AN EXPLORATORY STUDY UNIVERSITY TEKNOLOGI MALAYSIA’S INNOVATION TOWARD COMMERCIALIZATION

BAWER MARWAN ABDULAHAD

A dissertation submitted in partial fulfilment of the requirements for the award of the degree Master of Management (Technology)

Faculty of Management
University Technology Malaysia

September 2013
Dedicated to those who stand still with me on completion of this dissertation.

A little thing from you always a great deal for me

Forever.
ACKNOWLEDGEMENT

First of all, enormous thanks to my family members especially my father Dr. Marwan Abdullah Mahmood for being my backbone always. Thanks to Almighty God, for answering my prayers by giving me the strength to face the challenges.

Many special thanks go to my supervisor Assoc. Prof. Dr. Kamariah Ismail. The supervision and support that she gave was truly helpful for the progression and smoothness of this dissertation. The co-operation is much indeed appreciated.

Many grateful thanks also go to the examiners Dr. Effandi Yusoff and Mr. Ahmed Zaimi for their big contribution.

Many thanks to my lovely friends especially Tan Sing Lin and Yamunah a/p Vaicondam, who always stand on my side and helped me to understand Malaysian culture and Malaysia.
ABSTRACT

Commercialization in university has increasingly been considered as a complementary and attractive solution to new technology innovation and product marketing. However, the rate of commercialization amongst academic researchers and inventors has been discouraging. The aim of this study was to identify the problems and issues on the process of innovation and commercialization and then improve the commercialization rate in Universiti Teknologi Malaysia (UTM). To achieve these goals seven factors were examined to identify how they affect on the university’s innovation and commercialization. These factors were market driven innovation, financial support, marketing and selling strategy, improve technology, time to market and time constrain, the relationship between university and industry as well as the university policy and system with the special focus on the relationship between university and industry and its effect on the commercialization rate in UTM. This study was based on a qualitative research method and was designed to use a case study approach. A total of sixteen face-to-face interviews were conducted. Respondents were chosen from inventors, academic researchers and Innovation and Commercialization Centre staff in UTM. The researcher utilized the content-analysis approach to analyze the data obtained from the semi-structured interviews. The results indicated that, the most critical factor was relationship between university and industry and role of financial support. This study also addressed the implications and recommendation for research and practitioners. Suggestions were provided to enhance the role of academic researchers and inventors toward commercialization.
ABSTRAK

# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>CHAPTER</th>
<th>TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DECLARATION</td>
<td></td>
<td>ii</td>
</tr>
<tr>
<td>DEDICATION</td>
<td></td>
<td>v</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENT</td>
<td></td>
<td>vi</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td></td>
<td>vii</td>
</tr>
<tr>
<td>ABSTRAK</td>
<td></td>
<td>viii</td>
</tr>
<tr>
<td>TABLE OF CONTENTS</td>
<td></td>
<td>ix</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td></td>
<td>xiv</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td></td>
<td>xv</td>
</tr>
</tbody>
</table>

1 INTRODUCTION
1.1 Background of Study  1
1.2 Problem Statement    6
1.3 Purpose of the Study 8
1.4 Research Objectives  8
1.5 Research Questions   8
1.6 Significance of Study 9
1.7 Scope of the Study   10
1.8 Research Framework   10
1.9 Research Layout      12
2 LITERATURE REVIEW

2.1 Introduction 14
2.2 Definitions and Background of Innovation 14
2.3 Oslo Manual and Innovation 18
2.4 The Use of Oslo Manual towards University 19
2.5 Oslo Manual and Types of Innovation 21
  2.5.1 Product Innovation 21
  2.5.1.1 Theories on Product Innovation 22
  2.5.2 Process Innovation 25
  2.5.2.1 Theories on Process Innovation 25
  2.5.3 Market Innovation 27
  2.5.3.1 Theories on Market Innovation 28
  2.5.3.2 Marketing Innovation and Strategy Theory 32
  2.5.4 Organizational Innovation 34
  2.5.4.1 Theories on Organization Innovation 35
  2.5.5 Source and Supply of Innovation 37
2.6 Commercialization 38
  2.6.1 Definition of Commercialization 38
  2.6.2 Background on Commercialization and Other Theories 39
  2.6.3 Commercialization in Universities 40
  2.6.4 Overview of Commercialization in Malaysia Universities 41
  2.6.4.1 The Role of ICC to Drive Commercialisation in UTM 43
  2.6.4.2 Problems of Commercialization in Malaysian Universities 45
  2.6.5 The Relationship between Commercialization and Innovation 46
  2.6.6 The Problems of Commercialization and Innovation 47
  2.6.6.1 Motivation & Commitment of the
Inventors 49
2.6.6.2 University Support and Funding 50
2.6.6.3 Innovation Process 51
2.6.6.4 Market Research and Market Validation 52
2.6.6.5 Market Driven Technology 54
2.6.7 Academic Entrepreneurship 57
2.6.8 Entrepreneurs Transfer Technology from University to Industry 58

3 METHODOLOGY
3.1 Introduction 60
3.2 Research Procedure 60
3.3 Research Design 62
3.4 Population 63
3.5 Sampling 64
3.6 Method 67
   3.6.1 Designing the Semi-Structured Interview 69
   3.6.2 In-depth Interview Questions 69
3.7 Data Collection 70
3.8 Data Analysis 71
3.9 Conclusions 73

4 DATA ANALYSIS AND FINDINGS
4.1 Introduction 74
4.2 Background of Respondents and Information for Inventions 75
4.3 Summary of the Findings 78
   4.3.1 First Research Objective: To study the problems of innovation and commercialization process in Universiti Teknologi Malaysia 78
   4.3.1.1 Commercialization Pre-requisite Stage 78
   4.3.1.2 Innovation and Commercialization Process 84
4.3.1.3 The Main Target Markets 90
4.3.1.4 Success in Commercialization 94
4.3.1.5 Quality of Technology 96
4.3.1.6 Customers Satisfaction 98

4.3.2 Second Research Objective: To study the main factors that influences the university’s innovation and commercialization process 100
4.3.2.1 University’s Commercialization Competitive Edge 100
4.3.2.2 Weaknesses of University Commercialization 107
4.3.2.3 Factors Affecting the Commercialization 113

4.3.3 Third Research Objective: To develop the effective innovation and commercialization model for Universiti Teknologi Malaysia 115
4.3.3.1 Contributing factors for a successful innovation and commercialization practice 115
4.3.3.2 Suggestions for developing successful commercialization model 122

4.4 Summary of Significant Findings of the Research 131
4.5 Conclusion 133

5 DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction 134
5.2 Discussion 134
5.2.1 Summary of Findings from In-depth Interview 135
5.3 Addressing the Aims and the Finding themes 136
5.3.1 First Research Objective: To study the problems of innovation and commercialization process in Universiti Teknologi Malaysia 136
5.3.1.1 Market Driven Innovation 138
5.3.1.2 Role of Financial support 139
5.3.1.3 Improve Technology 141
5.3.2 Second Research Objective: To study the main factors that influences the university’s innovation and commercialization process

5.3.2.1 University Policy and System 143
5.3.2.2 Timing to the Market and Time Constrain 144
5.3.2.3 Relationship between university and Industry 145
5.3.2.4 The important factors that affecting the commercialization prioritize these factors according the importance 146

5.3.3 Third Research Objective: To develop the effective innovation and commercialization practice for Universiti Teknologi Malaysia 148

5.3.3.1 Upgrade the Relationship between University and Industry 150
5.3.3.2 Upgrade the University Policy and System 151

5.4 Conclusion 152
5.5 Limitations 154
5.6 Recommendation for Future Research 155
5.6.1 The University 155
5.6.2 Researcher and Inventors 157

5.7 Contribution of the study 158

REFERENCES 159
## LIST OF TABLES

<table>
<thead>
<tr>
<th>TABLE NO.</th>
<th>TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>UTM’s IPR May 2013</td>
<td>44</td>
</tr>
<tr>
<td>3.1</td>
<td>Purposive Sampling</td>
<td>65</td>
</tr>
<tr>
<td>3.2</td>
<td>Respondent’s Background</td>
<td>67</td>
</tr>
<tr>
<td>4.1</td>
<td>Respondent’s Background</td>
<td>77</td>
</tr>
<tr>
<td>4.2</td>
<td>Existing Themes</td>
<td>114</td>
</tr>
<tr>
<td>4.3</td>
<td>Summary of Significant Findings</td>
<td>132</td>
</tr>
<tr>
<td>5.1</td>
<td>Major Themes of the Questions from Objective One</td>
<td>137</td>
</tr>
<tr>
<td>5.2</td>
<td>Major Themes from the Findings of Objective Two</td>
<td>143</td>
</tr>
<tr>
<td>5.3</td>
<td>Respondents Highlight on the Existing Themes</td>
<td>147</td>
</tr>
<tr>
<td>5.4</td>
<td>Major Themes of the Questions from Third Objective</td>
<td>149</td>
</tr>
</tbody>
</table>
## LIST OF FIGURE

<table>
<thead>
<tr>
<th>FIGURE NO.</th>
<th>TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Basic model of product innovation management</td>
<td>24</td>
</tr>
<tr>
<td>2.2</td>
<td>Organizational type and innovation</td>
<td>36</td>
</tr>
<tr>
<td>2.3</td>
<td>Technology commercialization from a university to a firm</td>
<td>59</td>
</tr>
<tr>
<td>3.1</td>
<td>The research wheel</td>
<td>61</td>
</tr>
<tr>
<td>5.1</td>
<td>An Effective Commercialization Practice</td>
<td>156</td>
</tr>
</tbody>
</table>
CHAPTER 1

INTRODUCTION

1.1 Background of Study

The history of innovation can be observed when human beings start to think how to deal with their lives. Gollin (2008) indicates that from ancient to modern times, successful societies are those which promote rewards and capture individual creativity and innovation. According to Guus et al, (2012) the history of innovation is divided into three generations. The first generation, considers innovation as science or craftsmanship which refers to the early of mankind. The second generation, called the rise of Research & Development (R&D). Finally, in nineteenth century, this generation made a systematic innovation activities in large corporations, also they started innovation became Research & Development (R&D). The third generation, called the Raise of the System Approach which has been divided into three linear approach developments, in late twentieth first century, increasing market and technology demands, second new R&D management, third, processes of innovation have been affected by factors and actors on various levels of aggregation.

After innovation process became the main focus, many scholars discussed about innovation. Robert et al, (2007) indicates that nowadays we can see the rapid pace of technological development which has carried many national economies forward during
the past 200 years. Continuing the innovation which has been diffused through the marketplace made this development possible. For instance, entrepreneurs have been an instrumental factor in the commercializing innovations, specifically radical or breakthrough innovations such as: the airplane, automobile, personal computer. Since technologies have been growing more sophisticated and industries have become more high-tech, as well as universities become more sufficient and an effective player in the processes of invention, innovation and commercialization.

Commercialization in the university innovation became an important topic over two decades (Katherine, 2006). Commercialization can be described as the process by which inventions or latest technologies to become innovative or ready to market. For better understanding, the activities of commercialization provide the potential developments in the quality of life, by facilitating the access in industry to latest knowledge. A creative university leads to the availability on developed products and services. Meanwhile there are evidences which make commercialization of Research University to contribute to the national and regional growth of economic and international competitive advantage. These outcomes of economy are extremely desirable for policy makers because they represent the relatively direct benefit arising from public investments in university research that can be usable for justifying those expenditures.

Nowadays, the significance of universities and their research development as well as commercialization (R, D & C) activities is widely recognized (Djokovic & Souitaris 2008). Previously, most of the universities were focusing on R&D, nonetheless, more recently there are many progressing shift towards the inclusion of commercialisation activities. Collier and Gray (2010) defines commercialization as the character of the third mission, they also indicates that researchers in the universities produce innovations as a result for the research activities which reflects to be exploited commercially. However, the transformation from research and development to commercialization can be a path strewn with many pitfalls. Nowadays studies on the
university research commercialization and the various models for university technology transfer are receiving more attention (Jolly, 2011; Siegel et al., 2003). Present research also desires to examine commercialization of the research output in Malaysian universities and it would attempt to explore notable factors affecting commercialization process.

In Malaysia the exotic phrase, Vision 2020, has been coined to signify a lofty and long term objective, so as to be a fully developed nation by 2020 (Islam, 2009). However, Malaysian believed that some challenges would stand on the way of achieving the Vision 202. Also, the fundamental change is demanded, not only in economic and social performance, but also in the delivery of public goods and services that underpin the ability to develop the country. Whereby, as a result they committed themselves to a Government Transformation Programme (GTP). Foremost the Vision roadmap details the objectives, outcomes and the initial set of actions, as it has identified in the areas like Ministerial Key Result Areas (MKRAs) and National Key Result Areas (NKRAs). Meanwhile, parallel with National Economic Action Council (NEAC) which they formulating the New Economic Model, and the Economic Planning Unit (EPU) toward developing the Malaysia Plan. Both can be a roadmap and should be read together with this plan. Thus the government will focus on unlocking the growth and innovation potential of SMEs, creating domestic, regional and global champions as well as innovation and R&D infrastructure to be developed in areas with competitive advantage (Islam, 2009).

In Malaysia there has been a limited study on commercializing the innovation activities, particularly in research universities. It is also realized that academic researchers are viewed as the critical process, question such as: what type of commercial research activities has appeared among academic researchers in Malaysian research universities are still open for research. Under the Tenth Malaysian Plan (MOHE, 2010) commercialization and innovation development has been assigned as niche by the Malaysian Ministry of Higher Education which implies the emphasis and urgency. The
aim of the Government of Malaysia is to encourage an environment where research and innovation will flourish. Innovation is the key importance in spurring economic growth in a developing country like Malaysia. The Government of Malaysia adheres to the principle that knowledge and ideas should be harnessed for wealth creation and societal well being. The traditional resource based economy is fast being replaced by knowledge based economy. Thus, Intellectual Property can become a key factor in driving this knowledge based economy into the future (MOHE, 2010).

According to Malaysian Ministry of Science, Technology & Innovation their ninth recommendation has been accepted after the meeting with Prime Minister in 30th of November 2007 to transform Malaysia from the resource based to the innovation economy base through the National Innovation Model (NIM) (MOSTI Annual Report, 2012). National Innovation Model (NIM) has been described as the tool of balancing approaches between driven technology innovation and driven market innovation. In the model of driven technology innovation, scientists and researchers being funded for R&D, also technology will be improved fundamentally. Therefore, scientists and researchers eventually are commercializing their ideas to the international market. Meanwhile in the model of driven market innovation, the market has been determined before goes to the entrepreneur’s knowledge who can acquire the excellent technology and science. Foremost, Ministry of Science, Technology & Innovation (MOSTI Annual Report, 2012) mentioned Science, technology and innovation as the central of success in today's modern economy. They also provide the Second National Science & Technology Policy as the framework for improving performance and Malaysian long-term economic growth. The aim of this policy is to:

- Raise the national capacity and capability to research and development (R&D), developing technology and acquisition.
- Encourage partnerships among industry and funded organizations.
- Place Malaysia as the technology provider to the strategic key and knowledge industries.
• Enhance knowledge transformation to products, processes, services or solutions.
• Foster the values of the society and approaches that identify S&T as critical to future prosperity, as well as the need of life-long learning.
• Ensure that S&T utilization can accords the emphasis through approaches on the conformity with sustainable developmental goals.
• To progress the new knowledge based industries.

On top of that, Agensi Inovasi Malaysia built to assist Malaysian SMEs in moving up the value chain through innovation. AIM was established to stimulate and develop the innovation eco-system in Malaysia towards achieving the vision 2020. AIM also been established under the Prime Minister department apart of MOSTI. They plan to do this by providing opportunities for them to take advantage of innovation methodologies, policies and outcomes and complement the initiatives introduced by SME Corp. AIM’s role in this is to stimulate rapid new-wave wealth creation by commercializing research & development, as well as inventions and innovations that have been developed but not capitalized upon. Between the large corporations and the SMEs in Malaysia lie a number of companies that currently suffer from the “Middle Child” Syndrome. Unlike large companies that have the financial resources to take their business to another level, or the SMEs, these companies appear to be “stuck” as they do not know where to turn to for help and eventually flounder in a valley of stagnation.

According to Aziz et al, (2011) Universiti Teknologi Malaysia (UTM) has the highest number of commercialization output among Malaysia universities. They analyzed UTM commercialization infrastructure and procedures that can provide the blueprint for all Malaysian higher education’s and institutes to follow. They also describe UTM context as an operator for providing an overview on commercialization environment towards research universities in Malaysia. Foremost, to indicate that blueprint that presented as the background of university followed by the Universiti Teknologi Malaysia’s research, development and commercialization policies as well as structures.
1.2 Problem Statement

Isabelle (2004) indicates that innovation and commercialization usually has been used to overlap methods in order to refer on the processes for discovering knowledge, technology development and converting all these to new process. She also mention commercialization is an ongoing process from mind and creativity to innovation and then to market. Meanwhile, adapt products and services as well as processes so as to be sold or compete in the market place.

Malaysian Government nowadays realized that they are trapped within the middle income plateau (NEM, 2010). However the requirements are to approach the developed status in 2020, while national progress and competitiveness can be charted against innovation and not skills based performance. It has been clear that Malaysia need to shift their direction since late in nineties but it has been noticed that the progress was slow. This comes from some reasons such as: lacks of fully engaged innovation ecosystem in the country, the education key components, ventures and industry which lead to entrepreneurial activity, government.

According to the Ministry of Science, Technology and Innovation, Intellectual Property Commercialization Policy (MOSTI Annual Report, 2009) in Malaysia, national policy cannot be seen in governing the commercialization and ownership of intellectual property in funding government projects. Therefore, it is necessary to formulate the single policy that would cover as much as possible the different situations to the common application by the government such as: government agencies and Research Institution, meanwhile providing funding to research, development as well as Commercialization purposes. That Intellectual Property Commercialization Policy is addressing these problems. Foremost, Ministry of Higher Education (MOHE, 2009) indicates that in Malaysia there is a sad paucity of innovative human capital (IHC) both in quantity and quality, and because of the important brain drain while concluded in the MOHE’s blueprint Agenda on Innovative Malaysian (AIM, 2009).
There are some studies has been done on commercializing the university innovation in Malaysia such Sudulah (2002) which he argued that the prospective collaborations among the universities and industries in Malaysia, the findings of survey which contained the indicators on the passiveness in Malaysian universities such as: the insufficiency on the innovative products toward commercialization, lack of researches on commercialization and lack convictions and commitment between academic staffs toward innovation and commercialization. Senin (2006) states the lack of funding in university industry and technology problems, lack of expertise and entrepreneurships, less commitment among academics, problems in institutions and limited linkage with industry.

In Universiti Teknologi Malaysia some problems can be found firstly, funding on the process of innovation and commercialization. Second, the innovative products does not reach the market demand, there is timing mismatch, because the inventors will develop the product until prototype then patenting it and stop it. Meanwhile, most of the university inventers are focusing on patenting and publications but they claim that commercialization is not their job. Third, lack of convictions and commitment between university and industry is alarming. However, the decision makers have a significant impact on increasing the processes of commercialization and the culture in the university is strongly needed to be upgraded. University could be able to transform the knowledge from the laboratory toward commercially viable products (Ismail, 2011). The above mentioned problems will make the products low quality of technology and low quality of commercialization rate.
1.3 Purpose of the Study

The purpose of this research is to study the innovation and commercialization current process in Universiti Teknologi Malaysia so as to understand the main problems and issues which influences the university’s innovation and commercialization process.

1.4 Research Objective

The objectives of this research are as follows:

1- To study the problems of innovation and commercialization process in Universiti Teknologi Malaysia.

2- To study the main factors that influences the university’s innovation and commercialization process.

3- To suggest the effective innovation and commercialization practice for Universiti Teknologi Malaysia.

1.5 Research Questions

The questions of this research are as follows:
1- What is the current innovation and commercialization process in Universiti Teknologi Malaysia?

2- What are the main factors that influence the effectiveness of university’s current innovation and commercialization process?

1.6 Significance of the Study

Base on the objectives above, the importance of this study is described. The finding and suggestions of this study will contribute to the existing knowledge which will be useful to university innovation process and other reader to further development on the factors that affect the innovation and commercialization process.

According to the objective the use of this study are well described because it offers input to the university policy makers to provide a better trend and picture toward innovation and commercialization as well as identifying the influenced factors. However, by indicating the problems and being successful of providing a better process for innovation and commercialization is critically in need for Universiti Teknologi Malaysia in order to generate the income for the university’s management. Therefore, current study desires to investigate research commercialization operations at UTM. The findings of the study increase the body of knowledge on technology transfer and university commercialization particularly in UTM and generally in Malaysia.

Furthermore the empirical of the study will provide suggestions to move the efforts to increase the commercialization of the innovative products, thus strengthen on the systematic understanding on the issue. Although, the concentration of this study on commercializing the university’s product differs from other fields due to the lengthy and
great development on patenting, commitment and collaboration in university. The findings of the study will be useful for the university.

1.7 Scope of the Study

The study will focus on the current commercialization process and innovation in Universiti Teknologi Malaysia. The study also focuses on what are the factors that influence the university innovative process towards commercialization. The data collection for this study will focus on the interviewing among the Universiti Teknologi Malaysia’s inventors and Innovation & Commercialization Center’s staff.

1.8 Research Framework

The framework of this study as it captured in (Figure 1.1) is stretched from Universiti Teknologi Malaysia as an exploratory study on the inventors and staffs of innovation towards commercialized products. After this, the study focused on the innovation issues listed in the framework which has lead to problems in innovation and towards commercialization.
Figure 1.1 Research Frameworks

UTM

Inventors / Researchers

ICC

Innovation

Motivations and commitment of inventors
University support Funding
Innovation process
Market research and Validation
Market Driven Technology

Commercialization
1.9 Research Layout

Chapter 1 explanations in brief about the innovation and commercialization in general then leads elaborate more on about commercialization in Malaysian university specifically in Universiti Teknologi Malaysia and what are the problems faced in universities commercialization. Later the focus transmit on the components of the study; which contains the problem of statement, purpose of study, objective of the study, the research question and the significance of this study. The scope study was discussed, based on the university innovation towards commercialization.

Chapter 2 starts with providing definition on the innovation and commercialization in overall. The chapter gives and explanation about the types of innovation bas on the Oslo Manual (2011). Besides, discussion on the relationships between innovation and commercialization was explored. After that the chapter gives another explanation on the problems of the innovation and commercialization process. The problem of commercialization consists; Motivation & Commitment of the Inventors, University Support and Funding, Innovation Process, Market Research & Market Validation and Market Driven Technology

Chapter 3 discussed about the methodology employed, with particular attention paid to the qualitative approach, as well as data collection based on the semi-structured interview. On top of that, this chapter provides research design, population as well as the method which includes semi-structured interview and in-depth interview questions and data collection. Data analysis procedures of the above data are described in this chapter.

Chapter 4 documented the findings of data analysis conducted on 16 of university inventors as well as the ICC staffs. Initially, the chapter starts with
background of the respondent and the data were analyzed based on the interview questions which were derived from the research objectives. Next some themes were extracted to cover the research objectives. Finally, seven significant themes were highlighted and these themes were chosen based on McKenna (1994) analysis.

Chapter 5 discusses the results of the study based on the seven significant themes. Later in this chapter, reported on the discussion of the findings compared to literature review that presented in chapter 2. Next, the conclusion, recommendation and recommendation of this study are explained in detail. Ultimately this chapter presents recommendation of future potential research and contribution of this study has been made.
REFERENCES


MOHE (Ministry of Higher Education) 2010, Niche 1: commercialisation and innovation development, AKEPT (Higher Education Leadership Academy)


New Economic Model for Malaysia. Part I: Strategic Policy Directions. Federal Government Administrative Centre Malaysia, Putrajaya, 2010


Siti Hamisah Tapsir (2007), “University-industry partnerships: fostering strategic linkages at institutes of higher learning in Malaysia, Universiti Teknologi Malaysia


Journal of Nanjing University of Traditional Chinese Medicine, Vol. 37, No.1, pp. 39-44.


