SERVICES SDN. BHD.

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DECLARATION

“I declare that this thesis is my own work except the citation and excerpts of each of which I have mentioned in the references.”

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DEDICATION

This Final Year Project is dedicated to my parents for their loves, endless support, encouragement, attention and prayers.

ACKNOWLEDGEMENT

All praise are due to Allah S.W.T who had given blessing, strength, and knowledge in finishing this research entitled „the application of nanotechnology in the semiconductor industry: the case of Advanced Micro Devices (AMD) Global Services Sdn. Bhd.“ Slawat and salam also propose to the Prophet Muhamad SAW, the Uswatun Hasanah for all Moslems.

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ABSTRACT

Nanotechnology offers considerable promise extending from business opportunities throughout various industries to broader socio-economic benefits, especially in the context of pressing global challenges such as those related to energy, health care, clean water and climate change. This research is conducted to examine the application of nanotechnology in semiconductor industry at Advanced Micro Devices Global Services (AMD) Sdn. Bhd. The objectives of this research are to determine the factors that influence the semiconductor industry in the application of nanotechnology, to examine the impacts of nanotechnology application on the productivity of semiconductor industry, and to determine the most influencing factor that impact the productivity of the semiconductor industry through the application of nanotechnology. The research employed sample which comprises 200 questionnaires including the top management and the employees in AMD. The data collection will be analysed using IBM Statistical Product and Service Solution (SPSS) software. Throughout this research, the semiconductor industry will able to be more proactively engaged with biotechnology industry and must be at the forefront of adopting this emerging technology.

ABSTRAK

Nanoteknologi menawarkan peluang yang besar dalam peluang perniagaan menerusi pelbagai industri dalam aspek meluaskan kepentingan sosio-ekonomi, khususnya dalam konteks cabaran global seperti yang berkaitan dengan tenaga, penjagaan kesihatan, air bersih dan perubahan iklim. Kajian ini dijalankan untuk mengkaji aplikasi nanoteknologi dalam industri semikonduktor di Advanced Micro Devices Perkhidmatan Global (AMD) Sdn. Bhd. Objektif kajian ini adalah untuk menentukan faktor-faktor yang mempengaruhi industri semikonduktor dalam aplikasi teknologi nano, untuk mengkaji kesan aplikasi teknologi nano kepada produktiviti industri semikonduktor dan untuk menentukan faktor yang paling mempengaruhi yang memberi kesan kepada produktiviti industri semikonduktor melalui aplikasi teknologi nano. Kajian sampel yang diambil kerja yang terdiri daripada 200 soal selidik termasuk pengurusan atasan dan pekerja di AMD. Pengumpulan data akan dianalisis dengan menggunakan IBM Pakej Statistik untuk Servis Sosial (SPSS) perisian. Sepanjang kajian ini, industri semikonduktor akan mampu untuk terlibat dengan lebih proaktif dengan industri bioteknologi dan mesti berada di barisan hadapan dalam penggunaan teknologi baru yang terkini.

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CHAPTER 1

INTRODUCTION

1.1 Research Background

Advance technology or new innovation has always been facing awareness and acceptance challenges especially from society of developing countries including Malaysia. Furthermore, advance technology is considered as a new technology and it is very crucial to the developing countries as it believe to be able to solve organizational problem and able to increase economic growth (Nash, J., 2012). One of the sophisticated technologies that has been discussed is the nanotechnology. Nanotechnology is defined as "the science of materials and systems with structures and components that display a better novel physical, chemical and biological phenomenon that exist in the size of the nano-scale (1-100 nm)", one nanometer (nm) is one thousand million meters for. In comparison, a single human hair is about 80,000 nm wide (Tegart. G, 2002). People are interested in this nano because the properties of materials can be very different from those at a larger scale (NNI Report, May 2008).

Correspondingly, nanotechnology has become a new industrial revolution and many developed countries like the United States, European Union, Japan, Taiwan and South Korea have made significant investments in technology to maintain their market competitiveness (Uda Hashim & Elly Nadia, et al, 2008). Although this is new field of science and technology but it gives a huge potential benefits in industry. Components parts can be measured in a billionth of a metre and this means that nanotechnology is categorized as small science with huge and great potential since it can exploit benefits of ultra-small size allows the use of particles to deliver a range of profound and important benefits (Hassan and Mohamed, 2005).

Recently, nanotechnology has caused a stir around the world because its potential benefits and many countries taken a full attention over the development of nanotechnology including Malaysia. Malaysia launched its nanotechnology initiatives in 2010 which include R&D and education as well as socio-economic nanotechnology plans (Uda Hashim, Elly Nadia, et al, 2009). Malaysia has its own policy on nanotechnology and initiatives as well as a strategic plan for managing the technology, as extensively stressed by the Ministry of Science, Technology and Innovation (MOSTI) has come out with five areas of focus in adopting nanotechnology, namely agriculture, energy, food and environment, manufacturing, as well as electrical and electronics sector (The Straits Times, 10 August 2015).

Furthermore, the exports of electrical and electronic in Malaysia (E & E) are expected to increase by 20-30% in 2020 with nano technology and the rise of the Internet of Things (IOT). Science, Technology and Deputy Innovation Secretary General Dr Zulkifli Mohamed Hashim said: "In 2014, total exports of E & E are RM256 billion, driven by strong global demand for semiconductor applications and the rapid emergence of IOT" (Sun daily, 31July 2015). According to the Development Agency for ICT, Micro and Nano electronics (MIMOS) Chief Executive Officer Datuk Abdul Wahab Abdullah said: "As the national announce a research centre for micro and nano electronics, we have played a major role in the development of the E&E sector. According to Business Circle on August 2015 states

that the Nano Semiconductor Technology Centre nanotechnology will serve as a key enabler and as a catalyst to thrust nanotechnology as a new growth engine.

However, major agencies are also needed to guide the direction of nanotechnology management in order to sustain the technology. The adoption of nanotechnology in manufacturing activities is still in its infancy in Malaysia and this technology offers a huge potential economic gain if exploited strategically. Another reason is Malaysia aspires to become a developed nation by 2020 and many of the strategies should be included to implement nanotechnology in many areas in Malaysia including in manufacturing activities. Moreover, economic growth is being driven increasingly by the application of advance technologies (Austin, R. H., & Lim, S., 2008). The beginning of the 21st century already addressed as the nanotechnology growth and Malaysia should ahead in implementing nanotechnology in many industries.

1.2 Problem Statement

Malaysian government has taken a serious concern about the development of nanotechnology recently. In the Third Industrial Master Plan (IMP3) for 15-year period (2005-2020) is reported to recognize nanotechnology as the new emerging field in industries especially in semiconductor industry (Lim. S, 2008). According to Bloomberg TV Malaysia (23 October 2015) states that Malaysia's National Budget 2016 unveiled the allocation of RM1.5 billion to be provided under Ministry of Science, Technology and Innovation (MOSTI) for R&D and the focus will be on biotechnology, nanotechnology, advanced manufacturing, and advanced materials.

However, according to National Symposium on Science and Technology on 2010 states that the current development of nanotechnology in Malaysia is still facing of some shortfalls such as nanotechnology is still new to the Malaysia's expertise, no conclusive plan to develop nanotechnology in industries, no clear road map on nanotechnology R & D will be going on and lack of efforts to promote awareness in nanotechnology. Against the targeted forecasts, Malaysia's exports of electrical and electronics (E&E) products will not increase by 20-30% if this problem persist. There must be strategies to implement nanotechnology in electric and electronic industries in order to achieve this target.

Furthermore, Rae.L (2006) states that there are several problems of nanotechnologies in semiconductor industry, including the challenge to device designers to put more features into the same or smaller devices without significantly increasing cost, consumer products are becoming more feature rich, with consumers unwilling to pay much more for these features. In addition, it is also extremely complex to investigate up to the device for failure analysis and other tests. This will require new test equipment, probers, and new nanoscale measurement standards.

1.3 Research Questions

The researcher questions in this research are

1. What are the factors that influence nanotechnology application in the semiconductor industry?
2. What are the impacts of nanotechnology application on the productivity of the semiconductor industry?
3. What are the most influencing factor that impact the productivity of the semiconductor industry through the application of nanotechnology?

1.4 Research Objectives

The objectives in this research are

1. To determine the factors that influence the semiconductor industry in the application of nanotechnology.
2. To examine the impacts of nanotechnology application on the productivity of semiconductor industry.
3. To determine the most influencing factor that impact the productivity of the semiconductor industry through the application of nanotechnology.

1.5 Scope

This research only focuses on the applications of nanotechnologies in Advanced Micro Devices Global Services (AMD) Sdn. Bhd. an electronics firm located in Bayan Lepas, Penang. The respondents consist of the departmental managers, technical staff, process engineers, quality engineers, production staff (manufacturing associates in Advanced Micro Devices Global Services Sdn Bhd. The researcher will distribute the questionnaire to 200 respondents approximately. The questionnaire will help the researcher to obtain more information and accurate data.

1.6 Significance of the Study

The potential benefits of nanotechnology in several fields of manufacturing, nanoelectronics, computer technology, medicine, aeronautics, space exploration, environment, energy, biotechnology, agriculture, national security, science and education has encouraged the government to increase the funding to MOSTI for nanotechnology R&D that enabling the growth of a significant number of research centers pursuing nanoscience and technology (Elley Nadia, 2009).

Starting from the encouragement given by the government, the electronics industry has introduced a new generation of technology, which has taken a decade to develop. This new generation will need be compatible with a number of devices and applications including optical, sensors, and biological in semiconductor industry (Rae. A, 2004). Apart from this, nanotechnology is taking place in manufacturing processes to decreasing dimensions and lowering the cost of production. Throughout this research, semiconductor industry especially will be ahead in applying the nanotechnology.

Besides, this new industrial innovation especially nanotechnology needs early integration of science, technology and manufacturing to achieve world class product and services. In specific, nanotechnology is about people and it is about making sure we educate, integrate ideas, technology and knowledge to produce better products which enhances our environment and standard of living. Therefore, it is very crucial for young people and the broader community recognise nanotechnology as crucial innovation to develop a successful economic in the future (Uda Hashim, Elley Nadia, et al, 2009).

1.7 Summary

In this chapter, the researcher has emphasized the introduction and background of the research study clearly. Then, the research problem has been identified. The research question and research objectives are being developed to complete the whole research study. With new breakthrough discoveries in nanotechnology and the rise of IoT, Malaysian can raise the E&E sector by 20-30 percent by 2020. Nanotechnology as an emerging technology has been identified as a technological solution for upgrading and value adding relevant manufacturing activities in Malaysia.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter reviews all the theories and literature which focuses on the key items that are used in this research.

2.2 Semiconductor Industry

The electrical & electronics (E&E) industry is the leading sector in Malaysia's manufacturing sector and it can be categorized into four different subsector which are consumer electronic, electronic compound, industrial electronic and electrical (Raduan C. R, Beh L. S., et al, 2006). These four subsectors are focusing on deepening and strengthening the ecosystems of semiconductors, solar and LED technologies. In achieving target to rise the E&E exportation by 20 to 30 percent in

2020, Malaysia has discover the potential of implementing nanotechnologies in manufacturing industries including AMD industry.

2.3 Regulation Responses

Policy and regulation of industry development of nanotechnology is the need to be supported by an act that provides various bodies and entities the necessary powers to carry out its tasks effectively while developing and sustaining nanotechnology as a competitive and vibrant industry. This may include provisions for the use of public funds in undertaking research and development in nanotechnology. Industrial standards for nanotechnology will ensure it is employed with regards to the definition, terminology, measurement, processes and administration of a national nanotechnology complex. These standards must be based on internationally recognized protocols and definitions.

2.3.1 Malaysian Regulatory Framework

According to Asia Nano Forum Nanotech (2013), based on global regulatory trends in nanotechnology industry, there will be three pillars for the development of a comprehensive regulatory and safety framework for Malaysia as shown in Figure 2.1 below.

According to Minister of Science, Technology and Innovation (2013), the regulatory and safety enforcement structure, as depicted in Figure 2.1 will be a crucial part of the national nanotechnology policy. Nanotechnology regulatory and safety issues are pivotal to the development of the sector. According to Asia Nano