FACTORS AFFECTING THE SUCCESS OF NANOTECHNOLOGY PRODUCT COMMERCIALISATION IN MALAYSIA

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ABSTRACT

Issues on research, innovation and commercialisation of nanotechnology have since become hot as some began disputing and debating the level of research and innovation on nanotechnology in Malaysia. In Malaysia, although small, nanotechnology based products have begun entering the market. Also, the number of companies commercialising this product is restricted. While studies on the success of nanotechnology commercialisation are being constantly discussed abroad, in Malaysia investigations on the subject are practically small. With this in mind, this study has identified factors closely related to the success of nanotechnology product commercialisation. Among the factors are capital investment, customer focus, management team, business strategy, product quality and company infrastructure. The sample for this study composed 93, consisting of companies currently commercialising nanotechnology. Questionnaires and mail were used in the survey process. The hypotheses were tested using correlation and regression analysis. The findings from the correlation reveal that capital investment, customer focus, management team, business strategy, product quality and company infrastructure have significant relationship with the success of nanotechnology commercialisation while regression analysis indicate that the combination of these factors contribute to the success of nanotechnology product commercialisation. However, only capital investment and business strategy showed any real significance on the success of nanotechnology commercialisation. Subsequently, a regression analysis was carried out, to order the importance of these factors. The results revealed that capital investment as being the most important factor, in this study, with β coefficient of 0.321 followed by business strategy with β coefficient of 0.316. The β coefficients for the other factors (company infrastructure, management team, customer focus and product quality) were small and not that significant.

Keywords: nanotechnology, commercialisation success, profit

ABSTRAK

Isu tentang penyelidikan, inovasi dan pengkomersialan nanoteknologi imenjadi isu hangat apabila terdapat segelintir pihak yang mempersoalkan tahap penyelidikan dan inovasi nanoteknologi di Malaysia. Di Malaysia, produk berasaskan nanoteknologi telah memasuki pasaran walaupun jumlahnya agak kecil. Selain itu, bilangan organisasi yang mengkomersialkan produk ini adalah terbatas. Meskipun kajian tentang faktor kejayaan pengkomersialan produk nanoteknologi telah banyak dibincangkan di luar negara, namun kajian ini masih kurang dijalankan di Negara ini. Bertitik tolak daripada hal ini, kajian ini mengenalpasti faktor-faktor yang mempunyai hubungkait dengan kejayaan pengkomersialan produk nanoteknologi. Antara faktor yang diteliti ialah faktor pelaburan modal, tumpuan pelanggan, pasukan pengurusan, strategi perniagaan, kualiti produk, dan infrastruktur syarikat. Sampel kajian meliputi sejumlah 93 syarikat yang mengkomersial kan nanoteknologi pada masa ini. Soalselidik dan surat-menyurat digunakan dalam tinjauan ini. Hipotesis kajian telah diuji dengan analisis korelasi dan regresi. Dapatan kajian daripada korelasi memperlihatkan bahawa pelaburan modal, tumpuan pelanggan, pasukan pengurusan, strategi perniagaan, kualiti produk dan infrastruktur syarikat mempunyai hubungkait yang signifikan dengan kejayaan pengkomersialan nanoteknologi. Analisis regresi pula memaparkan bahawa gabungan faktor-faktor ini membuahkan kejayaan pengkomersialkan produk nanoteknologi. Walaubagaimanapun, hanya pelaburan modal dan strategi perniagaan yang memberikesan yang benar-benar signifikan terhadap kejayaan pengkomersialan nanoteknologi. Seterusnya, analisis regresi dijalankan bagi menyusunatur faktor-faktor tersebut mengikut kepentingan. Hasil kajian mendapati bahawa modal pelaburan merupakan faktor terpenting dalam kajian ini dengan nilai pekali β sebanyak 0.321 diikuti oleh perancangan perniagaan dengan nilai pekali β sebanyak 0.316. Nilai β bagi faktor-faktor yang lain (infrastruktur syarikat, pasukan pengurusan, tumpuan pelanggan dan kualiti produk) adalah kecil dan tidak begitu signifikan.

Kata Kunci: nanoteknologi, kejayaan pengkomersialan, keuntungan

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TABLE OF CONTENT

LIST OF TABLES

Table		Page

LIST OF FIGURES

LIST OF ABBREVIATIONS

ANF	Asia Nanotechnology Forum
NNI	National Nanotechnology Initiative
R&D	Research and development
MOSTI	Ministry of Science Technology and Innovation
TPM	Technology Park Malaysia
NCER	Northern Corridor Economic Region
MIGHT	Malaysia Industry Government Group for Higher Technology
MTDC	Malaysian Technology Development Corporation
MASTIC	Malaysia Science and Technology Information Centre
SR	Strategic Research
IRPA	Intensification of Research and Development in Priorities Area
IGS	Industry Research and Development Grant Scheme
TAF	Technology Acquisition Fund
DSM	Development of Standard Malaysia
DAGS	Demonstration Application Grant Scheme
CRDF	Commercialisation of Research and Development Fund

CHAPTER ONE

INTRODUCTION

1.1 Introduction

This chapter describes a brief research background that discusses the commercialisation issues in Malaysian context. It helps readers to capture the idea and inspiration for current research regarding nanotechnology commercialisation in Malaysia industry. Additionally, chapter one covers the problem statement, research questions, research objectives, and significance of the study along with the justification in the scope of study. Organisation of the thesis is provided at the end of the chapter.

1.2 Background of Study

Nanotechnology has been identified as a new source of economic growth. It is forecasted that nanotechnology sector will grow in an exponential rate for the next ten years. An increasing number of countries that drive nanotechnology initiatives have increased commercially viable nanotechnology-based products in the market. Table 1.1 shows the government funds for nanotechnology development.

Table 1.1

Funds Injected by Government for Nanotechnology Development

NO.	COUNTRY	AMOUNT
1	Japan	US$ 2.8 billion (2006-2010)
2	Taiwan prov. of China	US$ 689 million (2009-2014)
3	Republic of Korea	US$ 259 million (2009)
4	China	US$ 62.5 million (2009)
5	Singapore	US$ 80 million (2009)
6	India	US$ 200 million (2009-2014)
7	Russia	US$ 5 billion (2008-2011)
8	Thailand	US$ 60 million (5 year plan)
9	Australia	US$ 100 million (5 year plan)
10	Islamic Republic Iran	US$ 60 million (2008)
11	Vietnam	US$ 100 million (5 year plan)
12	New Zealand	US$ 13.8 million (2009)
13	**Malaysia**	**US$ 35.26 million (2006-2010)**

Source: ANF Summit Report (2009) cited in APCTT Report (2010)

APCTT Report (2010) estimated that the market for nanotechnology products will increase to US$2,600 billion by 2014, compared with US$6 billion in 2007 and US$500 million in 1999, and in consequence about 10 million new jobs will be created in areas related to nanotechnology. It is predicted that the global market for nanotechnology by 2011 will be US$25 billion with a growth rate of 19.1 per cent per year. By 2015, the global market for nanotechnology-based products will be in the region of US$1 trillion (Cientifica, 2003). Figure 1.1 indicates the global sales of products incorporating nanotechnology.

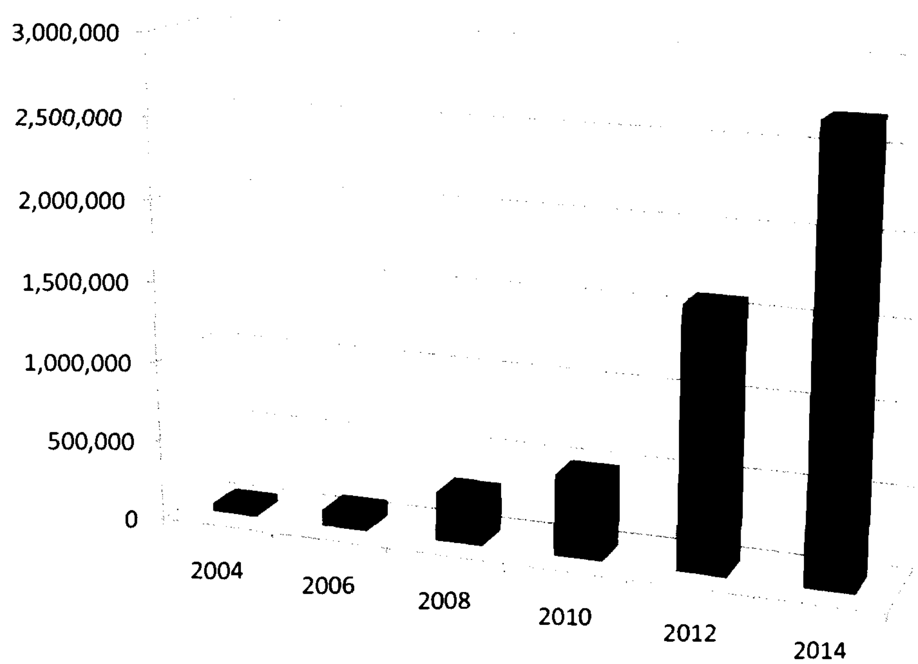

Figure 1.1
Global sales of products incorporating nanotechnology (in US$). Source: ANF Summit Report (2009) cited in APCTT Report (2010)

Nanotechnology is still considered new in Malaysia although it has been introduced early in 1990s. Nanotechnology has first recognition in Malaysia when it was introduced in the Intensification of Priority Research Area (IRPA) program of the 8th Malaysia Plan. Currently, there are 300 researchers in nanotechnology field (Halim, 2010 as cited in APCTT Report, 2010 pg: 95). During its early appearance in a national symposium, the nanoscience communities in Malaysia recommended the government to allocate bigger funding and coordinate national research and development (R&D) activities.

So far, there are nine total projects that have been tasked by the Performance Management and Delivery Unit (Pemandu) in the Prime Minister's Department to the Northern Corridor Implementation Authority (NCIA) to oversee and coordinate. Despite of this, a total of RM158.6 million has been earmarked for the projects over

2011 and 2012. Over and above the enabler projects, the NCIA is also partnering with Pemandu to attract private investors in the Northern Corridor Economic Region (NCER), which encompasses the four states of Perlis, Kedah, Penang and Perak (Emmanuel, 2011). Figure 1.2 shows an estimated public and private funding for nanotechnology in 2005 by world region.

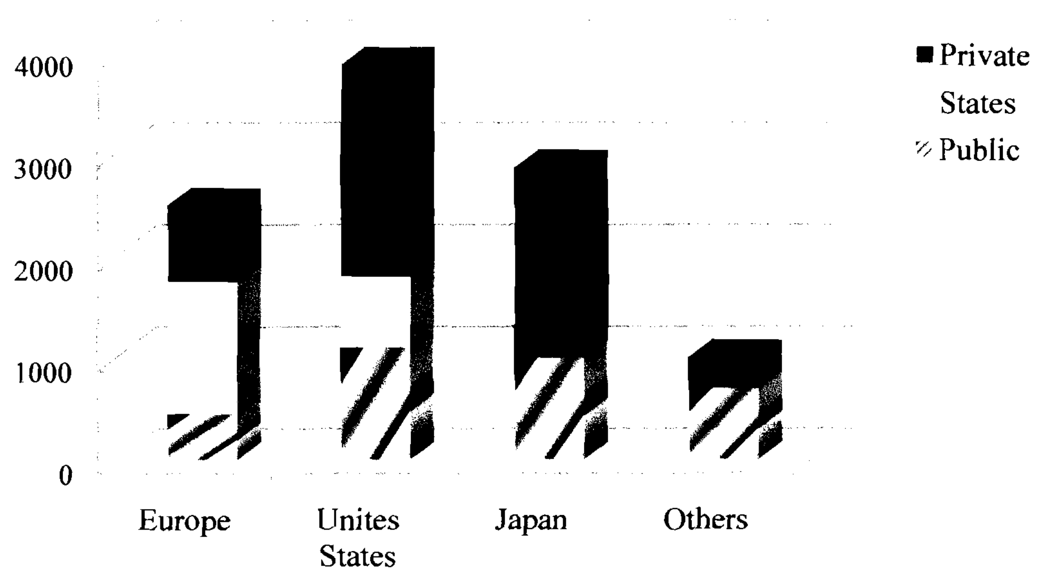

Figure 1.2
Estimated public and private funding for nanotechnology in 2005 by world regions in million \$. Source: update figures from Hullman (2006)

Refering to Figure 1.2, there is only one third of the total funding stem from private sources in Europe, while in the United States, the private sources are around 54% and in Japan they account for almost two thirds. For all other, mainly emerging Asian countries (including Malaysia), the share is around 36%. In absolute number, the United States research community spends more than 3.5 billion dollar for nanotechnology, while this is 2.7 billion in Japan and less than 2.5 billion Europe. This shows the difference between Asian countries and its competitors in nanotechnological research. It is noted that the public and private funding level is competitive, but Asian industry is lagging behind.

It is unfortunate that many nanotechnology researches were conducted by separate research groups without central coordination and planning but Malaysia is fortunate to be part of the Asia Nanotechnology Forum. Japan started the national nanoscience and technology programs since the mid 1980s and many ASEAN countries like Malaysia, Thailand, Singapore, and Vietnam have already embarked on nanotechnology since the early millennium. In 2003, Asia contributed over US$1.5 billion in nanotechnology program and it is continuously raising its role in the global nanotech arena (Uda, 2009).

According to Azaruddin (2011), the purchaser of a manufactured product in Malaysia today is paying for its design, raw materials, capital, transportation, storage and sales. Additional money, usually a fairly low percentage, goes to the owners of these businesses and if personal nanofactories can produce a wide variety of products when and where they are wanted, most of the other services (such as transportation and infrastructure) will become unnecessary.

Ramanathan as cited in APCTT (2010) mentioned that several developing countries from Asia-Pacific are now trying to take advantage and opportunity of the information and communication technology (ICT) that they missed before. However, the main issues were the lack of technology advanced in terms of nanoscience and nanotechnology. As a result, the issue that needs investigation is the way towards achieving success with this technology.

The issue of research, innovations and commercialisation has become hot debate when certain parties dispute the level of research and innovation in Malaysia. In Malaysia, nanotechnology based products have entered the market although at small quantities. The government does realise that there are a lot of research findings from institutions of higher learning resulting in products that are able to be commercialised but they are too slow to be in the market. Meanwhile, there are less numbers of organisations that are involved in commercialising nanotechnology products in Malaysia. Among the Malaysian universities, Universiti Teknologi Malaysia (UTM) has had the highest commercialisation output as presented in Table 1.2.

Table 1.2
Malaysian University Research Commercialisation until August 2008

Universities	**Total Commercialised Products**	**Total R&D with Potential for Commercialised Products**
Universiti Malaya (UM)	3	31
Universiti Sains Malaysia (USM)	15	9
Universiti Kebangsaan Malaysia (UKM)	0	33
Universiti Putra Malaysia (UPM)	16	15
Universiti Teknologi Malaysia (UTM)	6	110
Universiti Islam Antarabangsa Malaysia (UIAM)	2	4
Universiti Teknologi Mara (UiTM)	8	0
Universiti Utara Malaysia (UUM)	0	21
Universiti Pendidikan Sultan Idris (UPSI)	0	8
Universiti Malaysia Sarawak (UNIMAS)	0	4
Universiti Malaysia Sabah (UMS)	0	26
Universiti Tun Hussein Onn Malaysia (UTHM)	3	16
Universiti Malaysia Terengganu (UMT)	2	4
Universiti Teknikal Malaysia Melaka (UTEM)	0	0
Universiti Malaysia Pahang (UMP)	1	29
Universiti Malaysia Perlis (UniMAP)	2	3
Total	**58**	**313**

Source: Adopted from (Kamarulzaman, Hezlin and Mariati, 2011)

Based on these issues, this study reviews on factors influencing the success in commercialisation of nanotechnology based products. A set of questionnaire was developed and used to conduct a survey among companies that invest in nanotechnology. The analysis on the answers of the questionnaire is expected to provide some directions and guidelines for successful commercialisation of nanotechnology products in Malaysia.

1.3 Problem Statements

This research is conducted in the context of the Malaysian nanotechnology sector which has been receiving a great deal of attention from the government. Based on literature precedence and strategic approach, this study develops and presents an integrative framework for better understanding on how the strategic factors in combination influence the nanotechnology commercialisation success as measured by profitability and overall success in the Malaysian context. In consequence, this research seeks to examine which factors are prevailing and in what order of importance in their combined contribution towards commercialisation success.

Malaysia's efforts on nanotechnology development have been dreadfully slow and hampered by a number of barriers. The nanotechnology sector in Malaysia is still in its infancy and occupies a market share of less than 0.5 percent of the total nanotechnology revenue in the global nanotechnology sales. Figure 1.3 shows the number of nanotechnology products, according to region.

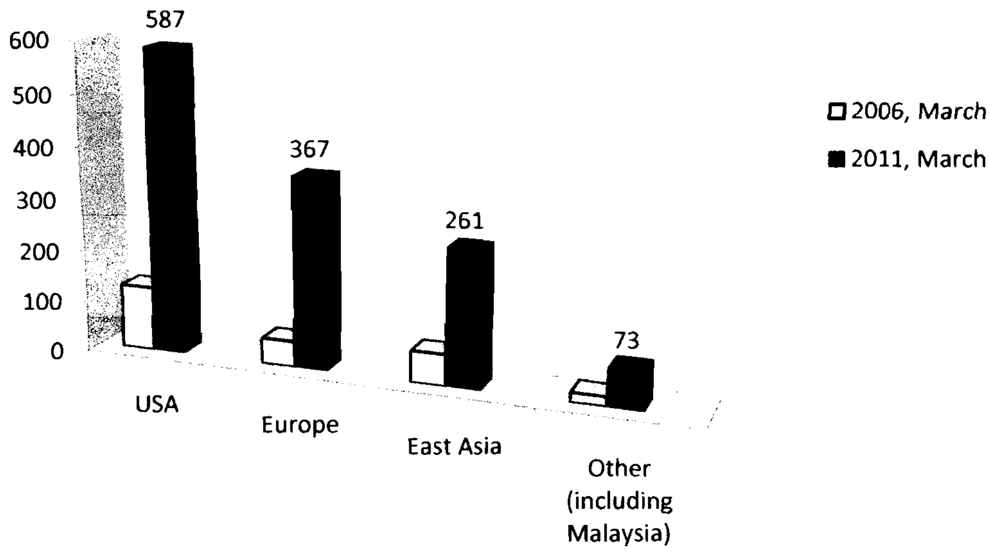

Figure 1.3
Numbers of Nanotechnology Products, According to Region
Source*: http://www.nanotechproject.org/inventories/consumer/analysis_draft/*

The inventory in the report includes products from 30 different countries. Figure 1.3 illustrates the breakdown of products by region and indicates that companies based in the United States have the most products with a total of 587, followed by companies in Europe (UK, France, Germany, Finland, Switzerland, Italy, Sweden, Denmark and Netherlands) with a total of 367. While East Asia (including China, Taiwan, Korea, Japan) in the third place with a total of 261, and elsewhere around the world including Australia, Canada, Mexico, Israel, New Zealand, **Malaysia**, Thailand, Singapore and Philippines with a total of 73 products.

Perhaps nanotechnology is considered new in Malaysia and the absence of nanotechnology products are still less being customer focus among Malaysian. This problem is caused by the lack of efforts to promote awareness in nanotechnology (National Symposium on Science and Technology, 2004). Besides, Rautaray (2010), Oriaki (2004), and Abbey (1989) argue that to achieve success in business, they need marketing information; such as target customer and identifying specific customer need to guide them produce products that fulfil unmet market field.

Hardin (2010) found that the primary barrier to the development of nanotechnology product is lack of access to early-stage capital where a large amount of money is needed to invest in nanotechnology area. According to Crawley (2007), the low level of venture capital is largely due to a shortage of suitable investment targets. In term of investment amounts in nanotechnology, the USA leads other countries by investing US$3.7 billion, followed by Japan with US$750 million and European Union with US$1.2 billion in investment (source: MIGHT Report, 2006 as cited in Hashim et al. 2009).

Commercialisation of new technology can be challenging. Having a large amount of capital and a great market opportunity is not enough (Oriaki, 2004). A strong project management and technical people are needed to transform this opportunity to business. But, the question of how the leader will guide the team into direction has become a debate. Hashim et al. (2009) suggest that nanotechnology projects need for short-term and long-term human resource planning, while Shapira and Wang (2008) reiterate that some customers have difficulty in understanding the benefit of nanotechnology and inconsequence, this problem lead the marketers to give double efforts in promoting nanotechnology product. Mustaffar (2007) proposed to have an integrated business functions or units in order to gain big rewards from nanotechnology investment.

Many analysts having studied the apparent success of Japanese firms have hypothesized that a key strategic ingredient was product quality (Ouchi, 1981). Similarly, several observers have suggested that it is also a fundamental element of success for United States companies (Garvin, 1984). Despite this apparent importance, relatively little empirical work has been undertaken to quantify the impact of product quality on profitability.

Based on the above discussion, it is apparent that there is a need for empirical research that highlights factors influencing the success of nanotechnology product commercialisation in Malaysia industry. Realising that commercialising nanotechnology product in Malaysia is less discussed among researchers; this study tends to fulfil this gap. At the end of this research, it is hoped that study on factors contributing to the success of nanotechnology commercialisation will be revealed.

1.4 Research Questions

From the problem statement, this study seeks to answer the following main questions:

- What are the success factors of nanotechnology commercialisation in Malaysia?
- What is the relationship between these factors with the success of nanotechnology commercialisation in Malaysia?
- In what order of importance do these factors affect the success of nanotechnology commercialisation in Malaysia?

1.5 Research Objectives

The objectives in this research are as follows:

- To identify the success factors of nanotechnology commercialisation in Malaysia.
- To indicate the relationship between these identified factors with the success of nanotechnology commercialisation.
- To ascertain the order of importance in the success of nanotechnology commercialisation in Malaysia industry.

1.6 Scope of Study

This study is concerned with identifying factors that contribute to the success of nanotechnology commercialisation in Malaysia industry and analyzing the relationship between these organisation factors with the success in commercialising nanotechnology base-product. These factors have been identified separately by organisation's practices abroad but similar attempts are less done in Malaysia industry. Thus, this study will identify these recognized factors whether they had influence on nanotechnology business success in Malaysia.

Note that the process of commercialising nanotechnology includes a few stages, such as gaining ideas, research and development (R&D), manufacturing, and marketing. However, the scope of this study is limited to the end of the commercialisation process which is not involved the all stages of the commercialisation process.

The scope is limited to organisations that invest in nanotechnology around Malaysia which are registered from various websites such as alibaba.com, 701panduan.com, nanowerk and streetdirectory.com. These companies were chosen due to their contribution to nanotechnology business. The sample was selected randomly among 412 nanotechnology companies around the Peninsular of Malaysia that are listed from the websites. It is conducted from the years 2010 until 2012 time period.

1.7 Significance of the Study

There is no doubt about the fundamental role of technology in our socio-economic development. The important of Nanotechnology business to the Malaysian economy has less been accepted as one of the most important driving forces for economic development and social advancement. Nonetheless business in nanotechnology area has often been described as the engine of growth and account for Malaysia. Therefore, it is important to understand and assess the possible practice that would contribute to the success of nanotechnology product commercialisation in Malaysia industry.

This study is significant for a number of reasons. First, this study helps to identify the various interacting variables that contribute to the success of nanotechnology commercialisation in the Malaysian context. By understanding these relationships and new methods, strategies could be developed to improve the success in commercialising nanotechnology base product, which will directly help companies become more competitive in today's dynamic nanotechnology market.

Secondly, this study will assist the company's owner-managers which invest in nanotechnology area in understanding the problems faced by their company in their attempt to compete and survive in this competitive business environment. On the other hand, this study helps the company in clarifying the factors that can be practised in order to success in commercialising their nanotechnology products. Research institution and R&D firms will be able to utilize the findings of this study in order to formulate better strategies like collaboration with private company and take action to enhance the commercialisation of nanotechnology product that would ultimately lead to better performance.

Finally, as the government has assigned considerable huge amount of funds and grants to this sector, it is crucial to witness its contribution to the economy via continuance of the business. The outcomes of this study is hoped to be used by Malaysian Government in establishing the best strategies in developing nanotechnology entrepreneurs in Malaysia as the number of nanotechnology company in Malaysia is very limited. For the conclusion, this research is an important step in providing data to government, managers, businessman, practitioners and the public on how their investment can benefit from the nanotechnology revolution.

1.8 Thesis Structure

This thesis is divided into five chapters. The first chapter begins with the introduction of nanotechnology, followed by statements of its background, problems, objectives and scope. The chapter ends with a discussion of the significance of this study.

The literature is reviewed in the second chapter. This looks at various aspects of nanotechnology as applied in Malaysia, the commercialisation of technology innovation and the respective models, and the theory of technology commercialisation. A detailed discussion of a number of factors influencing nanotechnology is next reviewed followed by the measurement of commercialisation success. A theoretical framework review closes this chapter.

Chapter three focuses on the research methodology. This covers the design, data collection and analysis. An elaborate discussion on questionnaire design, framing the population, and data collection procedures were stated prior to a final description of the actual test.

Analyses of data and findings of the research are described in chapter four. It presents complete results and analyses of the study. This thesis ends with chapter five which discusses the key findings of the research objectives. The significance of the findings and their theoretical, practical and policy implications is highlighted. Recommendations for future research are also included in chapter five.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The objective of this chapter is to present the empirical and theoretical literatures on factors that contribute to the success of nanotechnology product commercialisation. The discussion starts with an introduction to nanotechnology followed by overview of nanotechnology in Malaysia, technology commercialisation theory, measurement of success in commercialisation of nanotechnology, success factors of nanotechnology commercialisation in Malaysia, the development of conceptual framework, and lastly the hypotheses of the study.

2.2 Introduction to Nanotechnology

Generally, nanotechnology deals with creating nanoparticles and manufacturing machines which have sizes within the size of 1 to 100 nanometres (Bainbridge, 2007; Poole and Owens, 2003; and Ratner and Ratner, 2003). Before we come to the detail of nanotechnology, let us go through the history and definition of nanotechnology. The idea of nanotechnology has been posed more than 50 years ago by a scientist, Richard P. Feynman. However, this idea has received attention again in early 1991, with the discovery of nano-sized carbon tubes by scientists from Japan, Sumio Lijima (Bainbridge, 2007).

Prefix 'nano' means one billionth. One nanometre is 1/1,000,000,000 of a meter, which is close to 1/1,000,000,000 of a yard (Ratner & Ratner, 2003). In a simple understanding of nanoscale, just imagine a human hair measures 80 000 nanometres across and a bacterial cell measures a few hundred nanometres across (Abdullah and Rusop, 2010). In reality, the normal human eyes are only able to see at the smallest things of 10 000 nanometres across. Table 2.1 shows a note on measures for nanometer.

Table 2.1
A Note on Measures

SI Unit	Abbreviation	Description
Meter	m	Approximately three feet or one yard
Centimeter	cm	1/100 of a meter, around half of an inch
Millimeter	mm	1/1,000 of a meter
Micrometer	µm	1/1,000,000 of a meter; also called a micron, this is the scale of most integrated circuits and MEMS devices
Nanometer	nm	1/1,000,000,000 of a meter; the size scale of single small molecules and nanotechnology

A further advancement of nanotechnology creates strong impact in economy and society in the coming decades. Definitely, nanotechnology will affect mankind in the 21st century. The manipulation of nanotechnology nowadays is across a vast array of fields including food and agriculture, cosmetic, pharmaceutical, information technology, manufacturing and environmental improvements (Bainbridge, 2007).

There are a lot of products base on nanotechnology that are related to agriculture and agro-based industry being developed and some of them have entered the market such as *'Slow release fertilizer'*. This kind of fertilizer can improve agriculture besides savings expenses (Abdullah & Rusop, 2010). Another success of nanotechnology that has entered the market is in cotton industry. The technique of electro spinning which cellulose on nanoscale is used to make low-value product such as cotton balls, yarn, as well as cotton batting (Gordon, 2002).

The function of nanotechnology and nanomaterials is also widely used in some cosmetic products comprising of makeup, moisturizers, sunscreen and hair care product (Lux Research, 2006). L'Oreal has a number of nanotechnology-related products in the market such as L'Oreal RevitaLift Double Lifting- a package of skin-care product. Other products such as, Natasya Gold and LuvMilla products are the result of advance research and development on natural source by implementing nanotechnology in the production stage. These products have entered the Malaysia's market.

Nanotechnology has begun to revolutionize the pharmaceutical area. A phosphate composite; calcium and hydroxyapatite have been made some adjustment into molecular components to finally develop a synthetic bone based on nanoparticles (Huang and Cheng, 2006). On the other hand, several commercial products use nanocrystallines as a drug-delivery platform as mentioned by Cornwell (2009). A treatment known as "Nanoseal Plus" was made for the dead teeth that can be used in root canal treatment. This type of dental materials is preserved in order to remain functional in mouth.

With the number of product existence in global markets, nanotechnology product seems to give market opportunities to governments, research institutions and private companies. From the above discussion, it is said that nanotechnology is recognized as having big potential and give benefits to industries.

2.3 Nanotechnology in Malaysia

Today, most industrial countries are developing nanotechnology programs and incorporating nanotechnology in their development plans as a potential driver in the future. Over 30 national governments have already launched nanoscience initiatives and begun to invest ponderously in research and development. The Asia Pacific has become a leading centre for nanotechnology funding and research. Rapid global nanotechnology development and increasing awareness of its potential impact have inspired Malaysian researchers, politicians, policy makers, and industrial stakeholders to bring Malaysia into the global nanotechnology arena.

Nanotechnology research and development in Malaysia has begun around 2001 as a Strategic Research (SR) program and funded by Ministry of Science, Technology and Innovation (MOSTI). The Malaysia's National Budget 2006 has allocated RM868 million to MOSTI for research and development. The focus will be on advanced manufacturing, advanced materials, biotechnology, nanotechnology, information & communication technology (ICT), and alternative source of energy, including solar, to encourage innovation among local companies and developing new products (Hashim et al., 2009). Moreover, there are 17 projects and three nanotechnology programmes that have been approved with the total funding of about RM143 million (USD37.6 million) for nanotechnology.

Funding schemes for nanotechnology R&D are as follows (source: Asia Pacific Nanotech Weekly, 2004):

- Intensification of Research and Development in Priority Areas (IRPA)
- Industry Research and Development Grant Scheme (IGS)
- Multimedia Super Corridor Research and Development Grant Scheme (MGS)
- Demonstrator Application Grant Scheme (DAGS)
- Commercialisation of Research and Development Fund (CRDF)
- Technology Acquisition Fund (TAF)

Malaysia has established the National (Malaysia) Nanotechnology Initiatives (NNI) in 2005 and has become a member of Asia Nano Forum (ANF). The establishment of Malaysia National Nanotechnology Initiative will result in the founding of the National Nanotech Centre which will serve as a central coordinating platform for driving the government nanotech policy and coordinating national research and development programs and infrastructure. The Malaysian Nanotechnology Centre will coordinate research and development, commercialisation activities, investment opportunities and industrial partnership in strategic areas. These are likely to provide the best sustainable growth for Malaysia.

Nanotechnology in Malaysia happens through the involvement of different government and local institutes and organisations. Organisations supporting nanotechnology development and commercialisation are summarized in Table 2.2.

Table 2.2
Organisations Supporting Nanotechnology

Supporting Field	**Name of Institution**
Technology Parks	Technology Park Malaysia (TPM) Kulim Technology Park
Technology Incubation Centres	Technology Park Malaysia (TPM) MSC Central Incubation Malaysian Technology Development Corporation (MTDC)
Innovation and Consultation Centres	Standards and Industrial Research Institute of Malaysia (SIRIM) Malaysia Industry Government Group for Higher Technology (MIGHT)
Information Services and Centres	Patent Information: SIRIM, Ministry Domestic Trade and Consumer Affairs Standard Information: SIRIM National Information Centre: Malaysia Science and Technology Information Centre (MASTIC)
Metrology, Standards, Testing and Quality (MSTQ) Systems	SIRIM Development of Standard Malaysia (DSM)

Source: Asia Nano Forum (2004)

Nanotechnology research is also actively conducted in several public institution of higher learning (IPTA), private institution of higher learning (IPTS) as well as institute of government. MOSTI has provide in 2004, RM 8.77 billion for education in biotechnology under grant impact while in Eight Malaysia Plan (RMK-8) government has approved more than RM60 billion of grant for education in nanotechnology (Hashim et al., 2009).

In Malaysia, education of nanotechnology is still considered as new. Only some of the universities and public education institutions are involved in nanotechnology. These are Universiti Putera Malaysia (UPM), Universiti Teknologi Malaysia (UTM), Universiti Malaya (UM), Universiti Kebangsaan Malaysia (UKM), Universiti Sains Malaysia (USM) as well as Universiti Teknologi Petronas (Hashim et al., 2009).

Universities in Malaysia are carrying out nanotechnology development through several Centers of Excellent. However, it is not specific to nanotechnology projects and crosses over into many other related areas. Their funding figures are provided in Table 2.3.

Table 2.3
Centres of Nanotechnology Excellent in Malaysia

Centre and Institute Higher Learning	Research Field	Million RM (for 3 years)
Institute of Micro engineering and Nanoelectronics (IMEN), Universiti Kebangsaan Malaysia (UKM)	Nanoelectronics	38.2
Ibnu Sina Institute for Fundamental Science Studies (IIS), Universiti Teknologi Malaysia (UTM)	Nanochemistry	31
Combinatorial Technology and Catalysis Research Center (COMBICAT), University of Malaya (UM)	Catalyst	15
Glycolipids Research Center (GLYCOLIPIDS), University of Malaya (UM)	Nanomaterials/ Surfactants	11.2

Table 2.3 (Continued)

Centre and Institute Higher Learning	**Research Field**	**Million RM (for 3 years)**
School of Physics, Universiti Sains Malaysia (USM)	Electronics (Blue LED)	22.5
School of Medical Science, USM	Molecular Nanotechnology	2.2
Institute of Advanced Technology (ITMA), Universiti Putra Malaysia (UPM)	Electronics, Nanomedicine	Unknown

Source: Asia Nano Forum (2004)

It was not until 2011, that a new centre of excellent have been developed which is the Institute of Nano Electronic Engineering (INEE) centred in Universiti Malaysia Perlis. It was established in November 2008 as a converging hub for innovation, research and expertise in Malaysia, particularly for the Northern Corridor Economic Region (NCER). Next is a discussion on the theory used in this study.

2.4 Theory of Technology Commercialisation

To help in the understanding on how can organisation gain success in commercialising nanotechnology product, this study refers to a technology commercialisation theory by David Teece (1986). Teece's theory has several dimensions, and this study wish to apply one of the dimensions called Complementary Assets. In the development of his theory, Teece observed that it is very rare that a technological innovation can be commercialised without the support of other assets known as complementary assets.

Complementary assets are assets, infrastructure or capabilities needed to support the successful commercialisation and marketing of a technological innovation, other than those assets fundamentally associated with that innovation (Teece, 1986). Examples of complementary assets include marketing, sales, human resources management, office space, information technology, transportation, manufacturing, and sales channels. Complementary assets are important for organisations wishing to commercialise and profit from an innovation.

A strategic decision facing a technology firm which has generated an innovation is how to access the financial resources and commercialisation capabilities necessary to bring a product to market (Wakeman, 2008). Teece (1986) argued that if the established firms have tight control over these complimentary assets then the technology firm's optimal strategy is to contract one of the established firms to commercialise the innovation.

More recent research has begun to address on how a technology firm's position relative to the requisite complementary assets affects its probability of profitability. In particular, Jacobides, Knudsen and Augier (2006) argue that a technology firm might use mechanisms such as standards-setting bodies to strengthen its position with respect to the complementary assets and thereby create an 'architectural advantage'. Jacobides et al (2006) operationalizes that argument by describing a clear mechanism by which a technology firm can influence its industry in order to achieve long-term profitability.

This study seeks to examine on how the complementary assets (factors) influence the success of the company in commercialising their nanotechnology base-product. To examine this, the measurement of success in commercialisation of business needs to be reviewed next.

2.5 Success of Nanotechnology Commercialisation

There are several methods used by companies to measure success in commercialising their product. Nanotechnology business success refers to the effectiveness of a company in accomplishing its objectives that are measured by profitability and overall success from nanotechnology commercialisation activity. This study conceptualises and defines the term "success in commercialising" as how successful the company is in the past three years in relation to nanotechnology business success.

Profit can be defined as the positive gain from an investment or business operation after subtracting for all expenses (Astebro, 2004). Profit based indicators that point to the successful of nanotechnology research and development's commercialisation are; percentage of sales from new product, return on investment (ROI) from new product, and the percentage of profits from new product (Mustaffar, 2007).

Cooper and Kleinschmidt (2007) concluded their study with reduction of the new product performance at the business-unit level to profitability and impact on the business. The profitability of the total business may include whether the total initiative meets profits objectives; its profitability relative to spending; sales percentage of new products achieved by the business unit; and the impact of the new products on both sales and profits of the unit.

According to Cooper and Kleinsmeidth (1998), in overall success, all things are considered like how successful the business unit's total new product efforts were when compared to competitors. The overall success can be indicated by looking at the level of difficulty in commercialising new product (Majid, 2010) and the proportion of nanotechnology projects that was successfully commercialised as cited in Walsh (2001) and Mustafar (2007).

To remain success in commercialising innovation products, companies need to explore and understand on what factors may give contribution to the successful of their business. Following this is a discussion on factors influencing the nanotechnology commercialisation success.

2.6 Factors Affecting the Success of Nanotechnology Commercialisation

Some firms are successful in commercialising a technology, while a great majority fails (Oriaki, 2004). There are no easy steps to achieve commercial success. However investigation of the experiences and practices of firms that have been successful suggest there are critical factors that can enhance a firm's chances for success in commercialising technology innovation. Table 2.4 summarizes the studies that have been done in related field.

Table 2.4
Summarisation of Study on Factors Influencing the Commercialisation of Nanotechnology Product

Author	Objective(s)	Method	Descriptions
Mc. Neil et al. (2007)	Identifying the barriers to nanotechnology commercialisation	• Qualitative research. • Focus group, roundtable and interviews • Participants: venture capitalist, nano business companies, scientists, academics, public official and researchers.	The relevant barriers: • Lack of proper infrastructure • Lack of coherent policy • Lack of trained RSE • Funding.
Oriakhi (2004)	• To evaluate the critical success factors in nanotechnology commercialisation • To identify the factors that will enhance the adoption of nanotechnology.	Interview approach with companies developing and commercialising nanotechnology.	Success factors in nanotechnology commercialisation are: • Strong management and technical team • Identify feasible technology. • Target market/customer focus • Intellectual Property • Smart strategic alliances • Capital investment

Table 2.4 (Continued)

Author	Objective(s)	Method	Descriptions
Waitz & Bokhari (2003)	Survey some of the key factors for success in nanotechnology commercialisation	Through experience of consulting firm (Quantum Insight) with hundred of nanotech startups.	Inception: • Having a strong intellectual property position. • Based on the strategic plan. • Well-balance-team. Funding: • Government funding Growth: • Collaboration to access to manufacturing. • Has strong target market. • Needs of industry infrastructure. Exit Stage: • Combination of the state of nanotechnology and the state of economy.
Shapira & Wang (2008)	Explore the policy, institutional, economic, social and cultural factors that contribute to commercialising of nanotechnologies.	• Bibliometric research • Interviews- policy makers, researchers, business representative.	Firm A: • Money is the main issue • Difficult to access government resources as the firm is small firm. • Marketing- less of customer focus. Firm B: • Collaborating with universities and foreign company. • Research facilities are available. • Lack of skilled R&D personnel. • Marketing issues.

Table 2.4 (Continued)

Author	Objective(s)	Method	Descriptions
			Firm C: • Have enough R&D personnel • Collaborate with universities • Need capital investment cost to afford equipments • Nano concept is not attractive to customers
Shah (2004)	• To study the various commercialisation modes of Micro and Nanotechnology. • To determine various factors responsible for the success of a startups in the field of Micro and Nanotechnology.	• Qualitative analysis	Success factors for MNT firms in UK: • Commercial experience with strong target market knowledge. • Well-balanced team with various skills. • Links with universities to carrying out IP. • Funding the company through the venture capital. • Identifying a clear market space and market opportunity. • Having a supportive infrastructure to make easily access to government and university laboratory. • A strong IP position at the inception of the company. • Strategy to partner with the larger corporation.

These reviews from the past studies together with the general books on these issues bring this research to place focus on six factors that may critically affect the success in commercialisation of nanotechnology product (capital investment; customer focus; management team; business planning; nanotechnology product quality and company infrastructure). These factors will be briefly discussed next.

2.6.1 Capital Investment

One of the biggest challenges of starting and operating a business is financing. Financing options vary, depending on the current stage of the business and entrepreneur's acceptable level of external involvement.

Two of the largest sources of equity financing are venture capital firms and financing "angles". Venture capital is money invested by a professional management group or individual, seeking a higher than average rate of investment return (Arkebauer, 1995). They invest in young liquid high-growth companies expecting to provide a 25 per cent to 50 per cent annual return on investment (O'Hara, 1995). Because of these requirements, this source of funding is usually not appropriate or available to start-up business. Instead, firms fund a small per cent of projects considered, provide guidance and management advice and hope to have one or two highly profitable ventures to meet their expectations (O'Hara, 1995). Obviously, in order to find that one success, venture capitalists must be very selective about the businesses they fund.

According to Sargent (2011), data on economic outputs used to assess competitiveness in mature technologies and industries, such as revenues and market share, are not available for assessing nanotechnology. Alternatively, data on inputs (e.g. R&D expenditures) and non-financial outputs (e.g. scientific papers, patents) may provide insight into the current United States position and serve as bellwethers of future competitiveness. By these criteria, the United States appears to be the overall global leader in nanotechnology, though some believe the United States lead may not be as large as it was for previous emerging technologies.

Commercialising nanotechnology innovations is capital intensive, and for nanodevices development the cost can easily run into many millions of dollars. Sophisticated tools, costly materials and highly skilled manpower are usually required. Therefore, the ability of a firm to creatively generate capital from various sources to finance the commercialisation efforts is a critical success factor. Money is very hard to get now that the financial atmosphere has returned to pre-internet bubble levels of risk tolerance for assessing potential investment as pointed out by Oriaki (2004).

The other common types of equity investors are private investors, known as financing "angles". Angles do not have the same strict profit producing criteria as venture capitalists but still target higher than average risk investments. They typically require at least a 20 per cent or greater compounded annual return on investment (O'Hara, 1995). Angles are less concerned with total return than venture capitalists because angles are typically wealthy enough that the investment returns are not critical to their income as proposed by Mason and Harrison (1996) cited in

(Hormozi, Sutton, McMinn, & Lucio, 2002). Investments are often made for personal reasons; for example, continued involvement in the business community and entrepreneurial process, or financing a business that produces socially useful products or brings economic benefits to a local community.

Crawley (2007) agrees that a large number of investment by government or any institution will give opportunity to nanotechnology industries as there would be funds where the firms can exploit the chances. Therefore, the lack of venture capital is mainly a result from lesser investment targets. On the other hand, Asuquo (2009) argues that from his findings, the hypothesis test claims that there is no significant relationship between obligated funds and the number of units sold per commercialised technology. This result shows that the linear correlation of funds is not a good predictor of technology commercialisation success.

Ross and Loius (2010) mentioned that the cost of capital for both U.S private technology venture start-ups and publicly listed companies is also lower when assessed from overseas sources, and it is often much more founder or entrepreneur and manufacturing for long term growth-oriented friendly. A shortage of funding or a low level of suitable investment targets has been cited as principal cause for this disparity of commercialisation opportunity (Hobsan, 2009).

Critically, a large amount of money is needed to develop nanotechnology research and development. Consequently, in return the funding or the capital will represent in the form of direct economic growth, and indirect social benefits once the technology is commercialised (Crawley, 2007). Most of the research and development projects have potential to be commercialised (Lin, Jiang, Wu, & Chang, 2011; Mc. Neil, 2007; and Lee et al. 1996).

Waitz and Bokhari (2003) found that there are many sources of funding. The ones typically considered for a nanotech startup are friends and family, angles, government, and corporate partners. Nanotechnology companies usually have significant capital requirements to make real progress. But because nanotechnology is a hot area in the press, it is possible to find high net-worth angles that will put in significant funds.

Hardin (2010) reported from his finding that the primary barrier is lack of access to early-stage capital, and the extent of this barrier is greater when the company contributes to the value chain for nanotechnology through R&D as opposed to through products or services. The more pervasive nanotechnology is within a company's operations, the less likely the company needs greater access to early stage capital to diffuse its nanotechnology.

Technology innovation typically requires large capital outlays and consequently access to capital or financial markets is critical to the success of discovery and commercialisation of new technology. Some have argued that technology and biotechnology is particular best served by patient and private capital rather than impatient public capital providers (Hosseini & Esmaeeli, 2010).

According to Sargent (2011), private investments in nanotechnology come from two primary sources, corporations and venture capital investors. Jiang et al.

(2010) pointed out that a firm faces the critical decision strategic on how to access the financial resources and commercialisation capabilities when they want to market their product. Otherwise, Crawley (2007) proposed that a lot of venture capital investment is needed in order to cultivate nanotechnology start-ups, while Hardin (2010) recommended state government could act as venture capitalists to overcome market failure in the capital market.

Firms whose profits come largely from commercialising their innovations but where the commercialisation requires large and expensive business assets (such as manufacturing facilities and distribution networks) are considered to be knowledge firms as far as the management or their intellectual capital is concerned (Sullivan, 1999). Moreover, start-up firms need capital. Small and medium business can receive sponsorship through alliances with large corporations, but as time passes they become more interested in hunting for new science and technology rather than possessing and developing their own technology. Rather than funding support, the government must provide other benefits to innovators, that is it must secure other incentive types such as tax benefits for the technology innovators.

Thus, it is stated here that capital investment has relationship with nanotechnology commercialisation. This study will explore the relationship between capital investment and the success of nanotechnology commercialisation. The hypothesis 1 is now proposed as follows:

(H1: There is a significant relationship between capital investment and nanotechnology commercialisation success).

2.6.2 Customer Focus

Customer is a very important asset towards the achievement of organisation. Lack of customer, lack of profit the organisation will gain (Mustaffar, 2007). Hence, it is important to make sure the needs and wants of the customer is completely being fulfilled. Waitz and Bokhari (2003) investigate to the companies that have created a nano-based technology with a target market in mind only to discover that the product did not meet the needs of that target market. This oversight was due to lack of domain knowledge on the management team.

Most company build the customer-focused strategy in order to attract the customer to buy their product. For a strategy to be customer-focused, it must reflect the customer voice (Hobson, 2009). In other words, a customer-focused strategy is a planned approach on how the company handle the customers at every touch point. It is more than just giving a great customer service. It is important to build trust in every transaction with customer. If they do not believe what the company has given, they would not come again for the service.

Rautaray (2010) argued that success is achieved when product development is aligned with the company strategy and has correctly identified specific customer need. This is realised by having someone on board with commercial experience, even if his knowledge of nanotechnology is not so high (Sharon, 2010). This explained that company must organize a goood strategy that may attract people to buy their product. The meaningful success to commercialisation of nanotechnology product is the ability to know what customer-focused is about. Meyers et. al. (1999)

argued that there is a relationship between customer satisfactions with company achievement. The more there are customer loyalty, there will be more improvement in product innovation. This will lead the company towards competitive advantage.

According to Hosseini & Esmaeeli (2010), the most basic business challenge in introducing any new technology is that of creating value for the customer. But even if the technology will create value for the customer, it is the rate of adoption and speed of commercialisation which in essence is the time to market may dramatically impact the financial or business success of that technology. Technology that has value can be marketed worldwide and consequently faces more difficult commercialisation challenges compared to technology that is commercially viable based on introduction and utilization in markets.

To build a good relationship with client, sellers must have a good concern with their customer. This is strategic planning that obviously comes in to the commercialisation of research and development product as pointed out by Pinto and Selvin (1989). To that, they added, the sequence of operations that are of concern to client such as analyzing the specific needs of clients' ideas, budget and time frame to product completion. Nelson et al. (2005) proposed that the level of customer satisfaction is usually described as the mission of business performance. The satisfaction level of customers is important in that is gives information for the management to examine their opinions regarding the new product. The higher the customer satisfaction level is, the higher the market share will be (Nelson et al. 2005 and Oriaki, 2004).

There is another specific reason for a firm to develop new products: exploiting new opportunities. The demand for certain product attributes can suddenly become so intense that a firm is well-advised to create and introduce new marketplace for the new products in order to exploit this new opportunity and meet the strong customer demand (Adis & Razli, 2009, and Hise, 1997). Previous work regarding the effect of the market orientation on business profitability by Narver and Slater (1990) found that market orientation was an important determinant of profitability for both commodity and non-commodity business.

In 2007, the Woodrow Wilson International Centre for Scholars' Project on Emerging Nanotechnologies (PEN) reported results of a nationwide poll of adults that found more than 42% had "heard nothing at all" about nanotechnology, while only 6% said they had "heard a lot". In addition, more than half of those surveyed felt they could not assess the relative value of nanotechnology's risks and benefits (Sargent, 2011). The PEN survey found a strong positive correlation between familiarity with and awareness of nanotechnology and perceptions that benefits will outweigh risks. However, the survey data also indicate that communicating with the public about nanotechnology in the absence of clear, could create a higher level of uncertainty, discomfort, and opposition.

Target customer is consulted in order to determine whether or not to adopt or reject the proposed innovation, which is in the first stage of the process of technological innovation as mentioned by Augustus, (1989). Hippel (1978) pointed out that potential customer for new product is often not known to product manufacturers until they make a request. Nelson et al. (2005) find that technological innovation is greatly associated with customer satisfaction and is found to be important forces to affect customer satisfaction strongly. Moreover, a significant correlation between technological innovation and customer satisfaction has been identified. Many researchers focused on this issue to create competitive advantage.

Hippel (1978) reiterate that when customer request for something, they do so to provide the specification for the function of the product responsive to the need that is based on the simple logic. Meadow, as cited by Hippel (1978) argued that project ideas from customers and marketing both show a higher probability of commercial success than do the ideas from the laboratory.

Augustus (1989) in his interview with a semiconductor company believes that company must respect the customer needs and always update what they want. Normally the company often knows what customers wants are and the combination of these customer ideas with the resources that the company had, need be brought to the market. Likewise it is also important to know what the customers need in the future life are, because they are always looking for new product.

Study by Cooper and Kleinschmidt (1987) pointed out that in order to upgrade the performance of new product development, the company must first collect related market information, evaluate both internal and external environment resources and plan development strategies of new products that match business goals. In reality, the development and design of new use some form of market information from survey results, market trends, and focus group testing (Ramaneshan et al., 2002). That means firms have to gather as much market information to better understand the market needs and wants and give better input for better product development.

Accordingly, Balachandra (1997) agrees that the source of a new product idea has received much attention from researchers. In fact it is suggested by some researchers that the organisational source of a new product idea can generate interest and motivate the technical personnel to devote their energies to making the new product idea work. Due to that, some authors recommend that new product ideas be generated from the marketing department, as it is closer to customers.

From the previous discussions, it is posited here that customer focus influence the success in commercialisation. The hypothesis 2 suggested to be stated for this study is thus as below:

(H2: There is a significant relationship between customer focus and nanotechnology commercialisation).

2.6.3 Management Team

In looking at how to achieve successful teams, many factors have been suggested in the literature by a number of different researchers (McDonough III, 2000). McDonough finds that increased use of cross-functional teams in new product development is related to higher project success. However, achieving cross-functional team success appears to be more complicated than previously thought. For example, across the set of factors identified in this research, the most frequently mentioned is obtaining the team behaviour of cooperation. Setting appropriate project goals, a stage-setting step that is completed early in the project, follows closely is relative importance. Finally, providing good team leadership as an enabler is the third most frequently mentioned factor in achieving success. This suggests that companies must work in all dimensions to maximize the profitability of achieving team success.

According to various studies of factors involved in small business failures, 98% of the failures stem from managerial weakness. Two percent are due to factors beyond the control of the persons involved (Crawford-Lucas, 1992). A balance of marketing operations, financial skills, and experience are keys in promoting success for entrepreneur. As a team, the management must work well together.

Project is goal-oriented. Oriaki (2004) and Mustaffar (2007) highlight that success factor in new product development project commercialisation is coming from a good project leader that combines the ability from the leader to organize time, people, financial and sources. It is fortunate for the project leader to have a good management skill, interpersonal communication skill and have a deep knowledge on the technology that he or she wants to promote (Dregger, 1992). Crawley (2007) argues that the chances of success are increased by having at least one person with commercial experience, even if their knowledge of nanotechnology is not so high.

According to Elkins (1996), a mediocre product can make a company successful if there is excellent management. Conversely, bad management can make the best product a failure. Investors prefer to deal with a management team that has proven industry experience because it is considered a lower risk investment when compared to a less experienced management team. They are more concerned about execution skills rather than product.

Horn et al (2009) mentioned that marketing and sales team has to understand how to approach tricky questions about permeability of nanoparticles. For example, some cosmetic products claim that they are transforming skin at cellular level. But with nanotechnology, many people are concerned about nanoparticles penetrating the skin and entering the bloodstream. Thus, marketing and sales staff need to understand the basic science of the nanoparticles, as well as the current studies on their safety, and also be able to balance and deliver this information effectively to the public and others.

In one study Horn et al (2009) noted that, at a corporate level, one employer reported that workers in marketing, sales, legal, and general management need to develop knowledge of the company's use of nanotechnology, but in depth knowledge is not requirement. In fact, this employer did not recruit corporate workers who had specialized experience or training in nanotechnology concepts, but rather introduced workers to relevant issues on the job.

According to Kirihata (2007), it is very important to have a good management team at every stage in commercialisation. Study found positive correlations between commitment to top-down management and sharing of market needs with the progress in overcoming managerial difficulties during every stage of commercialisation. While at the commercialisation stage, serious managerial difficulties involving human resource issues can be found, especially in the shortage of human resources in the areas of marketing and sales. The correlation study shows a positive correlation between the progress in overcoming managerial difficulties and commercialisation process. These combined results suggest that managerial team is considered very crucial in the commercialisation process.

Shrader, Mulford, and Blackburn (1989) suggest that SME performance correlates with high levels of management skills, lean and sophisticated management, and the use of innovative and advance management. Shrader et al (1989) also suggest that planning might be a proxy for a number of organisational activities and characteristics such as managerial competence, managerial involvement, leadership style, and employee commitment.

According to Szakonyi (1994), success in a project does not only depends to individual or a division, but it requires teamwork from the whole organisation. In the other words; cross-disciplinary teams and cross-functional teams such as member from research and development division, manufacturing as well as marketing are needed in order to realize the success of commercialisation of product innovation (Mc. Neil et al. 2007; Valentin et al., 2004; and Large et al., 2000). Some authors (Palmberg and Miguet, 2009; Adis and Razli, 2009; Crawley, 2007 and Werner and Souder, 1997) have suggested that the organisation should receive strong support from the marketing function of the department for new product. Having a good internal teamwork between divisions in an organisation will encourage better communication and this certainly will leads to the smoothness of management of the commercialisation of product innovation process.

From the discussion above it is thus seems appropriate to state as in Mc. Neil et al. (2007), Crawley (2007), Mustaffar (2007), and McDonough III (2000) did that management team influence the success of commercialisation. This leads to this study third testable hypothesis which is:

(H3: There is a significant relationship between management team and nanotechnology commercialisation success).

2.6.4 Business Planning

Planning is deciding in advance what to do and how to do. It is one of the basic managerial business functions. Before doing something, the manager must formulate an idea of how to work on a particular task. Thus, planning is closely connected with creativity and innovation. It involves setting objectives and developing appropriate courses of action to achieve organisation objectives. A business plan is also a road map that provides directions so a business can plan its future and helps it avoid bumps in the road. The time of making a business plan thorough and accurate, and keeping it up-to-date, is an investment that pays big dividends in the long term.

The purpose of a business planning is to define the business and explain in as much detail as possible how the venture will operate in the current market. Most business owners are apprehensive about writing a business plan, but well-developed plan provides unlimited benefits (Arkebauer, 1995). Operating the company on paper first provides as opportunity to evaluate potential problem areas and thus work out solutions without real world consequences (O'Connor, 1998).

Business planning also communicates goals throughout the organisation and helps the business stay focused on its objectives. After implementing the proposed strategies, the owner or manager can use the plan as a benchmark to identify both achievements of goals and areas that need improvement. However, business planning should not be limited to a strat-up tool but, instead, used as a working document to continually re-evaluate progress and clarify goals for the future. While a good business plan will not guarantee success, it can go a long way toward reducing the odds of failure (Crawford-Lucas, 1992).

The business plan is not a do-it-and-forget-it business planning exercise but a living document that needs to be updated throughout the lifecycle of the business. A business plan is a written document describing the nature of the business, the sales and marketing strategy, and the financial background, executive summary, and containing a projected profit and loss statement. A business plan is used for a number of reasons: 1) To raise capital for an expansion or start-up project; 2) To determine the direction a company is going and how it intends to get there; and 3) To be used as an internal document to show both short and long term goals of the company (Crawford-Lucas, 1992). There are a number of areas in which a company may benefit by preparing and using a plan. These include financing, strategic planning and for everyday operations.

According to Clark (1999), the critical factors that had been identified to the success of a project are that of being clear in objectives and scope; division of the project into the smaller sizes and being well-consisted in project planning and overall communication of the project. Seah et al. (1997) and Pinto and Selvin (1989) however argue that the important aspect to be concerned for the success of each project are that the project is always on schedule, allocation of resources is according to needs, motivation is given to the project's team and also practically the monitoring and control of the project done till finished.

Orser, Hogarth-Scott, & Riding (2000) found from the analysis of firm size and business plan data, that larger firms were more likely to engage in planning. A highly significant statistical relationship was also noted between successive years of revenue increases and planning incidence. While the findings strongly support the importance of a business plan for SME owners who seek growth, the majority of businesses surveyed did not have a business plan. The presence of a business plan is highly correlated with the performance of the business and contributes to the growth of the firm (Orser et at., 2000).

On planning, Rautaray (2010) recommends that companies be focus on better business models, commercial experience, and exit strategies. Individual firms should take their nanotechnology-based processes and rather than attempting to apply it in multiple applications and industries, they need to focus planning on the areas of greatest need.

Cragg and King (1988) suggest that the interrelationships among planning, market-orientated activities, and characteristic of the owner/manager influence financial performance. Factors include marketing policies (particularly new product development), the use of written business plans (including strategic and operational planning), the number and productivity of the marketing/sales staff, and the size of the business.

These findings suggest that planning seems to be very important in the process of commercialisation. Thus, this study will explore on the relationship between business plans with nanotechnology commercialisation success. Hypothesis 4 is suggested as:

(H4: There is a significant relationship between business planning and nanotechnology commercialisation success).

2.6.5 Product Quality

Quality is the extent to which a product or service meets and/or exceeds customers' expectations. The realization of opportunities inherent in new technologies requires public trust (Aldrich and Fiol, 1994). Researchers argue that emerging technologies must have technology safety and business standards in order to gain public trust and legitimacy (Aldrich and Fiol, 1994; and Garud, Jain, and Kumaraswamy, 2002).

The role of product quality is now examined in order to determine its applicability as a means of gaining a comparative advantage. Jacobson and Aaker

(1987) detect feedback interactions between product quality and other strategic variables such as return on investment (ROI), market share and relative product quality. The findings suggest the importance of product quality and that the successful implementation of a quality strategy can facilitate increased profitability in both a focus and market share context.

In contrast to previous findings, PCB's results do not show a consistent direct effect of product quality on ROI. As a significant direct effect is observed for only half of the business groupings studied, PCB concludes that for some business groupings product quality may not be intrinsically valuable. Finding a significant positive influence of product quality on market share, they state that quality is an important determinant of market position. This result contradicts prevailing views by Porter (1980): pursuit of high quality strategy often requires the perception of exclusivity, which is incompatible with high market share.

Woolley and Rottner (2008) explore the relationship between innovation policy and new venture creation in United States. Specifically, two components of innovation policy in nanotechnology were examined which are science and technology (S&T) initiatives and economic initiatives- with their relationship with the founding of nanotechnology firms. The study finds a strong support relating new firm formation to S&T and economic initiatives. States with both S&T and economic initiatives had six times as many firms founded than those states without such initiatives. Study also finds evidence of a first mover advantage as states with the earliest innovation policies had higher rates of related firm founding over time.

Garvin (1984) provides a well-known framework for thinking about product quality that is based on eight dimensions: performance, features, reliability, conformance, durability, serviceability, aesthetics, and perceived quality. While his intent was to offer firms a vocabulary with which to discuss ways to compete strategically on quality, he does argue that these eight dimensions can be used to explain differences among the five traditional approaches to defining quality.

Nanotechnology safety is clearly an important and legitimate goal for quality. It is just that when people get down to the business of protecting human and the environment, the big idea of "nanotechnology" can become more of a hindrance than a help. Nanotechnology safety can be identified as the safe handling, use and disposal of specific materials, products and process that arise from its application (Maynard, 2009).

One class of products that raises some interesting safety questions is "nanomaterials", where materials are engineered at the nanometer-scale and they exhibit scale-specific properties. These materials are intentionally designed to do what they do because of their physical form, as well as their chemical makeup. So it seems reasonable to ask whether what they look like at the nanoscale also leads to new safety issues. According to Maynard (2009), for physical form to be of concern to human health or the environment, is that the material first has to get to a size where it can do harm. This means that chunks of it need to be small enough to be inhaled, ingested, or penetrate through the skin. However, for nanomaterials that can get into the body, there will be some cases where their physical form (size, shape, physical structure) can lead to them being dangerous above certain concentrations.

Based on the discussion above, this study will examine the relationship between product quality and the success in nanotechnology product commercialisation. Thus Hypothesis 5 is proposed as:

(H5: There is a significant relationship between product quality and nanotechnology commercialisation success).

2.6.6 Company Infrastructure

Infrastructure is basic physical and organisational structures needed for the operation of a society or enterprise, or the services and facilities necessary for an economy to function. It can be generally defined as the set of interconnected structural elements that provide framework supporting an entire structure of development.

Viewed functionally, infrastructure facilitates the production of goods and services, and also the distribution of finished products to markets, as well as basic social services in commercialising; for example, roads enable the transport of materials to a distributor, buildings, and permanent installations necessary for the support, redeployment and operation. The basic physical system of a business such as transportation, communication, sewage, water and electric systems are all examples of infrastructure.

According to Pierre (2010) business infrastructure links goals, activities, and people through planned processes and systems. Business infrastructure ensures the proper coordination of all human resources, business processes (sales process, collection process and service delivery process) and other operational tools (database, paper records, templates, checklists, equipment and furniture) necessary to ensure manageable, profitable growth. On the other hand, business infrastructure tends to ensure the consistency in delivery of customer value and it is the key to reaping the benefits of economies of scale.

IT infrastructure is the key role in the success of any business nowadays. This is because this is an area which covers almost all the physical hardware components used to connect computers of different users in the organisation. IT infrastructure organisation can usually includes things like phone lines, media broadcast, satellite antennas, repeaters, routers, aggregators, with only a few instruments. However, IT infrastructure services also include software used to send or received data and information (Arora, 2011).

A solid infrastructure is critical to growth success. Smart companies like Xerox are focusing upon their core business and building infrastructures that support it (Rooney, 2009). All of their growth is controlled, strategic, and methodical, and is supported by their infrastructures. They are doing this by ensuring that critical process including product development, sales and customer relationship management process are in place. Rooney (2009) suggest that successful organisations are seeking new ways to grow. They may expand into new markets, reduce production costs by moving some operations offshore, consilidate, and undergo a merger or acquisition. With infrastructures that can support these changes, companies are able to respond quickly and keep business moving forward.

Study from previous literature (Rooney, 2009; Pierre, 2010; and Arora, 2011) stated that to gain success in commercialisation, company needs to constantly review their facilities. Thus it is suggested that company infrastructure have contribution to the success of commercialisation. This study will then examine the relationship between this factor and the success of nanotechnology commercialisation. Hypothesis 6 is proposed as:

(H6: There is a significant relationship between company infrastructure and nanotechnology commercialisation success).

2.7 Research Framework

After having reviewed some literatures on commercialisation success, this study develops a research framework. A research framework normally illustrates the relationship between the various variables in a study (Sekaran, 2006). The development of the research framework in this study is constructed with reference to the literatures reviewed earlier on the factors that contribute to the success of nanotechnology commercialisation of the company. Based on the numerous literature findings and discussion in the preceding sections, six factors have been selected as independent variables (capital investment, customer focus, management team, business planning, product quality and company infrastructure). While the dependent variable scores are based on the measurement of company profitability and overall success. Figure 2.1 draws the relationship between the variables in this study.

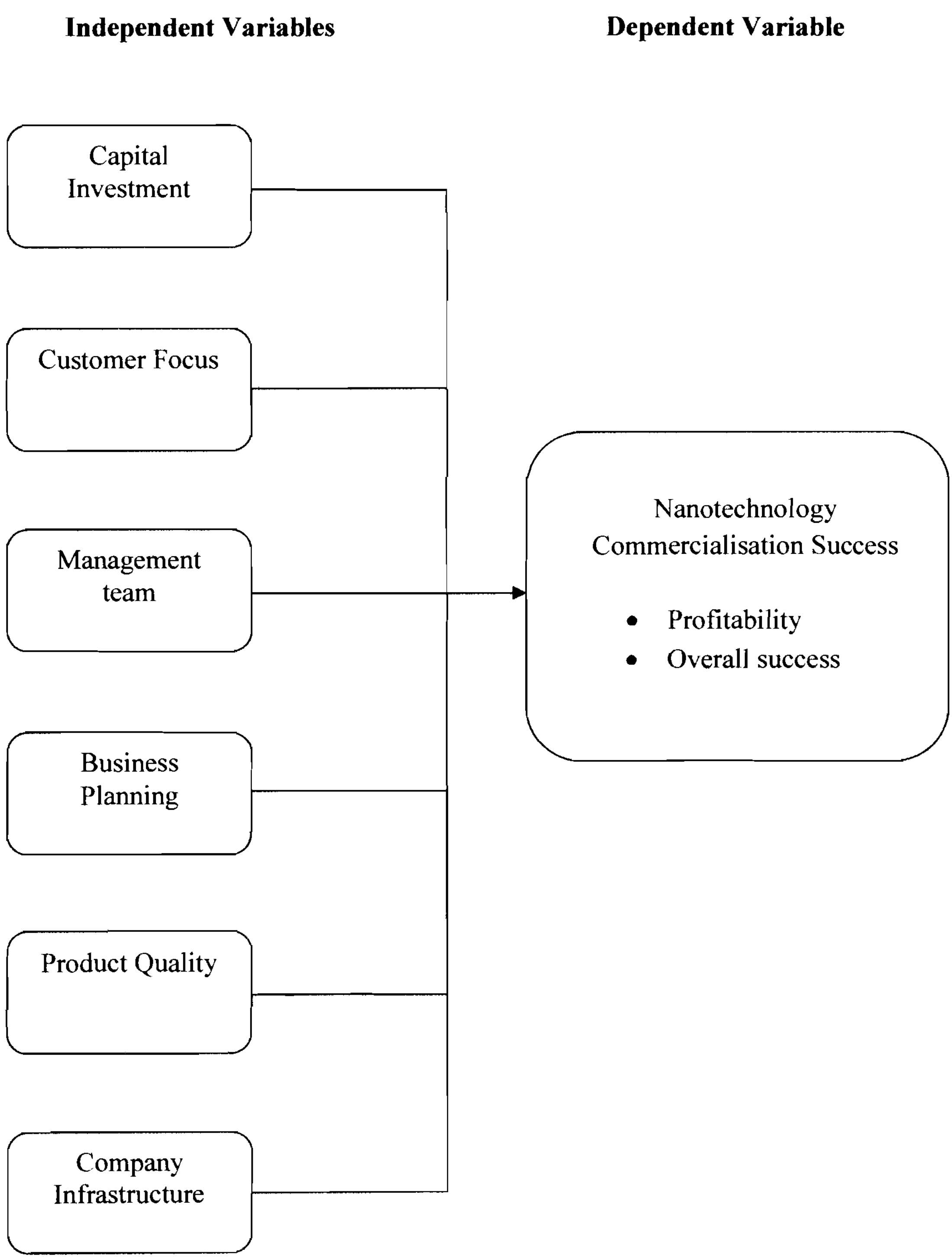

Figure 2.1
Schematic Diagram of the Research Framework

2.8 Statement of Hypotheses

H1 Capital investment significantly correlates with nanotechnology commercialisation success.

H2 Customer focus significantly correlates with nanotechnology commercialisation success.

H3 Management team significantly correlates with nanotechnology commercialisation success.

H4 Business planning significantly correlates with nanotechnology commercialisation success.

H5 Product quality significantly correlates with nanotechnology commercialisation success.

H6 Company infrastructure significantly correlates with nanotechnology commercialisation success.

H7 All of the six success factors in combination significantly affect the nanotechnology commercialisation success.

2.9 Chapter Conclusion

This chapter starts with the introduction of what are to be reviewed, then, followed by an overview of nanotechnology in Malaysia industry, discussion of commercial success, and factors influencing nanotechnology commercialisation success. Based on the results of these literature reviews, several conclusions seem reasonable. The reviewed literatures strongly suggest that these six success factors (capital investment, customer focus, management team, business planning, product quality and company infrastructure) are vital in describing their relationships that may contribute to the success of nanotechnology commercialisation. A research framework was then developed that pictures how the six success factors independent variables relate to that single response dependent variable (the success of nanotechnology commercialisation). Seven hypotheses are then stated based on this framework. The next chapter is devoted to discussing the methodology of the study.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter explains the method used in conducting the research. It includes discussions on the research design, data collection sources, data analysis and the particular instrument of this study. Of particular impotence is the layout on the design of questionnaire, the conduct of pilot testing, and the validity and reliability of these constructs. A note on the actual study period is finally mentioned.

3.2 Research Design

The method of research in this study is mainly in the quantitative domain. This type of method thus constitutes the data collection activities, measurement of variables studied and examining the significance relationship between the variables. This research investigates relationship that may exist between independent variables which are capital investment, customer focus, management team, business planning, product quality and company infrastructure, with a dependent variable- the success in commercialisation of nanotechnology product as deliberated by profitability and overall success. This study is cross-sectional where data were collected only once from every respondent during the study period.

3.2.1 Target Population

The target population for this study consists of organisations that invest in nanotechnology business in Malaysia. This study gathered and framed the number of population based from various databases. This was due to the concern of not being able to obtain enough responses from only one source.

In addition, the total number of organisation that commercialise nanotechnology product in Malaysia is not completely registered in a single main directory, but scattered around a few related directories. As a consequence, this study gathered information about targeted population from streetdirectory.com, alibaba.com, nanowerk as well as 701panduan.com and then finally framed a total of 412 organisations that have commercialised nanotechnology based products in Malaysia.

3.2.2 Sampling

This study is a sample investigation done mainly for the purpose of keeping cost in terms of money, time and available resources, low. According to Gerald (2007) statistical inference permits the drawing of conclusions about a population parameter based on a sample that can be quite small in comparison to the size of the target population. The sample of this study consisted of the organisations that invest in nanotechnology business around the peninsular of Malaysia.

A probability random sampling method was used as the sampling design in this study. Simple random sampling selects sample in such way that every possible sample of the same size is equally likely to be chosen. For a target population of 412 a sample size of about 200 is considered adequate for this, following the estimate suggested by Sekaran (2006). In addition, this sample size estimate is also in accordance to what was suggested by Roscoe (1975) who proposed that as a rule of thumb, any sample size larger than 30 and less than 500 are appropriate for most research. Table 3.1 draws a sample size for a given population.

Table 3.1
Sample Size for a Given Population Size

Population Size (N)	**Sample Size (S)**
50	44
100	80
200	132
300	169
400	**196**
500	217
1 000	278
1 500	306
3 000	341
6 000	361
10 000	370
30 000	379
75 000	382
>1 000 000	384

Source: Adopted from Sekaran (2006)

A simple random sample of 250 companies was selected from the 412 framed companies that are involved in the commercialised nanotechnology earlier identified from the various mentioned websites. This selection was done by first assigning numbers in consecutive orders to the sampling frame of companies. Next, in order to get to a list of selected random numbers, an excel computer program was used to generate these needed 250 random numbers. Finally with this list, these associated 250 companies becomes the random sample of this research.

3.2.3 Unit Analysis

Unit analysis or respondent in this study is an individual from the selected company. This person represents the company when answering the questionnaire. The person can be a marketing manager, marketing officer, production manager, R&D manager, or any other executive deem responsible by the company. Obviously it is expected that the respondent must be knowledgeable of the company's activities.

3.3 Data Collection Sources

The sources of data in this research can be divided into two, which are primary and secondary sources. Primary data refer to the information obtained firsthand in the research. Primary data for this study were collected by distributing questionnaires to different individual (marketing manager, production manager, accountant officer, or any marketing officer) via mail and electronic mail. To facilitate respondent feedback from traditional mail, a stamped self addressed envelope was attached with each questionnaire while a phone call was made first before questionnaire was sent afterwards by electronic mail.

While primary data are firsthand, secondary data refer to the information gathered from sources already existed. In this research, the secondary data sources are from the internet, company websites, books published and literature reviews from previous research. This research gathers the information about factors which in combination influence the success in commercialising nanotechnology product. Secondary data can be beneficial in terms of time and cost savings of finding information, however the data must be up-to-date information and from trusted sources.

3.4 Data Analysis

Procedures in the analysis of data include that of descriptive analysis, assumption test, correlation and regression. Mean and standard deviation of each variable were calculated for locating the centre and spread for further analyses. In testing the various hypotheses, this study widely used the t-test and F-test. The final use of regression should establish the order of importance of the six factors that influence on nanotechnology commercialisation. This study used SPSS and Minitab statistical software to aid in data analysis calculations.

3.4.1 Descriptive Analysis

According to Zikmund (2003), descriptive analysis refers to the transformation of the raw data into a form that will make them easy to understand and interpret. The analysis of data began with descriptive analysis that summarizes and display data. The mean and median are the two central measures utilized to locate the particular data while the standard deviation and inter-quartile range would measure data dispersion. Where appropriate, frequency and percentage tables gave an overall data summary. To visualize data, histogram is the main tool utilized in this study.

For this study, the descriptive analysis is done over the data from Section A and Section B of the questionnaire which summaries and displays the background characteristics of individuals and their company's profile. Indirectly, these data scenarios provide precautions when making appropriate and valid decision based on this research study data.

3.4.2 Mean Score

This study calculates the mean score of each variable in order to describe the average effect of the success factor. The possible range of the effect is then given by the calculated standard deviation. These calculated values will be kept for future tests and analyses.

3.4.3 Correlation Analysis

Correlation analysis seeks to measure the strength of relationship between any two variables and to identify whether the relationship is positive or negative. The strength of the relationship given by the calculated value of the coefficient of correlation (r) will in this study be describe in word as grouped given in Table 3.2.

Table 3.2
Strength of the Relationship between Variables

Value of r	Strength of relationship
-1.0 to -0.5 or 1.0 to 0.5	Strong
-0.5 to -0.3 or 0.3 to 0.5	Moderate
-0.3 to -0.1 or 0.1 to 0.3	Weak
-0.1 to 0.1	None or very weak

As this study needs to understand how a number of success factors are related among each other, the approach taken is to display a matrix of correlations. To identify significant correlations, the correlation matrix includes the respective p-values. A p-value provides a weight for the null of no correlation. A very small p-value (normally ≤ 0.05) is indicative of a significant correlation.

3.4.4 Multiple Regression Analysis

In multiple regression, the intension is to relates one dependent variable with a set of independent variables. In sum, multiple regression analysis is done to examine the simultaneous effects of several independent variables on a dependent variable that is interval scale (Sekaran, 2006). In this way, multiple regression analysis aids in understanding how much of the variance in the dependent variable is explained by a set of predictors.

The role of multiple regression in this study is to establish the way success factors affects the success of nanotechnology product commercialisation. The company's profitability and overall success are together combined as a measure of nanotechnology product commercialisation success here labelled as Y being a response or dependent variable. It is the response Y that is regressed on the six factors. The six factors being (1) Capital investment, (2) Customer focus, (3), Management Team, (4) Business Planning, (5) Product Quality, and (6) Company Infrastructure, are each here labelled as X1, X2, X3, X4, X5 and X6 respectively. The multiple regression model is:

$$E(Y) = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \beta 5X5 + \beta 6X6$$

The β's (i.e. $\beta0$, $\beta1$...... $\beta6$) are the regression coefficients that are to be estimated and E(Y) is the expected or average value of Y. The significance of regression will be established by the F-test and that of each β by the respective t-test.

3.4.5 Stepwise Regression

In stepwise regression, independent variable can be added or removed from a regression model based on the criteria of alpha to accept and alpha to remove. These alphas are test significance levels. After a number of regression steps, a final step results in a particular choice of the independent variables at a point where no other variable can be added or removed from this final regression model. Y is then regressed on these final X's. This resulted in the estimates of β's that should point to the order of importance of these success factors as well as noting those that may still be not contributing to the commercialisation of nanotechnology product success.

3.5 Instrument of Study

The mail questionnaire is the instrument for this study. A good and efficient postal service allows big geographical area coverage of respondents and is cost efficient when compared to a face-to-face interview survey. The quality of the data is held most important as this reflects the quality of this study. An approval letter from the University and a convincing cover letter explaining the purpose of this investigation, how respondent and the company's confidentially are handled, and what noble role the respondent plays, can helps boosts response. Another good practice that may increase response is the provision of self-stamped-addressed envelope.

No response is a problem as it may reflects other qualities not common to the responding group. This survey chooses to call back on those not responding either through the use of telephone or electronic mail, requesting the respondent for cooperation. English is the language of this survey questionnaire. This is the suggestion by the university specialist out of a pre-test study noting that the respondents are from industries in private sectors.

3.6 Questionnaire Design

Writing good questions is an important step for the success of a survey by mail. In this study, the questions are short and straight to the point by using simple words. All the questions were close-ended with ordered response choices. Compared to open ended questions, this kind of question is less demanding and easier for respondent to answer because they just have to tick at the choices answer provided.

The questionnaire developed in this study consisted of four main sections; (1) section A, the respondent personal information, (2) section B, the company profile, (3) section C, the measurement of success in nanotechnology commercialisation, and finally (4) section D which is factors affecting nanotechnology commercialisation.

3.6.1 Section A (Respondent Background)

The first section is about the respondent personal information. This section intends to analyze the respondent's gender, race, academic qualification, position in the company and year of experience in the company. All the questions are provided with possible answer choices that the respondent can choose from.

3.6.2 Section B (Company Profile)

Section B asks about the company profile. These questions seek to get information about the companies' nature of business, number of employee, number of years in operations, as well as the companies' ownership. All the questions are multiple choices typed.

3.6.3 Section C (Commercialisation Success)

Nanotechnology is a new technology development. From this new innovation technology, it will creates new product, manufacturing techniques, technology tools, as well as the process needed by a company in order to commercialise the product so that it can give a competitive advantage to a rival.

Hence, success in nanotechnology business needs a close attention. This section is significant to measure the level of success of nanotechnology commercialisation measured by profitability and overall success. The questionnaires are adopted with modification to nanotechnology product requirement from Mustafar (2007). The respondents are provided with Likert Scale where they can express their answers according to the degree of success in commercialising nanotechnology base product. Table 3.3 indicates the items used in measuring the success in commercialisation.

Table 3.3

Items Measuring the Success in Commercialisation

Profitability
1. Percentage of sales from nanotechnology products has________
2. Return on investment from nanotechnology product has________
3. Percentage of profit from nanotechnology product has_______
Overall Success
1. The level of difficulty in commercialising nanotechnology product has______
2. The proportion of nanotechnology products that are being commercialised has______.

3.6.4 Section D (Factors affecting nanotechnology commercialisation)

Section D is about the success factors of nanotechnology commercialisation. Six critical factors have been chosen for this study that may affect the success in nanotechnology business performance. The factors are: (1) capital investment, (2) customer focus, (3) strong management team, (4) business planning, (5) product quality, and (6) company infrastructure. Respondent were asked to circle the answers according to the degree of agreement base on Likert Scale. Table 3.4 and 3.5 show the items used to measure every construct of questions as well as the sources taken.

Table 3.4

Construct and Items Measured for Factors Affecting Nanotechnology Commercialisation

Measurement Construct	No. of Items	Source(s)
Capital Investment	4	All items were adapted from Mustaffar (2007) and the items were modified to make sure the items suitable for the nanotechnology industry.

Table 3.4 (continued)
Construct and Items Measured for Factors Affecting Nanotechnology Commercialisation

Measurement Construct	No. of Items	Source(s)
Customer Focus	4	All items were adapted from Ghazali (2010) and the items were modified to make sure the items are suitable for the nanotechnology industry.
Management Team	5	
Business Planning	5	Items were adapted from Al-Harash (2009) and the items were modified to make sure the items are suitable for the nanotechnology industry.
Product Quality	5	All items were adapted from Lelaki (2010) and the items were modified to make sure the items are suitable for the nanotechnology industry.
Company Infrastructure	3	

Table 3.5
Independent Variable Scale

Capital Investment

1. Our company's financial resources for nanotechnology activity is adequate.
2. Our company's budget is adequate to meet the stated goals from nanotechnology product sales.
3. In the past three years, our nanotechnology budget allocation has increased.
4. Our company's budget for nanotechnology activities is easily obtainable.

Table 3.5 (Continued)

Customer Focus
1. Our business objectives are driven primarily by customer satisfaction.
2. We like to survey our current and prospective customers.
3. We are concern about the successful and unsuccessful customers' experiences.
4. We measure customers' satisfaction systematically and frequently.
5. We give close attention to the after-sales service.
Management Team
1. We understand how we can contribute to create customer value.
2. We constantly monitor our level of commitment and orientation.
3. All of our business functions (eg: finance, operation etc.) are integrated.
4. We share resources with other business units.
Business Planning
1. Every person is committed to make sure the deadlines are met.
2. We effectively execute the actions detailed in the plan.
3. Rewards in the venture are clearly linked to the requirements of the plan.
4. The monitory system is well aligned with the plan.
Product Quality
1. The quality policy in our company is appropriate for the purpose of nanotechnology business.
2. Nanotechnology product quality is based on performance, features, reliability and conformance.
3. Nanotechnology safety is clearly an important and legitimate goal.
4. Nanotechnology product is free from any unsafe chemical or technology.
5. Our company always reviews the quality of nano-products from time to time to ensure its safety.

Table 3.5 (Continued)

Company Infrastructure	
1.	Our company provides buildings or workplace needed to achieve conformity of nanotechnology commercialisation activities.
2.	Our company provides equipments or utilities needed to achieve conformity of nanotechnology commercialisation activities.
3.	Our company provides supporting services such as transport and communication needed to achieve conformity of nanotechnology commercialisation activities.

3.7 Pilot Test

Emory and Cooper (1991), consider a pilot test as a procedure that would detect weaknesses in instrumentation as well as design and provide proxy data that should help in the probability sample selection. Before the actual test was conducted, a pilot test has been done by mailing the questionnaires over 40 respondents but only 20 responded. For this study, respondents were selected randomly within the companies that are involved in nanotechnology activities in Malaysia. The pilot test was carried out in August 2011 and the questionnaires were distributed to the selected respondents by mail.

3.8 Construct Validity and Reliability

In an attempt to ensure that the measures developed are reasonably good, it must meet two main criteria; validity and reliability. According to Sekaran (2006), validity refers to the extent to which the instrument measures what it is supposed to be measure while reliability refers to the consistency of this measurement instrument. These constructs were finalised based on the pilot test results.

3.8.1 Validity

In this research, opinions from managers and business practice people that have experience in nanotechnology product were referred to, collected and analyzed. Some concern was expressed on wordings of the questions and these either need change or addition several words to provide better understanding. Some commented on the fonts which are quite small. For the use of language, they agree with the use of English Language as the words used are simple and easy to understand. To test the validity of the questionnaire, factor analysis technique was performed and this will be highlighted in more detailed in chapter four.

3.8.2 Reliability

Another test that has been done during pilot survey was Cronbach's Alpha. Being a classical measure of reliability, Cronbach's Alpha is used to examine the internal consistency and reliability of the items within each scale. According to Mohamed (2008), Cronbach's Alpha is computed in terms of the average intercorrelation among the items measuring the concept. The closer Cronbach's Alpha is to 1, the higher is the internal consistency reliability. Alpha values greater than 0.6 are suggested as being adequate for testing the reliability of factors (Sekaran, 2006). The statistical summary for each scale of the pilot analysis are shown in Table 3.6. From the table, Cronbach's Alpha value ranged from 0.5 to 0.9, which shows high internal consistency except for items that measures overall success. However, with an alpha value of 0.561, it can be considered acceptable as this value is close to 0.6 (note that 0.561 to one significant figure is 0.6). Therefore, it was decided that no items were deleted.

Table 3.6
Statistical summary for each scale from pilot test

Variable/scale	Number of Items	Alpha value
Capital investment	4	0.859
Customer focus	5	0.784
Management team	4	0.737
Business planning	4	0.717
Product quality	5	0.779
Company infrastructure	3	0.674
Commercial success		
Profitability	3	0.935
Overall success	2	0.561

3.9 The Actual Test

The actual study was conducted beginning October 2011 and completed by February 2012. The final accepted questionnaires were distributed to 250 respondents selected in this research using the mail service. To facilitate respondent feedback, a self-addressed-stamped-envelop is accompanied with each questionnaire. Respondents who did not respond within two weeks were contacted by telephone or email. If the answers were incomplete or having some type of technical errors or where answers were not according to the requirements of the questions, respondents were followed up by telephone for the purpose of correction.

3.10 Chapter Conclusion

This chapter describes the research design, the type of sampling employed, the mail questionnaire construction method used in collecting data and also the various analysis techniques used for the study. Beside these, this chapter also reviews the construction of the measuring instruments for the constructs within the questionnaire which were then accepted as valid and consistent after going through their respective validity and reliability tests at a pilot level. Pilot study done at an earlier date managed to correct and finalised the questionnaire that was used in the actual study. The next chapter elaborate more on the appropriate statistical analysis and finally considers the findings of the study.

CHAPTER FOUR

ANALYSIS AND DISCUSSION

4.1 Introduction

This chapter presents the results of the data analysis for this study. This involved the following: preparing for data analysis, statistical analysis and hypothesis testing. The discussion of data analysis addresses four main sections such as the demographic data on respondent profile, validation of instrument, running assumption test, and hypothesis testing. The analyses were based solely on the data furnished by the respondents through returned questionnaires.

4.2 Rate of Return

Off 250 questionnaires distributed randomly to the organisations that commercialise nanotechnology, only 93 were attained back. This represents 37.2 percent response rate. This survey comes with a low response rate because many companies refused to participate in this as they strongly consider that information of the companies cannot be disclosed. Otherwise, some of the companies could not be contacted due of the incorrect telephone number and address. However, this response rate was quite reasonable in accordance with suggestion by Sekaran (2006) that suggests 25 to 60 percent of response rate are normal using mail.

4.3 Analysis of Demographic Data

Demographic statistics helps to assess if the sample were representative of the population. This section figures out the respondent profile and comprised information about the company background.

4.3.1 Respondent Profile

From ninety-three respondents, fifty-six of them are male and thirty-seven are female. Most of the respondents are Chinese which represent 60.2 percent, followed by Malay (32.3%). The average academic standing of the respondents is a bachelor degree (69.9%). Although the surveys were addressed to Marketing Manager, the respondents came from a variety of designations. However, all of these respondents are eligible since their responsibilities are directly related to the operation works. With regard to their position in the companies, most of respondents were marketing manager (39.8%), R&D manager (8.6%), production manager and technical manager represent 5.4% and 3.2% respectively, while 43.0% of respondents come from other position (sales executive, researcher, marketing officer and director). Three respondents have less than one year in their designations, while the majority of them have experience between one to five years, twenty-six respondents served between six to ten years and twenty-two respondents have more than ten years in their designation. Table 4.1 shows the breakdown of this demographic profile.

Table 4.1

Summary of Respondent Profile

Items	Frequency	Percentage (%)
Gender		
Male	56	60.2
Female	37	39.8
Race		
Malay	30	40.4
Chinese	56	57.4
Indian	4	4.3
Others	3	3.2
Education level		
Master degree	11	11.8
Bachelor	65	69.9
Diploma	14	15.1
Others	3	3.2
Designation		
Technical manager	3	3.2
Production manager	5	5.4
Marketing manager	37	39.8
R&D manager	8	8.6
Others	40	43.0
Years of designation		
Less than 1 year	3	3.2
1 to 5 years	42	45.2
6 to 10 years	26	28.0
More than 10 years	22	23.7

4.3.2 Company Profile

Table 4.2 presents the background of the company that these respondents are currently in. From the descriptive analysis, machinery and equipment, and information technology are the dominant industry representatives which are 30.1% and 23.7% respectively. 11.8% are cosmetic, 6.5% of the companies are categorized as pharmaceutical, and the smallest category is food and agriculture (5.4%). Other types of organisation (such as biotechnology, health care product, and photocatalist) represent 22.6%. Next, respondents were asked to indicate the overall number of employees in order to identify the size of the organisations. They were classified into three groups based on the classification used by Federation of Malaysia Manufacturer (FMM 2009). Majority of the respondents are from small organisation (number of employees less than fifty). Sixty-seven (72.1%) of the companies employed less than fifty, and only five (4.3%) has more than 250 employees. The breakdown of the data is illustrated in Table 4.2.

Table 4.2
Summary of Company Background

Items	Frequency	Percentage (%)
Nature of business		
Food and agriculture	5	5.4
Cosmetic	11	11.8
Pharmaceutical	6	6.5
Information technology	22	23.7
Machinery and equipment	28	30.1
Others	21	22.6
Number of employee		
Less than 20	38	40.9
20 to 50	29	31.2
51 to 100	16	17.2
101 to250	5	5.4
More than 250	5	4.3
Number of years operation		
0 to 5 years	3	3.2
6 to 10 years	48	51.6
11 to 15 years	29	31.2
16 to 20 years	10	10.8
More than 20 years	3	3.2
Ownership		
Malaysia owned	41	44.1
Joint venture	19	20.4
Multinational owned	16	17.2
Others	17	18.3

The percentage of the companies that has operated between six to ten years is 51.6% (majority) which can be categorized as at infancy or new. The proportion of ownership has revealed that (in descending arrangement) 44.1% are Malaysia owned, 20.4% are joint venture companies, while 17.2% are multinational owned and 18.3% represent others. In this section also, respondents are required to categorize their primary role in commercialising nanotechnology. Figure 4.1 illustrates the proportion of the companies' role in commercialising nanotechnology based products.

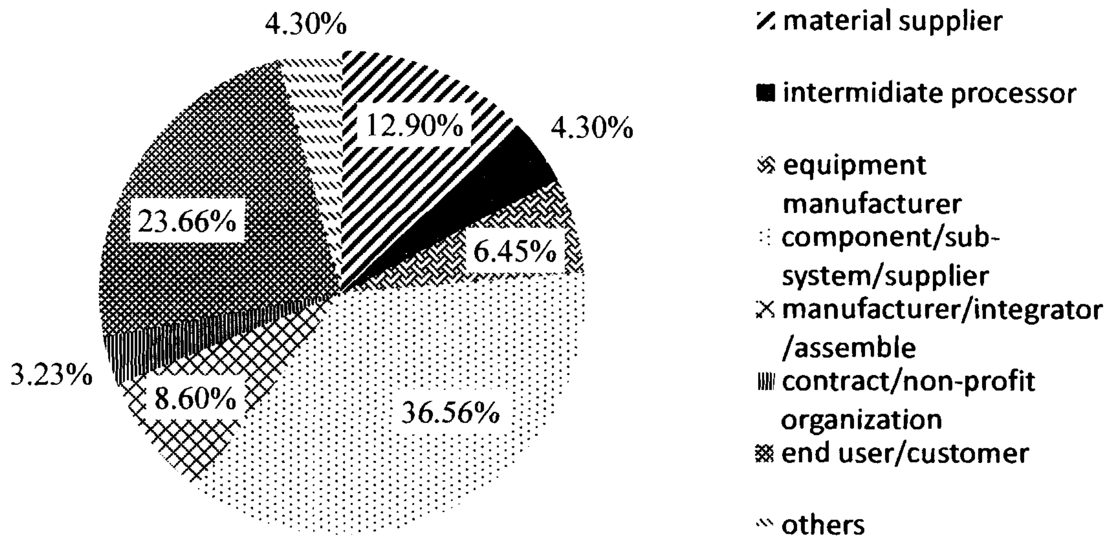

Figure 4.1
Organisation Primary Role in Commercialising Nanotechnology

Almost sixty percent of the organisation primary roles are in areas of component or subsystem supplier and end user or consumer. It is noticed that the organisation primary role is dominated by component or subsystem supplier of product incorporating nanotechnology.

4.4 Validation of Instrument

Validity and reliability of the data collected were conducted by using original data from the main survey. Factor analysis and inter-item consistency reliability or Cronbach's Alpha were obtained to assess the validity and reliability of the data.

4.4.1 Test for Validity

Before conducting the main analysis, a validity test was performed with all the items in the independent variables and dependent variables that are included in this study. Validity refers to the extent to which an empirical measure adequately reflects the real meaning of the concept under consideration. The content validity in this study can be considered adequate for the variables based on the previous related studies. This way of judging context validity is in accordance with Sekaran (2003). It is well to mention here that the university academic review from the technology management with knowledge of marketing does in no way disapprove this study judgement of validity.

Additionally, a construct validity using factor analysis was carried out to validate the instruments used in this study. The test was conducted based on the data collected from 93 cases. Factor analysis helped determine the construct adequacy of the measuring device. The analysis was carried out using the SPSS data reduction-factor analysis procedure. In the analysis, each factor was assumed to be a separate constructs. Each factor was valid as a construct if the set of items form into a single factor after the analysis. The principal component analysis method with varimax rotation was used to identify the underlying dimensions for each construct.

Factor analysis addressed the problem by analyzing the structure of the interrelationship (correlation) among a large number of variables from which it designs a set of common underlying dimensions. The factor analysis result indicated that multicollinearity between the produced factors was checked and the value of Kaiser-Meyer-Olkin (KMO) in this study, 0.808 was found to be acceptable thus supporting content validy (Refer Appendix C: Factor Analysis). Having found that this value is more than 0.5, it can also be suggested that the sample used was adequate (Zikmund, 2003). The results are outlined in Table 4.3.

Table 4.3
Results of Factor Analysis

Variables	Factor Loading						
	1	2	3	4	5	6	7
Capital investment						0.830	
						0.795	
						0.678	
						0.603	
Customer focus	0.829						
	0.757						
	0.782						
	0.844						
	0.768						
Management team			0.799				
			0.822				
			0.886				
			0.831				
Business planning					0.732		
					0.726		
					0.772		
					0.736		
Product quality				0.696			
				0.824			
				0.824			
				0.765			
				0.686			
Company infrastructure							0.822
							0.842
							0.817
Commercial success		0.821					
		0.807					
		0.721					
		0.694					
		0.600					
KMO			**0.808**				
Bartlett's Test of Sphericity			**2066.975**				
Sig.			**0.000**				

Table 4.3 presents the exploratory factor analysis of all the variables attributes for instrument validating. The factor loadings are roughly analogous to the correlation (or set of correlations) of the original construct with the factor. Each factor loading is a measure of the importance of the variable in measuring each factor. The reported

factor loadings for this study were all more than 0.6. These suggest that no items should be deleted in accordance with the rule-of-thumb suggested by Zikmund (2003). The inter-item consistency or reliability will be discussed in the next subtopic by the application of Cronbach's Alpha.

4.4.2 Test for Reliability

Reliability is an assessment of the degree of consistency between multiple measurements of variables. The most common reliability measure is Cronbach's Alpha. An internal consistency analysis was performed separately for the items of each independent variables and dependent variable using the SPSS reliability procedure. As shown in Table 4.4, the alpha values of reliability analysis for this study are all greater than 0.8. Being greater than the rule-of-thumb value 0.5, this indicates that the questionnaire items are reliable for the construct variable.

Table 4.4
Reliability Analysis Result

Variables	No. of items	Cronbach's Alpha
Capital investment	4	0.873
Customer focus	5	0.894
Management team	4	0.902
Business plan	4	0.881
Product quality	5	0.833
Company infrastructure	3	0.888
Commercial success	5	0.897

4.5 Examining the Data Variable Scores

The six success factors that represented independent variables are capital investment (X1), customer focus (X2), management team (X3), business planning (X4), product quality (X5), and company infrastructure (X6). The measurement of commercialisation success (Y) in this study is a construct for profitability and overall success. An adequate examination on the data gathered from the survey was conducted to ascertain whether underlying assumptions are met in order to use correlation and regression techniques. The main assumptions tested here are that of normality and multicolinearity.

4.5.1 Normality Test

The first assumption to be met is normality, which refers to the shape of the data distribution for each variable and its correspondence to the normal distribution. This assumption can be tested using statistical tests based on skewness and kurtosis. The statistical value (z) for the skewness and kurtosis value is calculated based on formulae in Table 4.5 and the result of these calculations are reported in Table 4.6.

Table 4.5
Z value of Skewness and Kurtosis

Skewness	**Kurtosis**
$Zskewness = \frac{Skewness}{\sqrt{6/N}}$	$Zkurtosis = \frac{Kurtosis}{\sqrt{24/N}}$

N is a sample size

Table 4.6
Normality Test of Distribution

Variables		Shape of Distribution			
		Skewness		Kurtosis	
		Statistic	z value	statistic	z value
X1	Capital investment	-0.421	-1.65748	0.001	0.00197
X2	Customer focus	-0.826	-3.25197	0.688	1.35433
X3	Management team	-0.520	-2.04724	-0.303	-0.59646
X4	Business planning	-0.991	-3.90157	0.872	1.71653
X5	Product quality	-0.032	-0.12598	-0.012	-0.02362
X6	Company infrastructure	-0.612	-2.40945	-0.587	-1.15551
Y	Commercial success	-1.289	-5.07480	2.213	4.35629

The result for skewness values obtained ranged from -5.07 to -0.13 while that for kurtosis ranged from -1.16 to 4.36. According to Park (2008), a normally distributed random variable should have z skewness or kurtosis values within plus or minus three. The output clearly suggests that all the success factor these variables are close to being normal with no severe problem. The histogram for all items score compared with a normal curve is given in Figure 4.2 to 4.8.

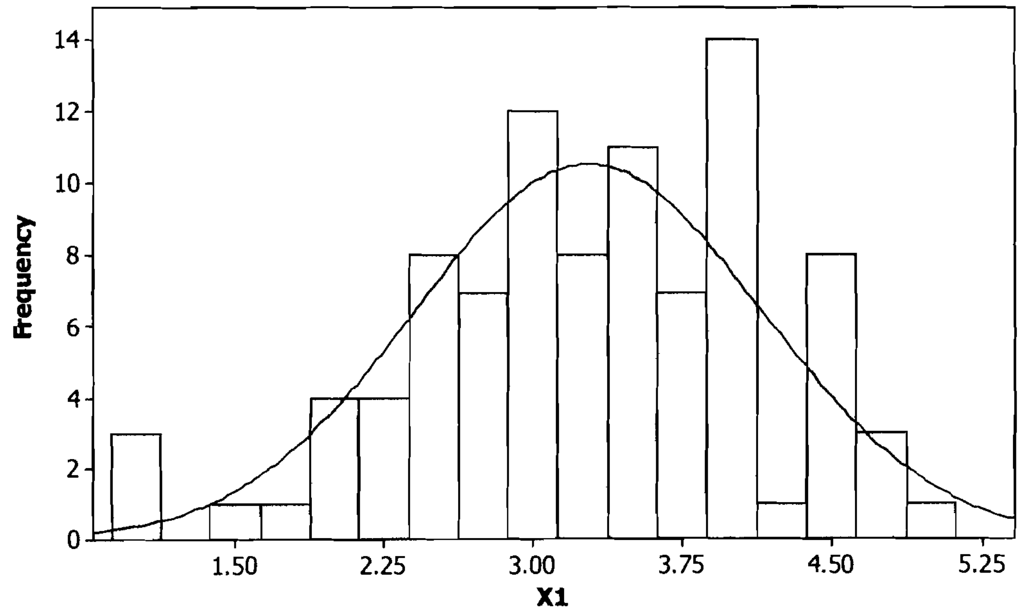

Figure 4.2: Histogram (with Normal Curve) of Capital Investment (X1)

Figure 4.2 illustrates a normal curve of Capital Investment, X1. The distribution of the data obtained is not that symmetric but with slight skewness. The distribution is termed left-skewed having a thin left tail. In this case, the mean is smallest perhaps due to the presence of an outlier. Here, among the averages, the mode has the greatest value, while in between the mean and the mode is the median. It is less peaked and on overall this can be taken as being close to being normal.

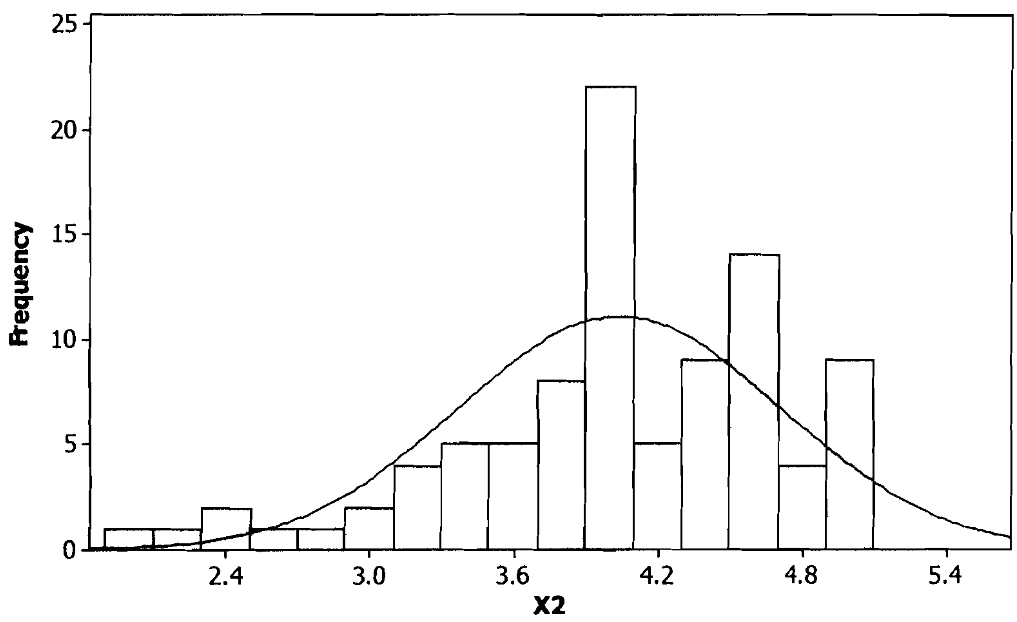

Figure 4.3: Histogram (with Normal Curve) of Customer Focus (X2)

Figure 4.3 draws histogram (with normal curve) of Customer Focus which is negatively skewed. The skewed distribution is asymmetrical because of a natural limit that prevents outcomes on one side. The distribution's peak is off centre toward the limit and a tail stretches left away from it. The skewness value-3.25 is slightly off range but the kurtosis value 1.35 is within the acceptable range of normal scores.

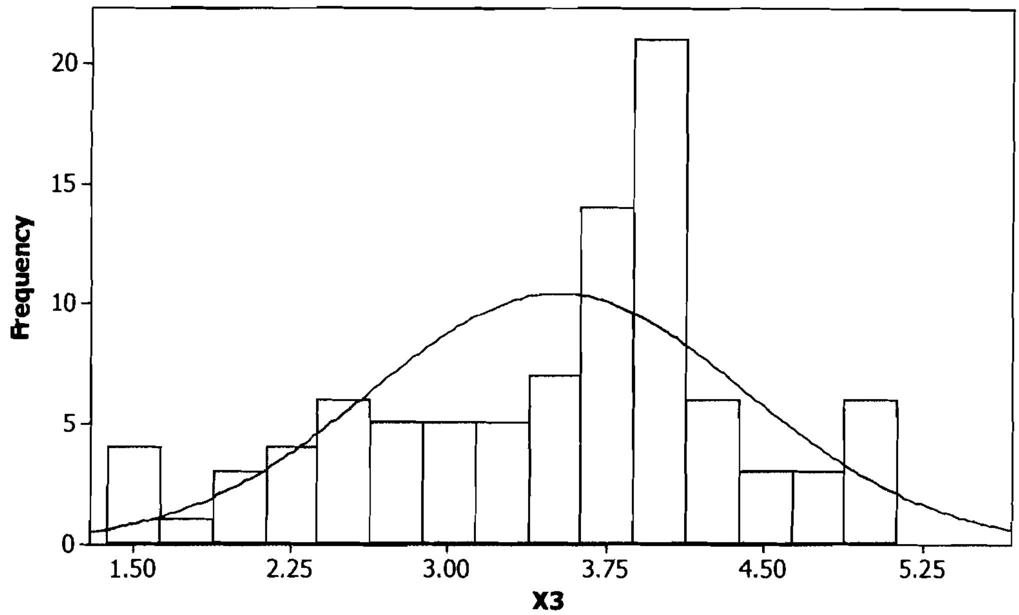

Figure 4.4: Histogram (with Normal Curve) of Management Team (X3)

Figure 4.4 frames a histogram (with normal curve) for Management Team. The figure suggests that the distributions are close to being normal. Refering to Table 4.6; the z skewness value being -2.0 is within the range of the scores being symmetrical and together with a kurtosis value close to zero, these scores can be reasonably taken as being normally distributed.

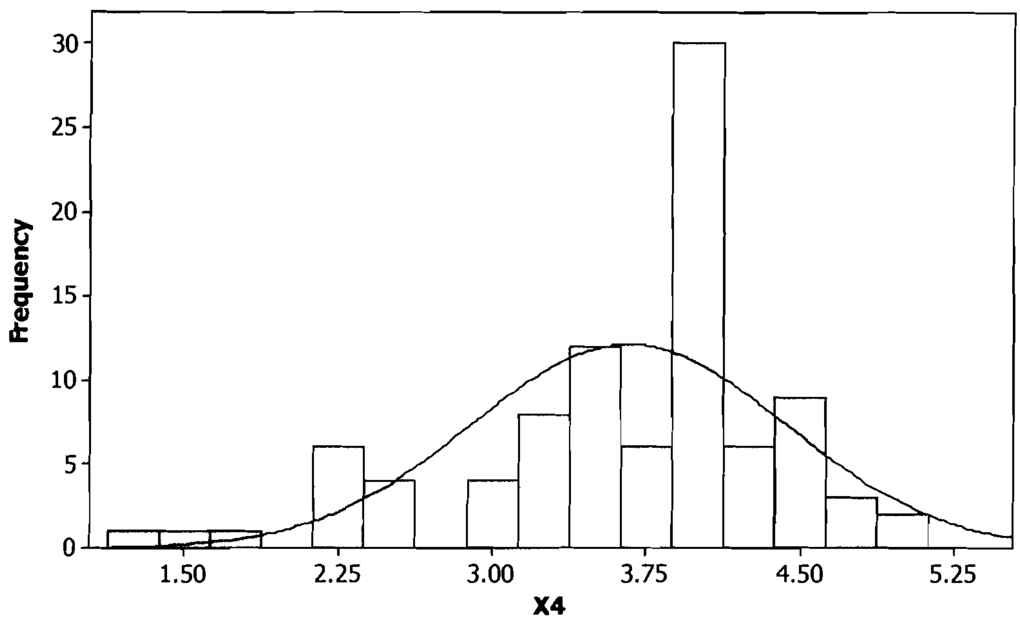

Figure 4.5: Histogram (with Normal Curve) of Buisness Plan (X4)

Referring to Figure 4.5, the histogram of Business Plan shows a slightleft-skewed or negatively skewed distribution. With a negatively skewed distribution, most of the scores tend to occur toward the upper end of the scale while increasingly fewer scores occur toward the lower end. It skewness z-value -3.9 is slightly out of range but the kurtosis z-value 1.7 is within range. Thus it can be taken to be near normal score variable for this study.

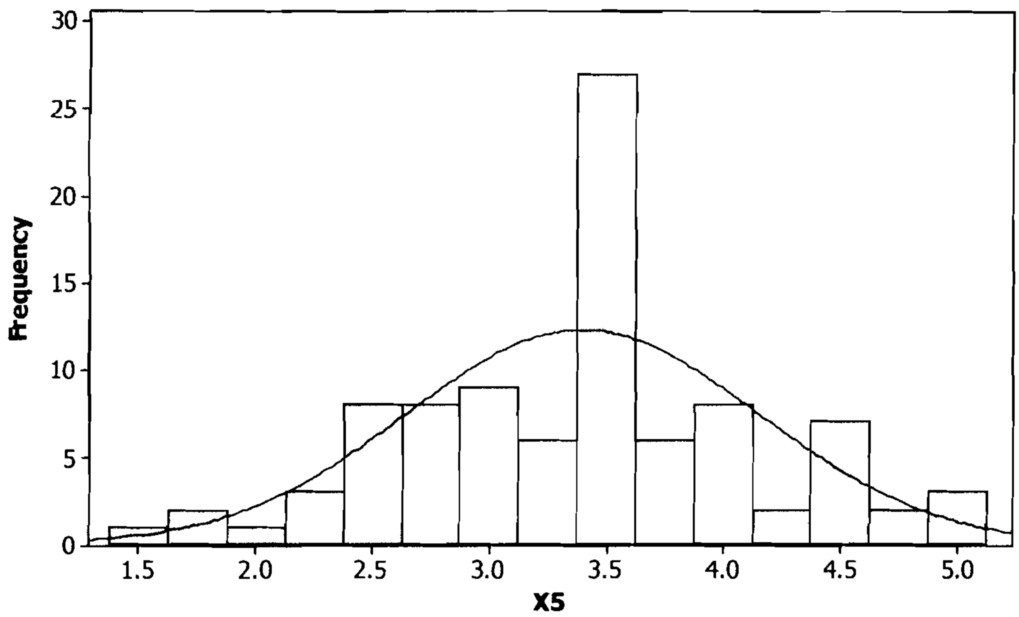

Figure 4.6: Histogram (with Normal Curve) of Product Quality (X5)

Figure 4.6 illustrates a normal curve of Product Quality, X5. The distribution of the data obtained is seen close to being symmetrical. Having both skewness and kurtosis z-value close to zero (-0.13 and -0.02 respectively) the scores can sably be taken as normal.

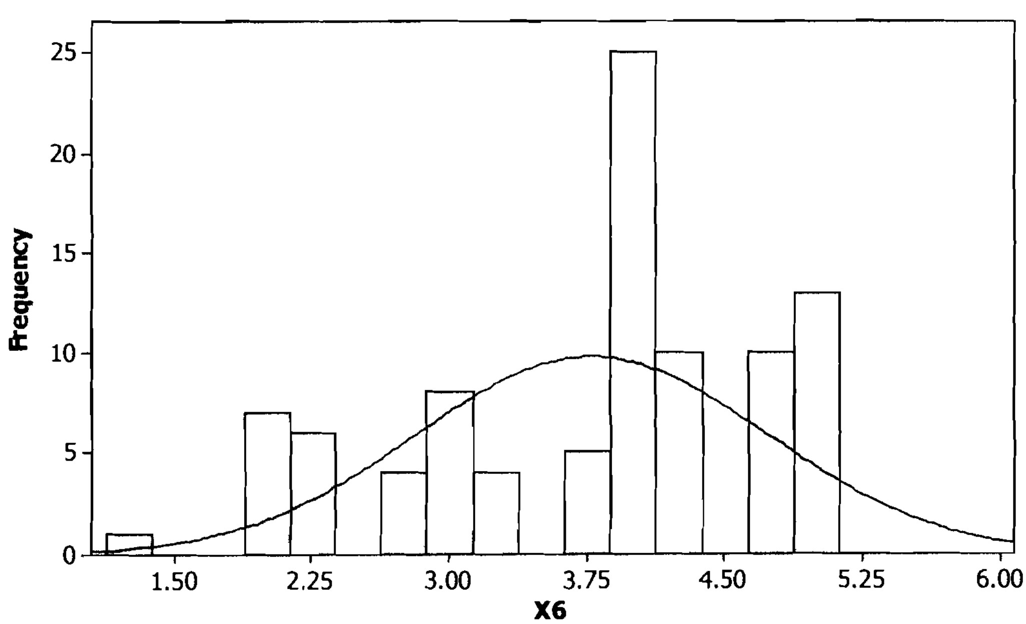

Figure 4.7: Histogram (with Normal Curve) of Company Infrastructure (X6)

Figure 4.7 presents a histogram of Company Infrastructure (X6). The histogram is asymmetrical with a skewness z-value of -2.4 but still within normally range. Together with a within range of kurtosis z-value (-1.6), the scores for company infrastructure can be taken as normal. Figure 4.8 is a histogram of the dependent variable representing the commercialisation success (Y). The scores are way off from being normal. The z-value of skewness and kurtosis is respective -5.07 and 4.36 and are out of range. It is thus difficult to account that these scores are having normal. However in regression analysis it is to be noted that the assumption of normally is in essence rest upon the random error term (ε).

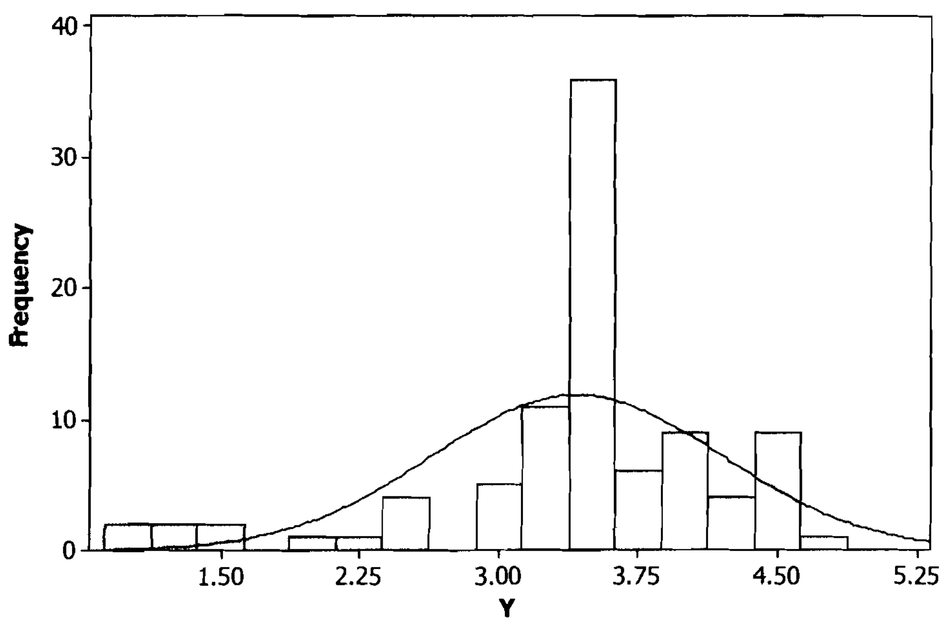

Figure 4.8: Histogram (with Normal Curve) of Commercialisation Success (Y)

In addition, implied in the regression model, is an error random term ε defined as the difference between the Y and its expected or average value E(Y). This error is assumed to be normally distributed having an average of zero and some unknown constant standard deviation σ. Here the normally of the error term was tested by the normal probability plot (p-p plot). The output is presented in Figure 4.9.

Figure 4.9: Normal P-P Plot of Regression Standardized Residual

Dependent Variable: Y

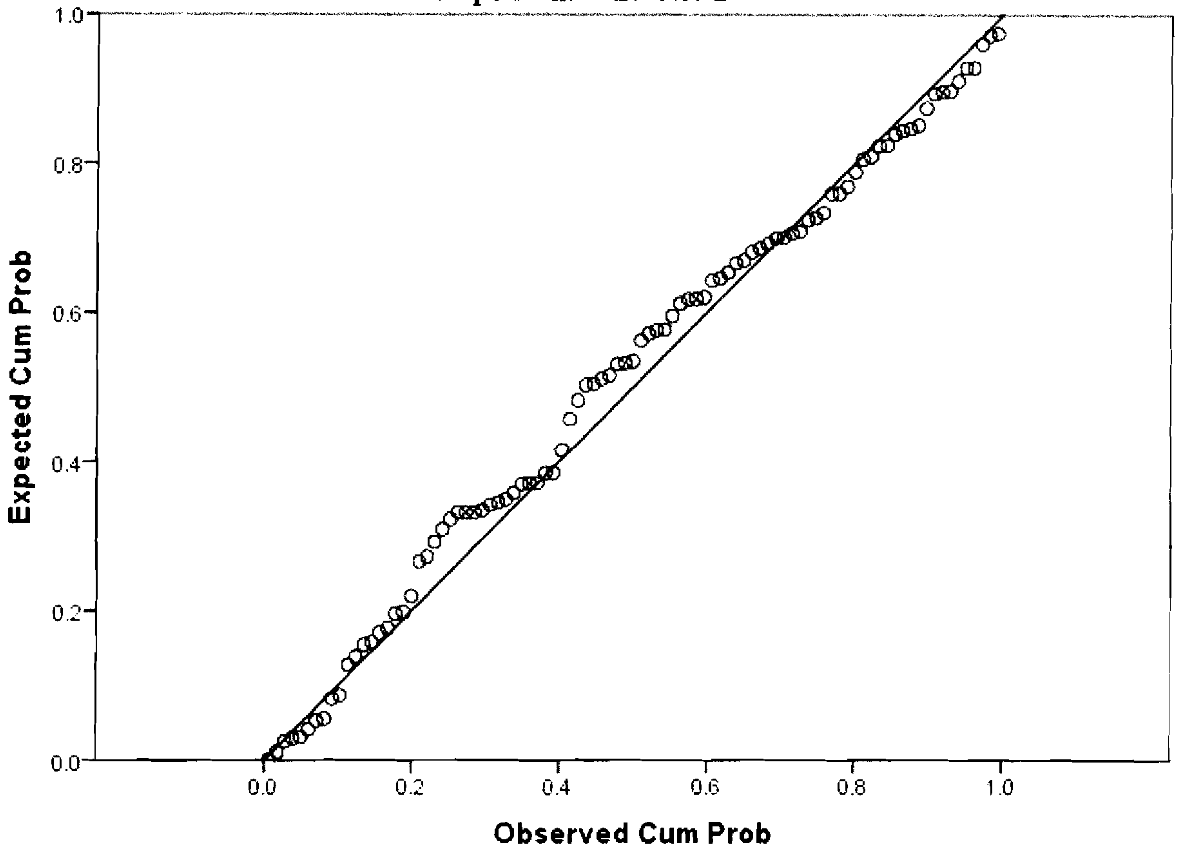

Figure 4.9:
Normal P-P Plot of Regression Standardized Residual

The normal plot of regression standardized residuals for the dependent variable (Y) represented by the dotted open-circle. These dots are about close to the straight line representing normal scores. The dotted and straight line is the normal line while the other is standardized residual. It is seen that the observed residual is not far above and far below the normal line. Therefore the normal probability plots together with the analysis based on skewness and kurtosis value provide sufficient evidence to suggest that the data of the present study are approximately normally distributed.

4.5.2 Multicollinearity Test

The next assumption to be fulfilled in this study in order to use regression analysis is multicolinearity. In regression analysis, independent variables (X's) must not correlate with each other. Otherwise the problem of correlated X's is referred to as multicolinearity. Two common measures for assessing both pairwise and multiple variables collinearity are tolerance value and variance inflation factor (VIF).

The results of this test are shown in Table 4.7. A common cut off threshold is a tolerance value of 0.10 which corresponds to VIF value of above 10. As presented in Table 4.7, the VIF and tolerance values indicate inconsequential collinearity. No VIF value exceeds 10.0 and the tolerance values show that collinearity does not explain more than 10% of any independent variable's variance. Thus, this indicates that there is no support for the existence of multicolinearity problem in this study.

Table 4.7
Result of Multicolinearity Testing

Variables	Collinearity Statistic	
	Tolerance	VIF
Capital investment	0.625	1.60
Customer focus	0.730	1.37
Management team	0.687	1.45
Business planning	0.584	1.71
Product quality	0.894	1.12
Company infrastructure	0.663	1.51

4.6 Descriptive Statistics of Variables

Descriptive analysis examines statistical description of variables in the study. Statistics such as mean, median and standard deviation are used in this study. These scores highlight the respondents' feedback obtained from the data collected through the questionnaires.

This section will evaluate the level of respondents agreement towards entire variables tested in this study. Respondents were asked to indicate their agreement towards the statements of the variables, using the five points Likert scale. Means score for each variable were then computed to determine their level of agreement based on three groups as presented in Table 4.8:

Table 4.8
Level of Agreement

Range of mean values	Level of agreement
1.00 to 2.33	Low
2.34 to 3.66	Moderate
3.67 to 5.00	High

Table 4.9 reports the descriptive statistics of all variables. Respondent in general have moderate level of agreement on factors: capital investment (X1), business planning (X3), management team (X4) and product quality (X5). This can be highlighted that nanotechnology companies do not practice those factors dreadfully. Meanwhile, it can be seen that only customer focus (X2) and company infrastructure (X6) have a high ratings on average which reports the mean value more than 3.67. This gives conclusion that most of the nanotechnology organisations give close attention to these two factors. For the variable Y, commercial success, respondents have agreed that their level of success in commercialising nanotechnology do not yet reach the high level. So, they still need to improve and focus more on the factors influencing the commercial success.

Table 4.9
Descriptive Statistics of Variable

	Variable	Mean	Stand Dev.	Median	Interquartile Range
X1	Capital investment	3.277	0.880	3.25	1.25
X2	Customer focus	4.040	0.670	4.00	0.80
X3	Management team	3.516	0.891	3.75	1.13
X4	Business planning	3.664	0.766	4.00	0.75
X5	Product quality	3.398	0.756	3.40	0.90
X6	Company infrastructure	3.770	0.949	4.00	1.50
Y	Commercial success	3.417	0.783	3.40	0.70

Table 4.9 also shows that the median for all the questions items is 4.0 except for capital investment (3.25), management team (3.75), product quality and commercial success (3.40 respectively). In general, the respondent's all factors standard deviation is around 0.8 point.

4.7 Hypothesis Testing

This section revealed the results of hypotheses testing involving the relationship between factors affecting nanotechnology commercialisation. The hypotheses (from H1 to H6) are concerned with the correlation of each factor and the success of nanotechnology product commercialisation. Meanwhile the seventh hypothesis investigates the impact of the six factors in combination on the level of success in nanotechnology product commercialisation. Two types of statistical techniques were used to conduct the hypotheses testing. The Pearson's product-moment correlation coefficient was applied to examine hypotheses 1 to 6 and multiple regression analysis was used to examine hypothesis 7.

Table 4.10
Hypotheses (from H1 to H6) of the study

Hypotheses	Statement of Hypotheses
H1	Capital investment significantly correlates with nanotechnology commercialisation success
H2	Customer focus significantly correlates with nanotechnology commercialisation success
H3	Management team significantly correlates with nanotechnology commercialisation success
H4	Business planning significantly correlates with nanotechnology commercialisation success
H5	Product quality significantly correlates with nanotechnology commercialisation success
H6	Company infrastructure significantly correlates with nanotechnology commercialisation success

Table 4.10 indicates the hypotheses from H1 to H6 in this study, while the statement of the seventh hypothesis is stated below:

H7: Capital investment, customer focus, management team, business planning, product quality and company infrastructure in combination affect the successful of nanotechnology commercialisation.

4.7.1 Correlation Analysis

As the levels of measurement of the variables concerned are interval and the normality assumption has been met reasonably, the parametric correlation technique was used to test hypothesis one to six. Therefore to answer the second research objective, the Pearson product-moment correlation method was used in this study to test hypotheses H1 to H6, which involves testing the relationships between each factor and nanotechnology commercial success.

4.7.1.1 Testing Hypothesis 1

Hypothesis 1 was tested to establish the relationship between capital investment (X1) and nanotechnology commercialisation success (Y).

Table 4.11
Correlation Coefficients between X1 and Y

		Correlation
	Capital investment (X1)	
Nanotechnology commercial success (Y)	Pearson correlation, *r*	0.625**
	P value	0.000

**Correlation is significant at the 0.01 level (2-tailed)
*Correlation is significant at the 0.05 level (2-tailed)

Table 4.11 shows capital investment is significantly associated to nanotechnology commercial success at value of r=0.625 and p<0.01. The strength of relationship is 0.625 which propose a strong correlation. This positive relationship suggests that higher respondents' preference in capital investment means the higher effects to nanotechnology commercialisation success will be. The null hypothesis of no correlation can be rejected as the p-value is very small (0.000), thus a significant correlation is established. Hence, the result supports H1.

4.7.1.2 Testing Hypothesis 2

Hypothesis 2 was run to examine the relationship between customer focus (X2) and nanotechnology commercial success (Y).

Table 4.12
Correlation Coefficients between X2 and Y

		Correlation
	Customer focus (X2)	
Nanotechnology commercial success (Y)	Pearson correlation, *r*	0.406**
	P value	0.000

**Correlation is significant at the 0.01 level (2-tailed)
*Correlation is significant at the 0.05 level (2-tailed)

Table 4.12 shows there is positive correlation between customer focus and nanotechnology commercial success with r=0.406. The strength of relationship is 0.406 which suggest moderate correlation. The alternative hypothesis of possible correlation between variables can be accepted, as suggested by the small p-value (0.000). Thus positive correlation here is significant and again H2 is accepted.

4.7.1.3 Testing Hypothesis 3

Hypothesis 3 was run to examine the relationship between management team (X3) and nanotechnology commercial success (Y).

Table 4.13
Correlation Coefficients between X3 and Y

		Correlation
	Management team (X3)	
Nanotechnology commercial success (Y)	Pearson correlation, *r*	0.420**
	P value	0.000

**Correlation is significant at the 0.01 level (2-tailed)
*Correlation is significant at the 0.05 level (2-tailed)

Table 4.13 shows there is positive correlation between management team and nanotechnology commercial success. The Pearson correlation, r=0.420 indicates moderate correlation. This proposed that management team give moderate effect to nanotechnology commercialisation success. The alternative hypothesis of correlation between these variables can be accepted as the reported p-value (0.000) is very small. Again, this indicates a significant positive correlation.

4.7.1.4 Testing Hypothesis 4

Hypothesis 4 was run to examine the relationship between business plan (X4) and nanotechnology commercial success (Y).

Table 4.14
Correlation Coefficients between X4 and Y

		Correlation
	Business planning (X4)	
Nanotechnology commercial success (Y)	Pearson correlation	0.598**
	P value	0.000

**Correlation is significant at the 0.01 level (2-tailed)
*Correlation is significant at the 0.05 level (2-tailed)

Table 4.14 shows there is positive correlation between business plan and nanotechnology commercial success. The strength of relationship is 0.598 which suggest a pretty strong correlation. So, the higher respondents' preference to business planning means the higher effect to the success of nanotechnology commercialisation will be. Similarly, company with less business planning tend to gain less success in commercialisation of nanotechnology. Having a small p-value (0.000), the null hypothesis can be rejected. Thus there is significant positive correlation between business plan and nanotechnology commercialisation success. The hypothesis H4 is accepted, indicating a strong positive correlation.

4.7.1.5 Testing Hypothesis 5

Hypothesis 5 was tested to establish the relationship between product quality (X5) and nanotechnology commercial success (Y).

Table 4.15
Correlation Coefficients between X5 and Y

		Correlation
	Product quality (X5)	
Nanotechnology commercial success (Y)	Pearson correlation, *r*	0.227*
	P value	0.029

**Correlation is significant at the 0.01 level (2-tailed)
*Correlation is significant at the 0.05 level (2-tailed)

Table 4.15 shows there is positive correlation between product quality and nanotechnology commercial success at 0.05 level of significant. The reported *r* value is 0.227 which suggested a weak correlation. This weak correlation could not define the relationship perfectly. Although weak, this positive correlation is accepted as the reported p-value (0.029) is small.

4.7.1.6 Testing Hypothesis 6

Hypothesis 6 was run to examine the relationship between company infrastructure (X6) and nanotechnology commercial success (Y).

Table 4.16
Correlation Coefficients between X6 and Y

		Correlation
	Company infrastructure (X6)	
Nanotechnology commercial success (Y)	Pearson correlation, *r*	0.435**
	P value	0.000

**Correlation is significant at the 0.01 level (2-tailed)
*Correlation is significant at the 0.05 level (2-tailed)

Table 4.16 shows there is positive correlation between company infrastructure and nanotechnology commercial success. The strength of relationship is 0.435 which suggest moderate correlation. The alternative hypothesis of correlation between these variables cannot be rejected, again because of a small p-value (0.000). Thus the positive correlation is considered significant.

4.7.2 Multiple Regression Analysis

This section attempts to test the seventh hypothesis H7. The objective is to determine the aggregate effect of six independent variables (capital investment, customer focus, management team, business planning, product quality and company infrastructure) on the success in nanotechnology product commercialisation. Multiple regression analysis was employed to evaluate the simultaneous effects of all the independent variables on the nanotechnology commercialisation success.

4.7.2.1 Testing Hypothesis 7

Hypothesis H7 tests for the combination effect of capital investment, customer focus, management team, business planning, product quality and company infrastructure on the success of nanotechnology commercialisation. The result for the significance of regression is presented by the analysis of variance (ANOVA) in Table 4.17.

Table 4.17
Aggregate Effect of the Independent Variables on Nanotechnology Commercialisation Success

R-Sq	R-Sq (adj)	Std. Error of the Estimate	F value	P value
0.537	0.505	0.55099	16.614	0.000

This is an F-test with an F-value 16.614 and a very small p-value reported as 0.000. Thus the null hypothesis of no regression cannot be accepted and the regression equation is taken to be significant. The standard error of the estimate is equal to 0.55099 estimates the model standard deviation (σ). This small value says that the data points scatter close to the estimated line indicating a good fit.

The coefficient of determination or R-Sq statistic explains what portion of the total variability or information contained in the response Y is due to regression. In this regression, 53.7% of the total variability in the commercialisation success measure Y is due to regression. This big portion of explanation indicates a good fit.

R-Sq(adj) is similar to R-Sq except for an adjustment that accounts for the sample size and the number of predictors. A big value of 50.5% is indicative of the regression being a good explanation or fit of variability in Y. The following Table 4.18 is a summary of all the t-test for the significance of the regression coefficients (β's).

Table 4.18
Influence of Predictors on Commercialisation Success

Variables	Unstandardized coefficient		Standardized coefficient	t	Sig. Value
	B	Std. Error	Beta		
Constant	0.119	0.440		0.270	
X1	0.321	0.083	0.361	3.889	0.000
X2	0.073	0.100	0.062	0.726	0.470
X3	0.092	0.078	0.105	1.182	0.240
X4	0.316	0.098	0.309	3.218	0.002
X5	0.034	0.080	0.033	0.425	0.672
X6	0.094	0.074	0.114	1.269	0.208

As shown in table 4.18, the regression coefficients of the six factors are different from zero but not all reach significant level. Only X1 and X4 reported the p-value <0.05. Even though there is significant relationship between nanotechnology commercialisation success and the six factors jointly, but X2, X3, X5 and X6 has no significant contribution to the prediction of improved commercialisation success. This can be concluded that nanotechnology commercialisation success is affected by the combination of all the six factors. Hence, H7 was supported.

4.8 Stepwise Regression

Stepwise regression removes and adds variables to the regression model for the purpose of identifying a useful subset of the predictors. This study applies the criteria probability-of-F-to-enter ≤ 0.05 and probability-of-F-to-remove ≥ 0.10. The stepwise regression is carried out to decide on which particular factor are significant. The result of this regression is in Table 4.19.

Table 4.19
Stepwise Regression Results

	Step 1	Step 2
Constant	1.5971	0.6347
X1	0.555	0.396
t-value	7.63	5.41
p-value	0.000	0.000
X4		0.406
t-value		4.82
p-value		0.000
S	0.615	0.551
R-Sq	39.02	51.53
R-Sq (adj)	38.35	50.45

Based on the step 2 in stepwise regression, it suggests only two variables (capital investment and business planning) give significant contribution to nanotechnology commercialisation success with a small p-value 0.000. Result of t-value indicate that capital investment give more contribution to the response variable rather than customer focus.

4.9 Order of Effect Importance

Based on multiple regression and stepwise regression analysis, the effect from the regressions analysis is ordered in descending order. The result is in Table 4.19.

Table 4.19
Order of Effect Importance

Ordered effect	X1	X4	X6	X3	X2	X5
Effect (β)	0.321	0.316	0.095	0.092	0.073	0.034
p-value	0.000	0.002	0.206	0.240	0.471	0.627

The two effects that contribute significantly to the success of nanotechnology commercialisation in order of importance are capital investment, X1 and business plan, X4. The other effect (X6, X3, X2, and X5) are small and not significant.

4.10 Chapter Conclusion

This chapter presents the summarisation of demographic background of respondents. After that, several assumptions were examined using normality and multicolinearity test before doing regression. The result reported that there was no multicolinearity problem and that the distribution can be assumed normal in this study. All research hypotheses have been tested to evaluate the research objectives. The next chapter will discuss the research findings followed by possible direction for future research, discussion and recommendation.

CHAPTER FIVE

DISCUSSION OF FINDINGS AND CONCLUSION

5.1 Introduction

This chapter discusses the findings of this research according to the results reported in chapter four. The first section contains a discussion of the results presented in chapter four. Next, some of the limitations of the research were examined. It is followed by the implications and suggestions of the study's relevance to researchers and practitioners. The final section presents the limitations and possible direction for future study. The report ends with the conclusion for the study.

5.2 Recapitulation of the Study

One of the purposes of this study was to explore the relationship between identified factors and the nanotechnology product commercialisation success. There are three main research questions that guided the study, these questions are:

a) What are the success factors of nanotechnology commercialisation in Malaysia?

b) What is the relationship between these factors with the success of nanotechnology commercialisation in Malaysia?

c) In what order of importance do these factors affect the success of nanotechnology commercialisation in Malaysia?

5.3 Discussion and Summary of Findings

The main objective of this study is to identify the factors that influence the nanotechnology commercialisation success in Malaysia market. This study also establishes the relationship between those factors with the nanotechnology commercial success and aims to analyze which is the most influencing factor that affects the successful of nanotechnology commercialisation.

Descriptive analysis was done for each variable in this study. The result shows that the mean value for the dependent variable (nanotechnology commercialisation success) is 3.417. Although this value is above average, it can still be considered less favourable to Malaysian industries. This level is consistent with the mean values of around 3.5 for all the studied success factors. Thus, this results point that Malaysian industries are simply averages in their practice of these six success factors. To be at a better level of commercialisation success, improvement efforts in the practice of these success factors needed more focus. A summary in Table 5.1 reports the descriptive statistic for each variable in this study.

Table 5.1

Descriptive Statistic for Research Variable (n=93)

Variables	**Mean**	**Standard Deviation**
Dependent Variable		
Commercialisation Success	3.417	0.783
Independent Variables		
Capital investment	3.277	0.880
Customer focus	4.040	0.670
Management team	3.516	0.891
Business planning	3.664	0.766
Product quality	3.398	0.756
Company infrastructure	3.770	0.949

5.3.1 Correlation Analysis

Table 5.2 summarizes the results of correlation analysis from the correlation tables in the previous chapter. The results of all the tests supported that the success of nanotechnology commercialisation is related to capital investment, customer focus, management team, business planning, product quality and company infrastructure.

Table 5.2

Hypothesis Result based on Correlation Analysis

Hypothesis	**Statement of Hypothesis**	**Correlation (p-value)**	**Result**
H1	There is a significant correlation between capital investments and nanotechnology commercial success.	0.625 (0.000)	Supported
H2	There is a significant correlation between customer focus and nanotechnology commercial success.	0.406 (0.000)	Supported
H3	There is a significant correlation between management team and nanotechnology commercial success.	0.420 (0.000)	Supported
H4	There is a significant correlation between business planning and nanotechnology commercial success.	0.598 (0.000)	Supported
H5	There is a significant correlation between product quality and nanotechnology commercial success.	0.227 (0.029)	Supported
H6	There is a significant correlation between company infrastructure and nanotechnology commercial success.	0.435 (0.000)	Supported

From the result of correlation analysis, capital investment is found to have positive and significant relationship with the success of nanotechnology commercialisation. The Pearson correlation 0.625 suggests a strong correlation. This indicated a strong relationship between capital investment and the success in commercialising nanotechnology. Most of the companies need sources of capital to commercialise nanotechnology because a large amount of money is needed in investing for nanotechnology. This outcome confirms with the study made by Oriaki (2004) who stated that the ability of a firm to creatively generate capital from various sources to finance the commercialisation efforts is a critical success factor.

Customer focus has moderate positive significant correlation on the nanotechnology commercialisation success with correlation value of 0.420 and a small p-value. This explained that company must organize a well defined strategy that may attract people to buy their product. Target customer is consulted in order to influence the company's success in their target sales. So it is important to respect the customers' needs and always update what they want. This finding is in accordance with Nelson et al (2005) and Meyers et al. (1999) that reported that there is significant correlation between customer satisfactions and company achievement.

It is clear that companies should provide a good management team in order to achieve success in commercialising nanotechnology based product. With a moderate correlation (0.420) that is significant, this study confirms that management team that comprises of a good team leader, right team behaviour cooperation, good internal teamwork and communication between divisions in an organisation correlates with the smoothness of management success in commercialisation of product innovation process. This finding is consistent with the previous study by

Mc. Neil et al. (2007), Valentin et al. (2004), and Large et al. (2000) who found that cross-disciplinary teams and cross-functional teams are needed in order to realize the success of commercialisation of product innovation.

As expected, the correlation between the business plan and success of nanotechnology commercialisation is strongly positive (0.598) and with a p-value of 0.000 is statistically significant. Thus the result supports the hypothesis that the success of nanotechnology commercialisation is correlated with business plan. It is here stressed that this finding is in accordance with Clark (1999) and Seah et al (1997) who proposed that the critical factors that had been identified to the success of a project are that of being clear in objectives and scope; and being well-consisted in project planning and overall communication of the project.

The variable 'product quality' seems to have a weak positive correlation (0.227) but significant (0.029) with the success of nanotechnology commercialisation for companies in Malaysia. Thus the finding by Jacobson and Aaker (1987) that product quality can facilitate increased profitability is supported only by a weak correlation. One possible reason for weak correlation is that organisations are moderate in their implementation of quality policy activities with customers becoming less aware and less sensitive to quality products.

The correlation between company infrastructure and success of nanotechnology commercialisation is moderately positive (0.435) and with p-value of 0.000 is significant. This supports that company's infrastructure plays an important assisting role in the success of commercialisation. Good infrastructures such as transportation, communication, sewage, water and electric systems, buildings and installation necessary for support and operation, necessarily facilitates the production of goods and services, as well as the distribution of finished products to market.

5.3.2 Regression Analysis

The multiple regression analysis results are presented in Table 4.17 and 4.18. The estimated regression model is

$$Y= 0.119 + 0.321X1 + 0.073X2 + 0.092X3 + 0.316X4 + 0.034X5 + 0.094X6$$

With a big F-value (16.614) and a very small p-value (0.000), the regression equation is considered significant. Thus, this supports the hypothesis that in combination the six success factors affect the commercialisation success of nanotechnology product in Malaysia. Table 5.3 is a summary for the analysis.

Table 5.3
Hypothesis Result based on Regression Analysis

Hypothesis	Statement of Hypothesis	F (p-value)	Result
H7	Capital investment, customer focus, management team, business plan, product quality and company infrastructure in combination effect the success of nanotechnology commercialisation	16.614 (0.000)	Supported

Although taken in combination the success factors are together significant in the regression explanation of nanotechnology product commercialisation success, but on individual basis, only capital investment and business plan that could bring about significant changes when referred to the β coefficients in the estimated regression equation.

5.3.3 Order of Effects Importance

This section has answered the third objective in this study which is to determine the order of importance of factors influencing nanotechnology commercialisation success. Looking at the β coefficient in the regression model, capital investment has a biggest significant positive effect followed by business planning. The other effects (customer focus, management team, product quality and company infrastructure) although positive but they are too small and insignificant. In order of importance thus are: capital investment, business plan, company infrastructure, management team, customer focus and product quality.

This result shows that industries involving in nanotechnology product commercialisation in Malaysia have strength mainly in capital investment and business plan but lacking in company infrastructure, management team, customer focus and product quality.

5.4 Implication of Study

This study offers several contributions to the literature in identifying the success factors in commercialising nanotechnology product with respect to the Malaysian industry. Players involved directly or indirectly in the nanotechnology product commercialisation activities must give serious priority to the six success factors that were found to positively correlate strongly with the success of product commercialisation.

Top level decision makers and managers of the industry should give due focus to capital investment and business plan as these are the first two biggest contributing factors to nanotechnology product commercialisation success The third in this priority list of contributing factors is company infrastructure. Although high on average (scored 3.7) the need to keep priority at this level is vital.

Management team work, customer focus and product quality are the last three in the priority list. Although small, the effect is positive and attention is appropriately seen in Malaysian industries (average levels being above 3 points). The implication is that industries should not lose track on these factors that seem to appear less important. Below in Table 5.4 is the overall summary statistics related to the above explanation of implication.

Table 5.4
The Overall Summary Statistics

Success Factors	**Mean** $\bar{X}$	**Correlation (r)**	**Standardized Coefficient (Beta)**
Capital Investment	3.277	0.625	0.361
Customer Focus	4.040	0.406	0.062
Management Team	3.516	0.420	0.105
Business Plan	3.664	0.598	0.309
Product Quality	3.398	0.227	0.033
Company Infrastructure	3.770	0.435	0.114

At the national level, Malaysian government and its related agencies such as Ministry of Science, Technology and Innovation (MOSTI), National Nanotechnology Initiative (NNI), and other contributing institutions, continue to play more active role in promoting the six success factors that were found to be significant contributor to the nanotechnology product commercialisation success.

The creation of grants and financial supports by this government proves to be substantive and should results in further improvements in the nanotechnology industry and its commercialisation success with the application of the six success factors in Malaysia.

Product quality though not significant, has positive effect in combination with other factors in contributing to the commercialisation success of nanotechnology products. The implication is that government agency such as SIRIM needs to constantly monitor various aspects of nanotechnology product quality standards, playing this role as a team together with the other Malaysian nanotechnology industry players.

5.5 Limitation of Study

Given these findings, it is important to note the limitations of this study. First, the perspective of this research is in the area of nanotechnology business in Malaysia. The sample used a simple random probability sampling method. The data and information gathered were from the private organisations sectors that commercialise nanotechnology which registered from various databases. In spite of this, caution are need as some of the study findings might not be applicable to other sectors.

Secondly, a respondent in this study is a single one person from one organisation. It was possible that the self-reported measures suffered from individual bias. Companies were, nevertheless assured of confidentially and anonymity to reduce this perceptual bias in the data.

Finally, this study only focused on the factors that affect the nanotechnology commercialisation success in Malaysia industry. Since the study had use questionnaires, the response to the questionnaire had several limitations. One limitation is the low rate probably because the participants are essentially volunteers.

5.6 Suggestion for Future Research

In view of the above limitations, the following are suggested for future research. Since this study focuses solely on the private sector, it is recommended for the future research to expend the study to public sector such as public research institutions, universities and the general public that are consumers of products in Malaysia. Furthermore, this study uses only one respondent representative one organisation, so the possibility of bias may exist in a way that the respondent unknowingly expresses his strong opinion on certain issues. Hence, to avoid this problem, future research should be handled to include a few numbers of respondents representing that one particular organisation.

This study was limited just to the end of the commercialisation process but does not heavily dealt with the beginning stages such as that gaining ideas, issues in research and development, and the various related problems in manufacturing. Since the process of the commercialisation of nanotechnology product is time consuming and concerned with several stages, so it is suggested that future studies take into account all the stages that are involved in nanotechnology projects. This then should investigate possible differences between factors that can have influence on the success of nanotechnology product commercialisation at different levels. A case-study method may be used to achieve this goal.

There is no doubt that all the six success factors on average level are applied in Malaysian nanotechnology industry as found in this study. The concern that of these six factors only two (i.e. capital investment and business plan) are significant contributors of commercialisation success, suggests that further in depth research be to explore reasons and possible hindrance and weaknesses experienced by those companies with respect to those non-significant contributors.

Customers play important role in product sales. While this research does not explore in detailed this area, it is also suggested that research be done to explores those expect of customers acceptance and perception of nanotechnology product in Malaysia. Involving customers in a study should be the basis of further research. Perhaps questionnaires can be distributed directly to the customer that use nanotechnology product.

5.7 Conclusions

In general, this study tends to identify the success factors in nanotechnology commercialisation. Specifically, this study establishes the relationship between those recognized factors with the nanotechnology commercial success in Malaysia industry.

This study provides new empirical evidence on the factors influencing the nanotechnology product commercialisation success at the firm level. It empirically investigates several factors i.e. capital investment, customer focus, management team, business plan, product quality and company infrastructure as the determinant of commercialisation success in nanotechnology sectors. Indeed, the aim of this study was to resolve the gaps that existed in the related literature. This study answered questions about significant and non-significant relationships between the six factors and the nanotechnology commercialisation success.

Based on the results of the study, it can be concluded by addressing the required points in order to meet the objectives of the research that were articulated at the beginning of this dissertation. The first conclusion is that there is a positive significant relationship between the six factors and the nanotechnology commercialisation success. The results indicated that all the independent variables are positive and significantly correlated with nanotechnology commercial success.

The second conclusion is based on the multidisciplinary approach that the single response to commercialisation success is the result from the combination of the six success factors studied. Multidisciplinary approach in this study indicated that the combination of success factors has significant impact on improving the success in nanotechnology product commercialisation. Thus, although only two of the six on individual basis are significant, the multidisciplinary approach taken has concluded that the success of nanotechnology commercialisation based product is influenced by the combination of the six studied factors.

To answer the last objective in this study, a multiple regression was used followed by stepwise regression in order to suggest an order of effect importance. It was revealed that the two effects that contribute to the success of nanotechnology commercialisation in order of importance are capital investment followed by business planning. The other less contributing factor in order of importance are company infrastructure, managerial team, customer focus and product quality.

The six factors as reviewed earlier for foreign markets are significant contributors to the commercialisation of nanoproducts. This is also found true for Malaysian market. Industries in Malaysian market have applied this success factors at an above average level but needed to place more efforts on possible improvement on those that are less in their contribution to the commercialisation success.

The results from this study may be useful to government and business industries in commercialising nanotechnology based product. For managers and business practitioners in particular, these findings would assist them in developing an appropriate course of action for implementing strategies that can potentially enhance the performance of the firms in commercialising nanotechnology products.

REFERENCES

Abbey, A. (1989). The Strategic Management of Technological Innovation. *Industrial Management*, Vol.31, Issue 5; p.16.

Abdullah, S., & Rusop, M. *Forum.* Retrieved February 22, 2010, ITTutor.net: http://www.ittutor.net/forums/index.php?showtopic=38218

Abdullah, S., & Rusop, M. *Nanoteknologi Mampu Tingkatkan Hasil Pertanian.* Retrieved 12 February, 2010, from MajalahSains.com: http://majalahsains.com/2010/01/nanoteknologi-mampu-tingkatkan-hasil-pertanian/

Adis, A. A., & Razli, I. A. (2009). Factors Affecting New Product Development in Malaysian Manufacturing Industry. *International Bulletin of Business Administration*, 19.

Aldrich, H. E., & Fiol, C. M. (1994). Fools Rush In? The Institutional Context of Industry Creation. *Academy of Management Review, 19* (4), 645-670.

Al-Harahsh, Issa Hlaeil (2009). Strategy Implementation within SME in Jordanian of Strategies within Marketing Performance. *Unpublished Master Thesis, Universiti Utara Malasysia.*

APCTT. Report (2010). Innovation in Nanotechnology:An Asia Pacific Perspective. (p. 137). New Delhi: United Nations ESCAP.

Arkebauer, J. (1995). *Guide to Writting a High-Impact Business Plan.* New York: McGraw-Hill.

Arora, A. (2011, September 11). IT infrastructure services – the key component for success in today's business world . *Governor Ed Rendell Infrastructure Third Way event*.

Astebro, T. (2004). Key Success Factors for Technologycal Entrepreneurs' R&D Projects. *Engineering Management, IEEE Transactions* , *51* (3), 314-321.

Asuquo, Gibson E. (2009). Analysis of Successful Commercialisation of Federally Funded R&D Energy Technologies. *UMI Dissertation*

Bainbridge, W. S. (2007). *Nanoconvergence: The Unity of Nanoscience, Biotechnology, Information Technology and Cognitive Science.* Prentice Hall.

Balachandra, R., & Friar, J. (1997). Factors for Success in R&D Projects and New Product Innovation: A Contextual Framework. *Engineering Management* , *44* (3), 276-287.

Cientifica. (2003). *The Nanotechnology Opportunity Report.*

Cooper, R. G., & Kleinschmidt, E. J. (2007). Winning Business in Product Development: the Critical Success Factors. *Research Technology Management* , 52-66.

Cooper, R. G., & Kleinschmidt, E. J. (1996). Winning Businesses in Product Development: The Critical Success Factors. *Research Technology Management* , Vol.39, Issue 4, p.18.

Cornwell, P. (2009). *Postmortem.* New York: Simon & Schuster, Inc.

Cragg, P. B., & King, M. (1988). Organizational Characteristics and Small Firms' Performance Revisited. *Entrepreneurship: Theory & Practice* , *13* (2), 48-64.

Crawford-Lucas, P. A. (1992). Providing Buisness Plan Assistance to Small Manufacturing Companies. *Economic Development Review* , *10* (1), 54.

Crawley, T. (2007). Commercialisation of Nanotechnology-Key Challenges. *Spinverse* (p. 27). Helsinki: Nanoforum, Finland.

Dreger, J. B. (1992). *Project Management: Effective Scheduling by J. Brian Dreger.* Wiley & Sons, Incorporated, John.

Elkins, L. (1996). Tips for Preparing a Business Plan. *Nation's Business* , *84* (6), 60R.

Emmanuel, M. (2011, March 21). *Current_News.* Retrieved April 9, 2011, from Bussiness Times: http://www.btimes.com.my/Current_News/BTIMES/articles/viyu/Article/print_ html

Emory, W., & Cooper, D. R. (1991). *Business Research Methods.* Mountain: Irwin (Homewood, IL).

Garud, R., Jain, S., & Kumaraswamy, A. (2002). Institutional Entrepreneurship in the Sponsorship of Common Technological Standards: The Case of Sun Microsystems and Java. *Academy of Management Journal* , *45* (1), 196-214.

Garvin, D. A. (1984). What Does Product Quality Really Mean? *Sloan Management Review* , 25-43.

Ghazali, Nuur Atikah (2010). the Influence of Market Orientation on the Performance of Students' Owened Business in UUM. *Unpublished Master Thesis, University Utara Malaysia.*

Gordon, N. (2002). *Tips for Bringing Nanotech Products to Market.* Montreal: Sygertech Consulting Group, Inc.

Halim, R. Z. (2010). Innovation in Nanotechnology:An Asia Pacific Perspective. *United Nations ESCAP*, (pp. 93-96). New Delhi.

Hardin, J. (2010). Barriers to the Diffusion of Nanotechnology. *Potential Economic Impacts on Nanoelectronics Conference* (p. 22). North Carolina: UT Austin.

Hardin, J. (2010, December 14). *news research.* Retrieved March 7, 2011, from Dallasfed: http://www.dallasfed.org/news/research/2010/10nano_hardin.pdf

Hashim, U., Elley, N., & Salleh, S. (2009). *Nanotechnology Development Status in Malaysia.* Retrieved 02 January, 2010, from Google: http://publicweb.unimap.edu.my/~ijneam/images/IJNeaM_2_1_119-134.pdf

Hippel, E. V. (1978). Successful Industrial Products from Customer Ideas. *Journal of Marketing* , Vol.42, Issue 1; p.39.

Hobson, D. W. (2009). Commercialisation of Nanotechnology. *Wiley Interdiciplinary Reviews: Nanomedicine and Nanobiotechnology* , *1* (2), 189-202.

Hormozi, A. M., Sutton, G. S., McMinn, R. D., & Lucio, W. (2002). Business Plans for New or Small Businesses: Paving the Path to Success. *Management Decison, 40* (8), 755-763.

Horn, C. V., Clearly, J., & Fichtner, A. (2009). *The Workforce Needs of Pharmaceutical Companies in New Jersey that use Nanotechnology: Preliminary Findings.* New Jersey: Arizona State University.

Hosseini, S. J., & Esmaeeli, S. (2010). To Determine the Challenges in Commercialisation of Nanotechnology in Agricultural Sector of Iran. *Research Journal of Biological Sciences* , *5* (6), 448-451.

Huang, Y. F., & Chang, H. T. (2006). Nile Red-Adsorbed Gold Nanoparticle Matrixes for Determining Aminothiols through Surface-Assisted Laser Desorption/Ionization Mass Spectrometry. *Anal. Chem.* , 1485-1493.

Jacobides, M. G., Knudsen, T., & Augier, M. (2006). Benefitting from Innovation: Value Creation, Value Appropriation and The Role of Industry Architectures. *Research Policy* , *35*, 1200-1221.

Jacobson, R., & Aaker, D. A. (1987). The Strategic role of Product Quality. *The Journal of Marketing*, *51* (4), 31-44.

Kamarulzaman, A. A., Hezlin, H., & Mariati, N. H. (2011). University Research, Development & Commercialisation Management: A Malaysian Best Practice Case Study. *World Review of Business Research*, *1* (2), 179 - 192.

Kirihata, T. (2007). *Critical Success Factors in the Commercialisation Process of Intellectual Property by New Technology Based Firms in Japan.* Kyoto: Kyoto University.

Large, D., Belinko, K., & Kalligatsi, K. (2000). Building successful technology commercialisation teams: Pilot empirical support for the theory of cascading commitment. *Journal of Technology Transfer,* 25, 169-180.

Lee, M., Son, B., & Lee, H. (1996). Measuring R&D effectiveness in Korean companies. *Research Technology Management,* 39(6), 28.

Lin, C., Jiang, J., Wu, Y.-J., & Chang, C. C. (2011). Assessment of commercialisation Strategy Using R&D Capability. *Industrial Management & Data Systems*, *111* (3), 45.

Mason, C. M., & Harrison, R. T. (1996b). Why Business Angles Say No: A Case Study of Opportunities Rejected by an Informal Investor Syndicate. *International Small Business Journal*, *14* (2), 35-51.

Maynard, A. (2009, August 29). Ten Things Everyone Should Know About Nanotechnology Safety. Helsinki.

Mazzola, L. (2003). Commercializing Nanotechnology. *Features* (pp. 1137-1143). California: Nature Publishing Group.

McDonough III, E. F. (2000). Investigation of Factors Contributing to the Success of Cross-Functional Teams. *Product Innovation Management*, *17* (3). 221-235.

McNeil, R. D. (2007, September). *Barriers to Nanotechnology Commercialisation.* Retrieved January 12, 2010, from Google Scholar: http://www.ntis.gov/pdf/Report-BarriersNanotechnologyCommercialisation.pdf

Mohamed, O. (2008). *Penulisan Thesis dalam Bidang Sains Sosial Terapan* (Cetakan Keempat ed.). Serdang: Universiti Putra Malaysia.

Mustafar, Mastora (2007). Faktor-faktor mempengaruhi Kejayaan Komersialisasi Hasil Penyelidikan dan Pembangunan (R&D): Satu Kajian Empirikal dalam Sektor Pembuatan di Malaysia. *Unpublished Thesis.*

Narver, J. C., & Slater, S. F. (1990). The Effect of a Market Orientaion on Business Profitability. *Journal of Marketing*, *54* (4), 20-35.

Nelson, R., Kokic, P., Ellison, L., & King, J. (2005). Structural Adjustment: a Vulnerability Index for Australian Broadacre Agriculture. *Australian Commodities*, *12* (1), 171-179.

Newbold, P., Carlson, W. L., & Thorne, B. M. (2003). *Statistics for business and economics.* Upper Saddle River: Prentice Hall.

O'Connor, J. (1998). *Natural Causes: Essays in Ecological Marxism.* New York: The Guildford Press.

O'Hara, P. (1995). *The Total Business Plan.* New York: John Wiley & Sons.

Oriaki, Christopher O. (2004). Commercialisation of Nanotechnologies. *Published Thesis in Massachusetts Institute of Technology Library*

Orser, B. J., Hogarth-Scott, S., & Riding, A. L. (2000). Performance, Firm Size, and Management Problem Solving. *Journal of Small Business Management*, *38* (4), 42-58.

Osman, T. M., Rardon, D. E., Friedman, L. B., & Vega, L. F. (2004). The Commercialisation of Nanomaterials: Today and Tomorrow. *ABI/INFORM Trade & Industry*, *58* (4), 21-24.

Ouchi, W. G. (1981). *Theory Z: How American Business Can Meet the Japanese Challenge.* New York: Addison- Wesley.

Palmberg, C., Dernis, H., & Miguet, C. (2009). *Nanotechnology: An Overview Based on Indicators and Statistics.* French: OECD Publishing.

Pierre, A. B. (2010, May 09). *Definition of Business Infrastructure.* Retrieved December 23, 2011, from Slideshare Present Yourself: http://www.slideshare.net/PromotionQueen/definition-of-business-infrastructure

Pinto, J. K., & Selvin, D. P. (1989). Critical Success Factors In R&D Projects. *Research Technology Management*, vol.32, Issue 1; p.31.

Poole, C. P., & Owens, F. J. (2003). *Introduction to Nanotechnology.* New Jersey: John Wiley & Sons.

Ramanthan. APCTT. Report (2010). Innovation in Nanotechnology:An Asia Pacific Perspective. (p. 137). New Delhi: United Nations ESCAP.

Ramaseshan, B., Caruana, A., & Loo, S. P. (2002). The Effect of Market Orientation on New Product Performance: A Study among Singaporean Firms. *Journal of Product & Brand Management*, *11* (6), 399-409.

Ratner, M., & Ratner, D. (2003). *Nanotechnology: A Gentle Introduction to the Next Big Idea.* New Jersey: Pearson Education.

Rautaray, D. (2010). Nanotechnology Beyond Basic Research: An Industrial Perspective. *Tech Monitor*, 17-20.

Rooney, R. (2009). Tremendous growth got you down? How to keep up with new business via a strong infrastructure. *Business Strategy Series*, *10* (5).

Roscoe, H. J. (1975). A Cross-sectional Test of the Effect and Conceptualization of Service Value. *Journal of Services Marketing*, *11* (6), 35-50.

Sargent, J. F. (2011). *Nanotechnology: A Policy Primer.* New York: Congressional Research Service.

Sekaran, U. (2006). *Research Methods for Business* (Fourth Edition ed.). New Delhi: John Wiley & Sons.

Shah, D. (2004). Success Analysis of Start-ups in the field of Microsystems and Nanotechnology in the U.K. *Dissertation, Heriot Watt University.*

Shapira, P., & Wang, J. (2008). From Lab to Market? Strategies and Issues in the Commercialisation of Nanotechnology in China. *Asian Business Management*, 461-489.

Sharon, M. (2010). Nanotechnology Comercialization in India Scenario. *Tech Monitor*, 38-41.

Shrader, C., Mulford, C., & Blackburn, V. (1989). Strategic and Operational Planning, Uncertainty and Performance in Small Firms. *Journal of Small Business Management*, *27* (4), 45-60.

Shea, C. M. (2005). Future Management Reserach Directions in Nanotechnology: A case study. *Journal of Engineering and Technology Management*, Vol.22, Issue 3, p.185-200.

Slater, S. F., & Mohr, J. J. (1990). Successful Development and Commercialisation of Technological Innovation: Insights Based on Stratetegy Type. *Product Innovation Management*, *23*, 26-33.

Su, H. N., Lee, P. C., & Tsai, M. H. (2007). Current Situation and Industrialization of Taiwan Nanotechnology. *Nanoparticle Research*, 965-975.

Sullivan, P. H. (1999). Profiting from intellectual capital. *Journal of Knowledge Management*, *3* (2).

Szakonyi, R. (1994). Measuring R&D Effectiveness. *Research Technology Management*, *37* (2), 27-32.

Teece, D. (1986). Profiting from technological innovation. *Research Policy*, *15* (6), 285-305.

Tegart, G. (2004). Nanotechnology: The Technology for the twenty-first century. *Emerald Group Publishing Limited*, *6* (6), 364-370.

Valentin, E. M., Sanchez, A. M., & Martin, L. (2004). Determining Factors in the Success of R&D Cooperative Agreements between Firms and Research Organizations. *Research Policy.* , Vol.33, p.17-40.

Waitz, A., & Bokhari, W. (2003, September 16). Nanotechnology Commercialisation Best Practices. Menlo Park, California, United State of America.

Wakeman, S. (2008). A Dynamic Theory of Technology Commercialisation Strategy.

Werner, B. M., & Souder, W. E. (1997). Measuring R&D Performance- US and German Practices. *Research Technology Management.* , Vol.40, Issue 3, p.28.

Woolley, J. L., & Rottner, R. M. (2008). Innovation Policy and Nanotechnology Intrepreneurship. *Entrepreneurship Theory and Practice.* , *32* (5), 791-881.

Youtie, J., & Shapira, P. (2008). Mapping the Nanotechnology Enterprise: A Multi-indicator Analysis for Emerging Nanodistricts in the US South. *Journal of Technology Transfer*, *33* (2), 209-223.

Zikmund, W. G. (2003). *Business Research Methods.* The Dryden Press.

APPENDIX A

(Questionnaire)

COLLEGE OF BUSINESS **NO:____**

SURVEY QUESTIONNAIRE

FACTORS CONTRIBUTE TO THE SUCCESS OF NANOTECHNOLOGY COMMERCIALIZATION IN MALAYSIA

Dear Respondent

I am a research student at Universiti Utara Malaysia currently pursuing a Master of Science in Management.

You have been chosen to be a respondent in this survey. I would be very grateful if you could spare a few minutes of your time answering this survey questionnaire to the best of your understanding.

The information you give would definitely be of value to this study. Please be assured that your responses will be confidential and anonymous. Statistical summary that would be reported in relation to this finding cannot in any way reveal you and your company identity.

Please return this questionnaire with the self-stamp-envelope provided to address mention below. If you have any enquiries, please contact me at **017-4625075** or **s806248@student.uum.edu.my**. Thank you again for your cooperation, and precious time.

Yours sincerely,

(MAWADDAH MOHAMAD)
MATRIC NO: 806248
KOLEJ TENAGA NASIONAL BERHAD (DPP TNB)
UNIVERSITI UTARA MALAYSIA
06010 SINTOK KEDAH

To be filled by respondent representing the company.
Please **tick (√)** the appropriate box(es) that best describes yourself.

1 Gender:
- [ ] Male
- [ ] Female

2 Race:
- [ ] Malay
- [ ] Chinese
- [ ] Indian
- [ ] Others (please specify):______________

3 Academic degrees attained:
- [ ] PhD
- [ ] Master Degree
- [ ] Bachelor
- [ ] Diploma
- [ ] Others (please specify):______________

4 Position in the company:
- [ ] Technical Manager
- [ ] Production Manager
- [ ] Marketing Manager
- [ ] R&D Manager
- [ ] Others (please specify):______________

5 Years served:
- [ ] Less than 1 year
- [ ] 1 - 5 years
- [ ] 6 - 10 years
- [ ] More than 10 years

End of Section A
Go to Section B on next page.

SECTION B: Company Profile

To be filled by respondent representing the company

Please tick (√) the appropriate box(es) that best describes this company

6 Nature of business:

- [ ] Food and Agriculture
- [ ] Cosmetic
- [ ] Pharmaceutical
- [ ] Information Technology
- [ ] Machinery and Equipment
- [ ] Others (please specify):______________

7 Number of employee:

- [ ] Less than 20
- [ ] 20 - 50
- [ ] 51 - 100
- [ ] 101- 250
- [ ] More than 250

8 Number of years in operations:

- [ ] 0 - 5 years
- [ ] 6 - 10 years
- [ ] 11 - 15 years
- [ ] 16 - 20 years
- [ ] More than 20 years

9 Ownership:

- [ ] Malaysia owned
- [ ] Joint venture
- [ ] Multinational owned
- [ ] Others (please specify):______________

10 What is your organization's primary role in commercializing nanotechnology?

- [ ] Material supplier (supplier of either nanoscale engineered or bulk materials)
- [ ] Intermediate processor (convert nanomaterials into value-adding products)
- [ ] Equipment manufacturer (for handling /processing at nanoscale)
- [ ] Component or Sub-system supplier (products incorporating nanotechnology)
- [ ] Manufacturer/integrator/assembler (of component or system)
- [ ] Contract or non-profit R&D organization
- [ ] End user/consumer (e.g durable goods for healthcare, machinery tools etc.)
- [ ] Others:__________________

SECTION C: BUSINESS PERFORMANCE

To the best of your knowledge, please describe <u>for the past three years</u> whether items below change by circling one appropriate number.

		Decreased substantially	Decreased	No changed	Increased	Increased substantially
11	Percentage of sales from nanotechnology products has________	1	2	3	4	5
12	Return on investment from nanotechnology product has________	1	2	3	4	5
13	Percentage of profit from nanotechnology product has_______	1	2	3	4	5
14	The level of difficulty in commercializing *nanotechnology product* has______	1	2	3	4	5
15	The proportion of nanotechnology products that has being commercialized has_______.	1	2	3	4	5

SECTION D: FACTORS INFLUENCING SUCCESS IN COMMERCIALIZATION

To be filled by respondent representing the company

Please indicate to what extent you agree with each of the following statements by circling one corresponding number

Capital investment

		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
16	Our company's financial resources for nanotechnology activity is adequate	1	2	3	4	5
17	Our company's budget is adequate to meet the stated goals from nanotechnology product sales.	1	2	3	4	5
18	In the past three years, our nanotechnology budget allocation has increased.	1	2	3	4	5
19	Our company's budget for nanotechnology activities is easily obtainable.	1	2	3	4	5

Customer Focus

		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
20	Our business objectives are driven primarily by customer satisfaction.	1	2	3	4	5
21	We like to survey our current and prospective customers.	1	2	3	4	5
22	We are concern about the successful and unsuccessful customers' experiences.	1	2	3	4	5
23	We measure customers' satisfaction systematically and frequently.	1	2	3	4	5
24	We give close attention to the after-sales service.	1	2	3	4	5

Management Team

		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
25	We understand how we can contribute to create customers value	1	2	3	4	5
26	We constantly monitor our level of commitment and orientation.	1	2	3	4	5
27	All of our business functions (eg: finance, operation etc.) are integrated.	1	2	3	4	5
28	We share resources with other business units.	1	2	3	4	5

Business Plan

		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
29	Every person is committed to make sure the deadlines are met.	1	2	3	4	5
30	We effectively execute the actions detailed in the plan.	1	2	3	4	5
31	Rewards in the venture are clearly linked to the requirements of the plan.	1	2	3	4	5
32	The monitory system is well aligned with the plan.	1	2	3	4	5

	Product Quality	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
33	The quality policy in our company is appropriate for the purpose of nanotechnology business.	1	2	3	4	5
34	Nanotechnology product quality is based on performance, features, reliability and conformance.	1	2	3	4	5
35	Nanotechnology safety is clearly an important and legitimate goal.	1	2	3	4	5
36	Nanotechnology product is free from any unsafe chemical or technology.	1	2	3	4	5
37	Our company always review the quality of nano-products from time to time to ensure its safety.	1	2	3	4	5
	Company Infrastructure	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
38	Our company provide buildings or workplace needed to achieve conformity of nanotechnology commercialization activities.	1	2	3	4	5
39	Our company provide equipments or utilities needed to achieve conformity of nanotechnology commercialization activities.	1	2	3	4	5
40	Our company provide supporting services such as transport and communication needed to achieve conformity of nanotechnology commercialization activities.	1	2	3	4	5

End of Section D

You are at the end of the questionnaire. Thank you for participating in this study. All responses will be treated with utmost confidential.
My sincere appreciation for your prompt return by post of this completed questionnaire.

APPENDIX B

UNIVERSITI UTARA MALAYSIA

06010 UUM Sintok, Kedah Darul Aman, Malaysia. Tel: 604 - 928 4000

Othman Yeop Abdullah Graduate School of Business
UUM College of Business

"KEDAH SEJAHTERA"

UUM/COB/A-3 (806248)

03 March 2011

TO WHOM IT MAY CONCERN

Dear Sir/Madam

DATA COLLECTION

COURSE : MASTER OF SCIENCE (MANAGEMENT) RESEARCH
SUPERVISOR : DR. AMLUS BIN IBRAHIM

This is to certify that the following is a postgraduate student from the College of Business, Universiti Utara Malaysia. She is pursuing the above mentioned course which requires her to undertake an academic study at any organization. The details are as follows:

NO.	NAME	MATRIC NO.
3.	Mawaddah Bt Mohamad	806248

In this regard, I hope that you could kindly provide assistance and cooperation for her to successfully complete the assignment given. All the information gathered will be strictly used for academic purposes only.

Your cooperation and assistance is very much appreciated.

Thank you.

"ILMU BUDI BAKTI"

Yours faithfully,

ROSLEE BIN MARDAN
Assistant Registrar
College of Business

c.c - Student's File (806248)

APPENDIX C

(Results from Analyses)

RELIABILITY TEST

Factor Analysis

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.808
Bartlett's Test of Sphericity	Approx. Chi-Square	2066.975
	Df	435
	Sig.	.000

Communalities

	Initial	Extraction
percentage of sales *from* nanotechnology products has	1.000	.869
ROI from nanotechnology product has	1.000	.842
percentage of profit from nanotechnology product has	1.000	.812
the level of difficulty in commercializing nanotechnology has	1.000	.688
the proportion of nanotechnology products that has being commercialized has	1.000	.567
our company's financial resources for nanotechnology activity is adequate	1.000	.783
our company's budget is adequate to meet the stated goals from nanotechnology product sales	1.000	.855
in the past three years, our nanotechnology budget allocation has increased	1.000	.700
our company's budget for nanotechnology activities is *easily obtainable*	1.000	.663
our business objectives are driven primarily by customer satisfaction	1.000	.762
we like to survey our current and prospective customers	1.000	.675
we are concern about the successful and unsuccessful customer's experience	1.000	.690

we measure customers' satisfaction systematically and frequently	1.000	.745
we give close attention to the after-sales service	1.000	.765
we understand how we can contribute to create customers value	1.000	.740
We constantly monitor our level of commitment and orientation	1.000	.785
All of our business function are integrated	1.000	.837
We share resources with other business units	1.000	.834
every person is commited to make sure the deadlines are met	1.000	.752
we effectively execute the actions detailed in the plan	1.000	.746
rewards in the venture are clearly linked to the requirements of the plan	1.000	.775
the monitory system is well aligned with the plan	1.000	.775
The quality policy in our company is appropriate for the purpose of nanotechnology business	1.000	.643
Nanotechnology product quality is based on performance, features, reliability and conformance	1.000	.764
Nanotechnology safety is clearly an important and legitimate goal	1.000	.703
Nanotechnology is free from any unsafe chemical or technology	1.000	.687
Our company always review the quality of nano-products from time to time to ensure its safety	1.000	.554
our company provide buildings or workplace needed	1.000	.765

Our company provide equipments or utilities needed	1.000	.856
Our company provide supporting services such as transport and communication needed	1.000	.826

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	10.036	33.454	33.454	10.036	33.454	33.454	3.730	12.433	12.433
2	3.169	10.564	44.018	3.169	10.564	44.018	3.511	11.703	24.136
3	2.792	9.308	53.326	2.792	9.308	53.326	3.329	11.097	35.233
4	2.248	7.494	60.820	2.248	7.494	60.820	3.104	10.348	45.581
5	1.632	5.439	66.259	1.632	5.439	66.259	3.053	10.177	55.758
6	1.409	4.695	70.954	1.409	4.695	70.954	2.988	9.960	65.718
7	1.173	3.909	74.863	1.173	3.909	74.863	2.743	9.145	74.863
8	.902	3.005	77.868						
9	.763	2.543	80.412						
10	.648	2.159	82.570						
11	.574	1.913	84.483						
12	.536	1.786	86.269						
13	.448	1.493	87.762						
14	.444	1.479	89.241						
15	.406	1.352	90.593						
16	.381	1.270	91.863						
17	.333	1.110	92.973						
18	.297	.989	93.962						
19	.261	.868	94.830						
20	.240	.801	95.631						
21	.213	.710	96.340						
22	.202	.673	97.014						
23	.170	.566	97.580						

24	.159	.530	98.110						
25	.130	.432	98.543						
26	.116	.386	98.928						
27	.107	.356	99.285						
28	.092	.306	99.590						
29	.073	.243	99.833						
30	.050	.167	100.000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component						
	1	2	3	4	5	6	7
percentage of sales from nanotechnology products has		.821					
ROI from nanotechnology product has		.807					
percentage of profit from nanotechnology product has		.721				.430	
the level of difficulty in commercializing nanotechnology has		.694			.428		
the proportion of nanotechnology products that has being commercialized has		.600					
our company's financial resources for nanotechnology activity is adequate						.830	
our company's budget is adequate to meet the stated goals from nanotechnology product sales						.795	
in the past three years, our nanotechnology budget allocation has increased						.678	
our company's budget for nanotechnology activities is easily obtainable						.603	.406

our business objectives are driven primarily by customer satisfaction	.829						
we like to survey our current and prospective customers	.757						
we are concern about the successful and unsuccessful customer's experience	.782						
we measure customers' satisfaction systematically and frequently	.844						
we give close attention to the after-sales service	.768						
we understand how we can contribute to create customers value			.799				
We constantly monitor our level of commitment and orientation			.822				
All of our business function are integrated			.886				
We share resources with other business units			.831				
every person is commited to make sure the deadlines are met					.732		
we effectively execute the actions detailed in the plan					.726		
rewards in the venture are clearly linked to the requirements of the plan					.772		
the monitory system is well aligned with the plan					.736		
The quality policy in our company is appropriate for the purpose of nanotechnology business				.696			
Nanotechnology product quality is based on performance, features, reliability and conformance				.824			
Nanotechnology safety is clearly an important and legitimate goal				.824			

Nanotechnology is free from any unsafe chemical or technology				.765			
Our company always review the quality of nano-products from time to time to ensure its safety				.686			
our company provide buildings or workplace needed							.822
Our company provide equipments or utilities needed							.842
Our company provide supporting services such as transport and communication needed							.817

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 6 iterations.

Component Transformation Matrix

Component	1	2	3	4	5	6	7
1	.408	.489	.355	.202	.409	.404	.312
2	-.024	-.023	-.584	.694	-.127	.037	.398
3	-.652	.087	.355	.514	.269	-.041	-.321
4	.594	-.375	.155	.375	.213	-.454	-.301
5	.108	-.308	.433	.240	-.656	.465	-.048
6	-.181	-.235	.429	-.054	-.016	-.433	.733
7	.103	.680	.110	.109	-.518	-.473	-.104

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

VALIDITY TEST

Validity

Case Processing Summary

		N	%
Cases	Valid	93	100.0
	Excluded[a]	0	.0
	Total	93	100.0

a. Listwise deletion based on all variables in the procedure.

Variable Y

Reliability Statistics

Cronbach's Alpha	N of Items
.897	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
percentage of sales from nanotechnology products has	13.51	9.361	.858	.847
ROI from nanotechnology product has	13.56	9.706	.837	.854
percentage of profit from nanotechnology product has	13.56	9.988	.804	.861
the level of difficulty in commercializing nanotechnology has	13.94	10.931	.593	.906
the proportion of nanotechnology products that has being commercialized has	13.78	10.301	.649	.896

Variable X1

Reliability Statistics

Cronbach's Alpha	N of Items
.873	4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
our company's financial resources for nanotechnology activity is adequate	9.71	7.491	.725	.840
our company's budget is adequate to meet the stated goals from nanotechnology product sales	9.73	7.133	.800	.810
in the past three years, our nanotechnology budget allocation has increased	9.89	7.184	.730	.838
our company's budget for nanotechnology activities is easily obtainable	9.99	7.272	.669	.864

Variable X2

Reliability Statistics

Cronbach's Alpha	N of Items
.894	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
our business objectives are driven primarily by customer satisfaction	16.11	6.880	.783	.861
we like to survey our current and prospective customers	16.12	7.497	.720	.875

we are concern about the successful and unsuccessful customer's experience	16.15	7.477	.696	.880
we measure customers' satisfaction systematically and frequently	16.16	7.658	.744	.870
we give close attention to the after-sales service	16.28	7.378	.761	.866

Variable X3

Reliability Statistics

Cronbach's Alpha	N of Items
.902	4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
we understand how we can contribute to create customers value	10.46	7.534	.725	.894
We constantly monitor our level of commitment and orientation	10.42	7.855	.797	.871
All of our business function are integrated	10.69	7.195	.793	.869
We share resources with other business units	10.62	6.955	.820	.859

Variable X4

Reliability Statistics

Cronbach's Alpha	N of Items
.881	4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
every person is commited to make sure the deadlines are met	10.96	5.259	.721	.858
we effectively execute the actions detailed in the plan	10.96	5.433	.740	.849
rewards in the venture are clearly linked to the requirements of the plan	11.02	5.456	.748	.846
the monitory system is well aligned with the plan	11.03	5.792	.775	.839

Variable X5

Reliability Statistics

Cronbach's Alpha	N of Items
.833	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
The quality policy in our company is appropriate for the purpose of nanotechnology business	13.58	9.724	.618	.803
Nanotechnology product quality is based on performance, features, reliability and conformance	13.59	9.027	.716	.774

Nanotechnology safety is clearly an important and legitimate goal	13.55	8.968	.691	.781
Nanotechnology is free from any unsafe chemical or technology	13.56	9.988	.586	.812
Our company always review the quality of nano-products from time to time to ensure its safety	13.68	9.873	.550	.822

Variable X6

Reliability Statistics

Cronbach's Alpha	N of Items
.888	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
our company provide buildings or workplace needed	7.48	4.187	.732	.883
Our company provide equipments or utilities needed	7.52	3.622	.835	.792
Our company provide supporting services such as transport and communication needed	7.62	3.607	.784	.841

NORMALITY TEST

Explore normality test

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
meanX1	93	100.0%	0	.0%	93	100.0%
meanX2	93	100.0%	0	.0%	93	100.0%
meanX3	93	100.0%	0	.0%	93	100.0%
meanX4	93	100.0%	0	.0%	93	100.0%
meanX5	93	100.0%	0	.0%	93	100.0%
meanX6	93	100.0%	0	.0%	93	100.0%
meanY	93	100.0%	0	.0%	93	100.0%

Descriptives

			Statistic	Std. Error
meanX1	Mean		3.2769	.09129
	95% Confidence Interval for Mean	Lower Bound	3.0956	
		Upper Bound	3.4582	
	5% Trimmed Mean		3.3087	
	Median		3.2500	
	Variance		.775	
	Std. Deviation		.88039	
	Minimum		1.00	
	Maximum		5.00	
	Range		4.00	
	Interquartile Range		1.25	
	Skewness		-.421	.250
	Kurtosis		.001	.495
meanX2	Mean		4.0409	.06950
	95% Confidence Interval for Mean	Lower Bound	3.9028	
		Upper Bound	4.1789	
	5% Trimmed Mean		4.0843	
	Median		4.0000	
	Variance		.449	
	Std. Deviation		.67021	
	Minimum		2.00	
	Maximum		5.00	
	Range		3.00	

	Interquartile Range		.80	
	Skewness		-.826	.250
	Kurtosis		.688	.495
meanX3	Mean		3.5161	.09243
	95% Confidence Interval for Mean	Lower Bound	3.3325	
		Upper Bound	3.6997	
	5% Trimmed Mean		3.5438	
	Median		3.7500	
	Variance		.795	
	Std. Deviation		.89139	
	Minimum		1.50	
	Maximum		5.00	
	Range		3.50	
	Interquartile Range		1.13	
	Skewness		-.520	.250
	Kurtosis		-.303	.495
meanX4	Mean		3.6640	.07940
	95% Confidence Interval for Mean	Lower Bound	3.5063	
		Upper Bound	3.8217	
	5% Trimmed Mean		3.7031	
	Median		4.0000	
	Variance		.586	
	Std. Deviation		.76568	
	Minimum		1.25	
	Maximum		5.00	
	Range		3.75	
	Interquartile Range		.75	
	Skewness		-.991	.250
	Kurtosis		.872	.495
meanX5	Mean		3.3978	.07835
	95% Confidence Interval for Mean	Lower Bound	3.2422	
		Upper Bound	3.5535	
	5% Trimmed Mean		3.4008	
	Median		3.4000	
	Variance		.571	
	Std. Deviation		.75556	
	Minimum		1.40	
	Maximum		5.00	
	Range		3.60	
	Interquartile Range		.90	

	Skewness		-.032	.250
	Kurtosis		-.012	.495
meanX6	Mean		3.7706	.09842
	95% Confidence Interval for Mean	Lower Bound	3.5751	
		Upper Bound	3.9661	
	5% Trimmed Mean		3.8086	
	Median		4.0000	
	Variance		.901	
	Std. Deviation		.94917	
	Minimum		1.33	
	Maximum		5.00	
	Range		3.67	
	Interquartile Range		1.50	
	Skewness		-.612	.250
	Kurtosis		-.587	.495
meanY	Mean		3.4172	.08117
	95% Confidence Interval for Mean	Lower Bound	3.2560	
		Upper Bound	3.5784	
	5% Trimmed Mean		3.4771	
	Median		3.4000	
	Variance		.613	
	Std. Deviation		.78278	
	Minimum		1.00	
	Maximum		4.80	
	Range		3.80	
	Interquartile Range		.70	
	Skewness		-1.289	.250
	Kurtosis		2.213	.495

Dev from Normal

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
meanX1	.085	93	.097	.972	93	.040
meanX2	.153	93	.000	.934	93	.000
meanX3	.173	93	.000	.944	93	.001
meanX4	.207	93	.000	.911	93	.000
meanX5	.093	93	.044	.985	93	.347
meanX6	.219	93	.000	.914	93	.000
meanY	.208	93	.000	.877	93	.000

a. Lilliefors Significance Correction

CORRELATION ANALYSIS

Correlations

Correlations

		meanX1	meanX2	meanX3	meanX4	meanX5	meanX6	meanY
meanX1	Pearson Correlation	1	.380**	.370**	.453**	.200	.478**	.625**
	Sig. (2-tailed)		.000	.000	.000	.054	.000	.000
	N	93	93	93	93	93	93	93
meanX2	Pearson Correlation	.380**	1	.273**	.414**	.112	.401**	.406**
	Sig. (2-tailed)	.000		.008	.000	.286	.000	.000
	N	93	93	93	93	93	93	93
meanX3	Pearson Correlation	.370**	.273**	1	.498**	.055	.082	.420**
	Sig. (2-tailed)	.000	.008		.000	.601	.437	.000
	N	93	93	93	93	93	93	93
meanX4	Pearson Correlation	.453**	.414**	.498**	1	.262*	.343**	.598**
	Sig. (2-tailed)	.000	.000	.000		.011	.001	.000
	N	93	93	93	93	93	93	93
meanX5	Pearson Correlation	.200	.112	.055	.262*	1	.248*	.227*
	Sig. (2-tailed)	.054	.286	.601	.011		.017	.029
	N	93	93	93	93	93	93	93
meanX6	Pearson Correlation	.478**	.401**	.082	.343**	.248*	1	.435**
	Sig. (2-tailed)	.000	.000	.437	.001	.017		.000
	N	93	93	93	93	93	93	93
meanY	Pearson Correlation	.625**	.406**	.420**	.598**	.227*	.435**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.029	.000	
	N	93	93	93	93	93	93	93

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

REGRESSION ANALYSIS

Regression

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	meanX6, meanX3, meanX5, meanX2, meanX1, meanX4[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: meanY

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.733[a]	.537	.505	.55099

a. Predictors: (Constant), meanX6, meanX3, meanX5, meanX2, meanX1, meanX4

b. Dependent Variable: meanY

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	30.263	6	5.044	16.614	.000[a]
	Residual	26.109	86	.304		
	Total	56.372	92			

a. Predictors: (Constant), meanX6, meanX3, meanX5, meanX2, meanX1, meanX4

b. Dependent Variable: meanY

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.119	.440		.270	.788		
	meanX1	.321	.083	.361	3.889	.000	.625	1.600
	meanX2	.073	.100	.062	.726	.470	.730	1.369
	meanX3	.092	.078	.105	1.182	.240	.687	1.456
	meanX4	.316	.098	.309	3.218	.002	.584	1.711
	meanX5	.034	.080	.033	.425	.672	.894	1.119
	meanX6	.094	.074	.114	1.269	.208	.663	1.508

a. Dependent Variable: meanY

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions						
				(Constant)	meanX1	meanX2	meanX3	meanX4	meanX5	meanX
1	1	6.806	1.000	.00	.00	.00	.00	.00	.00	.0
	2	.059	10.766	.00	.00	.00	.39	.02	.09	.1
	3	.049	11.736	.02	.33	.00	.00	.00	.33	.1
	4	.032	14.610	.03	.49	.11	.00	.00	.33	.1
	5	.023	17.362	.12	.17	.25	.20	.07	.04	.4
	6	.020	18.368	.03	.00	.00	.37	.87	.02	.0
	7	.011	24.412	.81	.01	.63	.04	.03	.18	.0

a. Dependent Variable: meanY

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	1.5931	4.3184	3.4172	.57354	93
Residual	-1.72142	1.07439	.00000	.53272	93
Std. Predicted Value	-3.180	1.571	.000	1.000	93
Std. Residual	-3.124	1.950	.000	.967	93

a. Dependent Variable: meanY

Figure 4.2: Normal P-P Plot of Regression Standardized Residual