BARRIERS TO ABSORPTIVE CAPACITY IN THE MALAYSIAN AEROSPACE SECTOR

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I dedicate this research to my beloved family members for their unwavering support, love and dedication throughout the course of my research.

In addition, I dedicate this research to the proud and beautiful nation of Malaysia and all Malaysians. Your nation has captivated me and will always hold a special place in my heart.

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ABSTRACT

International technology transfer and absorptive capacity play a trivial role in technological capacity building in newly industrialized countries. Despite various ambitious and visionary roadmaps, Malaysia's aerospace industry is still confined to basic manufacturing, maintenance, repair and overhaul and lacks substantial research and development and design activities. As absorptive capacity is a prerequisite for organizational learning, which is the basis for technological capacity building, identifying barriers to absorptive capacity is essential to explain why Malaysia is performing suboptimal in realizing technological capacity building in the aerospace realm. A questionnaire survey and in-depth one-on-one semi-structured interviews utilizing the Delphi survey method with respondents in the global, Southeast Asian and Malaysian aerospace sectors were executed. Data triangulation of the questionnaire and Delphi survey was applied. The generated data was statistically analyzed and the extracted results indicated inconsistencies in education and training and various institutional and organizational barriers as major impediments to Malaysian technological capacity building. The role of education and training for establishing sufficient levels of absorptive capacity is substantial and forms a fundamental part of a nation's ability to establish and cultivate absorptive capacity on a national or organization-specific level. Recommendations are provided to enhance Malaysia's absorptive capacity and assist the nation in the technological capacity building of its aerospace industry. This research further contributes to the extant literature on absorptive capacity by proposing a new model of necessitated absorptive capacity. The results carry significant implications for policy-makers, managers, professionals and academics in the field of international technology transfer and absorptive capacity.

ABSTRAK

Proses permindahan teknologi dan kapasiti penyerapan teknologi di peringkat antarabangsa memainkan peranan utama dalam kapasiti pembangunan teknologi bagi negara perindustrian baru. Walaupun pelbagai hala tuju bercita-cita tinggi dan berwawasan, namun industri aeroangkasa di Malaysia masih terhad kepada aktiviti pembuatan, penyelenggaraan, pembaikan dan baikpulih, mempunyai kelemahan yang ketara dalam aktiviti penyelidikan dan pembangunan serta rekabentuk. Oleh kerana kapasiti penyerapan merupakan pra-syarat kepada pembelajaran organisasi dan merupakan asas kepada pembinaan keupayaan teknologi, mengenalpasti halangan kepada kapasiti penyerapan adalah penting untuk menjelaskan kenapa pelaksanaan dalam merealisasikan pembinaan keupayaan teknologi dalam bidang aeroangkasa di Malaysia kurang memuaskan. Kajian soal selidik dan temuduga bersemuka separa-struktur terperinci menggunakan kaedah Delphi telah dijalankan dengan responden dalam sektor aeroangkasa global, Asia Tenggara dan Malaysia. Hasil yang dikeluarkan menunjukkan bahawa pendidikan dan latihan yang tidak konsisten dan pelbagai rintangan daripada institusi dan organisasi telah dikenal pasti sebagai penghalang utama kepada pembangunan keupayaan teknologi di Malaysia. Peranan pendidikan dan latihan untuk mengujudkan tahap kapasiti penyerapan yang memuaskan adalah penting dan menjadi asas kepada keupayaan sesebuah negara untuk mewujudkan dan memupuk kapasiti penyerapan di peringkat kebangsaan atau organisasi tertentu. Beberapa cadangan diberi untuk meningkatkan kapasiti penyerapan Malaysia dan membantu negara dalam pembinaan keupayaan teknologi industri aeroangkasa. Kajian ini seterusnya menyumbang kepada pertambahan literasi terhadap kapasiti penyerapan dan mencadangkan satu model baru kapasiti penyerapan yang diperlukan. Keputusan kajian ini memberi implikasi penting bagi penggubal dasar, pengurus, profesional dan ahli akademik dalam bidang permindahan teknologi antarabangsa dan kapasiti penyerapan.

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LIST OF SYMBOLS

c	-	Confidence interval, expressed as decimal
P	-	Percentage of respondents picking a choice, expressed as decimal
Z	-	Z value, 1. 96 for 95% confidence level
ρ	-	Logarithm
χ^2	-	Pearson Chi-Square

GLOSSARY OF TERMS

AAC	-	Asia Aerospace City
AC	-	Absorptive Capacity
ACRS	-	Asian Conference on Remote Sensing
ASEAN	-	Association of Southeast Asian Nations
CEO	-	Chief Executive Officer
CPI	-	Corruption Perception Index
DC	-	Developed Country
DLR	-	Deutsches Zentrum für Luft- und Raumfahrt e. V
EPU	-	National Aerospace Blueprint and the Economic Planning Unit
FDI	-	Foreign Direct Investment
GDP	-	Gross Domestic Product
HRM	-	Human Resource Management
IATA	-	International Air Transport Association
ICAA	-	International Civil Aviation Authority
ICT	-	Information and Communications Technologies
IF	-	Impact Factor
IJV	-	International Joint Ventures
IMP3	-	Third Industrial Master Plan
IPR	-	Intellectual Property Rights
IT	-	Information Technology
ITT	-	International Technology Transfer
LDC	-	Less Developed Country

MIGHT	-	Malaysia Industry-Government Group for High Technology
MITI	-	Ministry of International Trade and Industry
MNC	-	Multinational Corporations
MRO	-	Maintenance, Repair and Overhaul
NGO	-	Non-Governmental Organizations
NIC	-	Newly Industrialised Country
NLR	-	National Aerospace Laboratory
PBL	-	Problem Based Learning
R&D	-	Research and Development
RIS	-	Regional Innovations System
ROW	-	Rest Of the World
SCI	-	Science Citation Indexed
SME	-	Small and Medium-sized Enterprises
TAC	-	Technologically Advanced Country
TAF	-	Technology Acquisition Fund
TCB	-	Technological Capacity Building
UN	-	United Nations
US	-	United States
VSR	-	Variation, Selection and Replication

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CHAPTER 1

INTRODUCTION

1.1 Background and Problem Statement

In the following paragraphs a background to the research described in this dissertation is provided, culminating in a problem statement.

1.1.1 Background to the Research

International Technology Transfer (ITT) is a major player in obtaining return on public investment in research and development (R&D). In addition it stimulates innovation in business and commerce and contributes to economic growth (Venturini and Verbano, 2014). The extent of ITT activities expounds differences in per capita incomes between countries (Acharya and Keller, 2009). ITT constitutes access to overseas markets, expanded production possibilities, conceivable stronger political influence for the transferring country and means for infusion of advanced technology, creation of job opportunities and rapid economic development for the recipient country (Fan and Yu, 1983). Therefore, ITT of advanced technologies and their absorption into *Less Developed Countries* (LDC's) or the so-called *Newly Industrialized Countries* (NICs) holds substantial global importance. The term LDC generally refers to a country that is experiencing a low stage of economic development and has not reached the level of economic well-being that industrialized

nations have. The stages of development are defined as a function of the aggregate economic activity of a LDC and include the welfare of its inhabitants and technological sophistication (Rahnama-Moghadam *et al.*, 1995). To be considered NIC's (or sometimes referred to as *newly industrialized economies*), countries must satisfy at least two conditions: the establishment of a self-sustaining growth path and a sustained reduction in poverty and inequality leading to a continued improvement in the standard of living (Chowdhury and Islam, 1993). Malaysia is a second-tier South-East Asian NIC (Drabble, 2000). Malaysia's second-tier status has been linked to its resource wealth, which fostered rapid economic growth based upon primary production thus weakening the imperative to industrialize and to export manufactured products (Jomo and Rock, 1998). Developing nations should pursue an optimum approach to combine its existing technological capabilities with the acquisition from foreign sources (Leloglu and Kocaoglan, 2008).

Recently, absorptive capacity (AC) has received considerable attention from researchers concerned with the study of ITT. One of the first and most widely cited definitions of AC is suggested by Cohen and Levinthal (1990b) as "the ability to recognize the value of new external information, assimilate it and apply it to commercial ends." A high degree of AC is associated with an improved chance to successfully apply new knowledge towards commercial ends, producing more innovations and better business performance (Tsai, 2001). AC is also generally acknowledged as being one of the most significant factors determining organizational learning. Organizational learning is defined as a modification in organizational performance as a result of experience (Madsen and Desai, 2010). It encompasses the acquisition and interpretation of information resulting in behavioral and cognitive changes which ought to have an impact on an organization's innovativeness (Dimovski, 1994). Organizational learning comprises of five learning sub-processes: information acquisition, distribution, interpretation, integration, and

organizational memory influenced by four antecedent factors of participative decision making, organizational openness, learning orientation, and transformational leadership (Flores *et al.*, 2012).

AC is therefore not static but evolves through various learning processes (Todorova and Durisin, 2007). Research and development (R&D) and human capital are promoting AC (Griffith *et al.*, 2003; Muscio, 2007), R&D is significantly impacted by AC (Harris and Li, 2009), R&D human capital is an important indicator for AC and an organization's investment in R&D can lead to innovation via the enrichment of AC (Huang *et al.*, 2015). Thus, a high degree of AC and the subsequent organizational learning are essential to a nation's ability to facilitate lasting technological capacity building (TCB) and the establishment of R&D capabilities. In their case study of Japan's aircraft industry, King and Nowack (2003) provide a useful four-part framework (Figure 1.1) as a yardstick to measure TCB of a given industry. This organizing framework also incorporates the aerospace industry's Maintenance, Repair and Overhaul dimension (MRO).

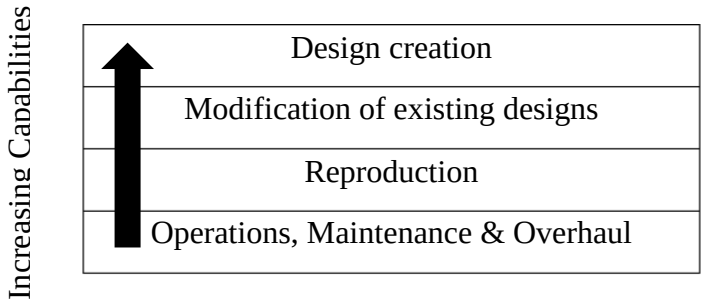

Figure 1.1 Organising technological capacity framework

1.1.2 Problem Statement

Despite years of aerospace and space technology and knowledge transfers, technological disparities exist between East Asian nations in general and in the Association of Southeast Asian Nations (ASEAN) in particular. Whilst contemplating latecomer technology development, Felker (2003) points out that Southeast Asia's NIC's "lagged in building capacities to adapt and improve imported technologies". Few locally owned enterprises venture into own-design or own-brand manufacturing, giving preference to labor-intensive and resource-based industries. The future of Southeast Asian countries is intimately linked with the development of a sustained scientific and technological capability. Southeast Asian countries have to develop new technology- and management-based capabilities (Sigurdson and Palonka, 2004). The extensive body of literature on AC, as further described in this dissertation, shows that the exertion of positive influence of advanced technologies on domestic production and growth of recipient NIC's depends prodigiously on the actual AC of the recipient NIC. A high degree of AC and the subsequent organizational learning of the recipient are evidently crucial in ITT and may well be characterized as the most important drivers for successful ITT with lasting results.

The executed comprehensive literature review revealed that most scholars have focused their research on AC in either a limited fashion (i.e. as part of wider research on another technology-related topic) or on a macro level contemplating ITT in broad general studies with the focus on a few aspects of the phenomenon. In addition, analysis of the literature indicates that a substantial amount of studies does not sufficiently consider the properties, characteristics, complexity and nature of the transferred technology and knowledge. After decades of research, the studies still do not sufficiently consider or even to various degrees neglect the ambiguity, multidimensionality and complexity of advanced technology whilst contemplating

AC. Furthermore, the literature shows that researchers have not yet adequately addressed the major barriers to AC from a holistic perspective, i.e. the interdependency of these often-structural barriers and how their combined effects continue to impede AC. Existing research has not sufficiently utilized integrated and comprehensive comparisons between the various barriers to AC from technological, socio-economic, educational, cultural and political and policy-related perspectives.

Acknowledging notable exceptions such as Singapore and countries like South Korea and Japan, Southeast Asian nations have not been fully able to translate aerospace technology transfers into lasting TCB and the establishment of R&D capabilities with high-value output. Despite Malaysia's various ambitious and visionary roadmaps such as the Ministry of International Trade and Industry's (MITI) Third Industrial Master Plan (IMP3), Malaysia Industry-Government Group for High Technology's (MiGHT) National Aerospace Blueprint and the Economic Planning Unit's (EPU) Tenth Malaysia Plan (2011 – 2015), the nation's R&D base does not sufficiently reflect the outlined ambitions. With the nation's Vision 2020, Malaysia aims to thrust the nation towards the transformation of its economy into a knowledge-based economy and thus attaining a level equal with the industrialized countries with respect to economic performance and technological capabilities (Mustapha and Abdullah, 2000). The endogenous theory of economic growth as postulated by (Romer, 1990), states that human capital and growth are at the nucleus of TCB and any successful attempt to technological change should be accompanied by a strong emphasis on these constituents.

Apparently, Malaysia is lacking sufficient R&D capabilities, inadequacy of supportive education and training infrastructure and a relatively weak science and technology base, lacking in scientific infrastructure, the proportion of R&D expenditures being equal to the level of a lower-middle-income country and the

educational level as a driver for Malaysia's weak R&D performance (Ramasamy and Yeung, 2007). Kanapathy (2001) signals that Malaysia's "shortage of critical skills, including creative talents and entrepreneurial capabilities, continues to plague the economy's transition to greater skill- and knowledge-intensive activities" and further perceives upgrading the level of local technological capabilities to support self-sustaining industrial dynamism as arguably the biggest challenge to Malaysia's industrialization process. Tidd and Brocklehurst (1999) have argued for a significant increase in Malaysian AC, based upon higher-level technical and managerial skills and greater internal R&D activity. They furthermore emphasize that the capability for developing indigenous expertise depends on the quality and quantity of human capital.

Malaysia's R&D inconsistencies have been further acknowledged by Lai and Yap (2004) whom identified the lack of sufficient financial resources and a lack of skilled R&D personnel as the most common internal factors. A mismatch of R&D activities, industrial R&D structural weaknesses and the missing intermediary institutional role are fundamental issues in the Malaysian R&D and innovation landscape (Chandran *et al.*, 2014). As a result, Malaysia's aerospace industry is considered underdeveloped after two decades since the introduction of the National Aerospace Blueprint (Tat, 2005). In her reflections on the Malaysian aerospace and defense industry, Balakrishnan (2008) points out that the industry's capabilities are still confined to basic manufacturing, MRO operations and lacks any substantial R&D and design activities. She further signaled that her view was echoed in 2006 by Malaysia's Ministry of Defence, which also assessed Malaysia's aerospace R&D and design capabilities as low. Utilizing comparative innovation system cases of Malaysia and Thailand, Wonglimpiyarat (2011) underlines the importance of technological development for economic advancement but concludes that Malaysia's government plans are inadequate. She urges Malaysia to pursue an upgrade in its

technology sector and to improve the nation's AC. Over the years, Malaysia has learned to utilize imported novel technologies from *Technologically Advanced Countries* (TAC'S) yet the nation's technological efforts do not exhibit innovative characteristics. Malaysia needs to upgrade its TCB from the relatively straightforward assembly stage to advanced design, development and manufacturing of new and indigenously conceived technologies (Chandran and Pandiyan, 2004). As AC is a prerequisite for organizational learning which is in turn the basis for TCB, identifying barriers to AC is essential to help explain why Malaysia is performing suboptimal in realizing TCB in the aerospace realm.

1.2 Research Questions

To fulfill the research aim and objectives, the following primary research question has been formulated:

Which critical barriers affect absorptive capacity of aerospace technology transfers and the subsequent technological capacity building in Malaysia?

To facilitate answering the primary research question, several secondary research questions have been formulated as follows:

1. What is the role of AC in the international transfer of advanced technology?
2. Which critical barriers and related issues to AC and their prevalence in Malaysia can be identified?
3. What is the role of education and training in AC?
4. What are the implications of the identified barriers for TCB in Malaysia?

1.3 Research Objectives

The overarching research objective of this dissertation is to identify the barriers and related issues pertaining to the role of AC in ITT in Malaysia.

This research aims to explore and identify barriers jeopardizing the establishment of a degree of AC, which in turn allows for value-added TCB. The identified absence of comprehensive and holistic studies in this area constitutes a gap in knowledge and this research provides an opportunity to bridge the gap and in addition contributes to a further understanding of barriers and constraints and their combined influence on AC.

The secondary objectives of this research are to:

1. Examine the main issues involved in education and training in the field of aerospace technology;
2. To assess if there is statistical difference in attitudes towards ITT and AC between Malaysian / Southeast Asian respondents and those from other parts of the world;
3. Provide recommendations for policy-makers, academics and professionals for overcoming the identified barriers and optimize the TCB of the aerospace sector in Malaysia;
4. Determine directions for further research in the fields of ITT and AC;
5. Advancing the existing scientific body of knowledge in the field of ITT, AC and education and training as a result of this research.

1.4 Research Hypotheses

Through the developed research methodology, this thesis attempts to find evidence to support the following four hypotheses:

1. The most critical barriers affecting the AC of aerospace technology transfer in Malaysia are: deficiencies in education and training; insufficient human capital; corruption, nepotism and cronyism, budget and funding.
2. The role of AC in ITT is vital to the recipient NIC's such as Malaysia.
3. Education and training play a vital role in the establishment of a sufficient level of AC.
4. The implications of the identified barriers to AC constitute a major impediment to TCB in Malaysia.

1.5 Theoretical Framework

The theoretical framework was developed in order to help answer the research questions, meet the objectives and prove the hypotheses, and consists of the following approach:

1. Detailed literature study into ITT, AC and barriers to AC.
2. Internet research of international and national aerospace organizations and many educational establishments the Asian region.
3. Designing a detailed questionnaire to test the hypotheses and data to help answer the research questions.

4. Interview key stakeholders and peers in the field of aerospace technology in Malaysia and Southeast Asia during Delphi survey iterations.

Chapter 3 provides a detailed description of the methodology developed and employed for this research.

1.6 Justification and Scope of Research

The justification for this research can be derived from the necessity of contributing to an enhanced understanding of the prevalence of barriers affecting AC in Malaysia. Its findings do not only aim to deepen the theoretical body of literature on the subject but, equally important, seeks to provide insights for practitioners in both technology transferring organizations and NIC's alike. Therefore, the research findings *ab initio* benefit academics and researchers involved in the field of ITT and AC. The identified absence of comprehensive and holistic studies constitutes a particular knowledge gap, which this research seeks to address.

Furthermore, the findings benefit professionals, academics and practitioners partly or entirely involved with the various stages of ITT processes and the effective absorption of advanced technology. Lastly, policy makers may translate the research findings into policy development to help lift barriers to a sufficient degree of AC of advanced technology within Malaysia. From an overall perspective this research contributes to a further improvement of TCB in NIC's and as such, bears global relevance. The author's previous employer, the National Aerospace Laboratory (NLR) in The Netherlands, has expressed interest in the research findings, as it is

relevant to NLR and its research and business practices in Southeast Asia in general and Malaysia in particular.

Special emphasis is placed upon the Southeast Asian nation of Malaysia as this research is conducted at UTM and seeks to be particularly relevant to the Malaysian context. Malaysia therefore constitutes the geographical delineation of this research. The research focus lies with the identification of barriers to AC typical within the geographical delineation of this research. However, despite the geographical delineation with respect to Malaysia, this research has a global relevance to other NIC's. Examples of aerospace technology transfers and their subsequent absorption in East Asian nations are included in this research because of their importance to the subject. As this research is concerned with aerospace technology, which is inherently characterized by a high degree of technological complexity, examples of advanced technology transfers outside the aerospace realm are included in the research if deemed relevant.

Furthermore, this research focused on the balance between the technology transfer process (technology transferee) and the technology acquiring process (technology recipient) as depicted in Figure 1.2. The balance between the two processes is important to determine the degree of AC. Critical barriers to AC can be identified and analyzed from the transfer and acquisition processes. This research will not focus on the dynamics surrounding the technology transferee nor will it contemplate barriers and issues, which are specific to the technology provider's perspective. The research is confined to the technology recipient's perspective and abides to the aforementioned geographical delineation. Lastly, as mentioned before, aerospace technology is part and parcel of this research; notable exceptions with regard to highly advanced technology are included on the basis of their relevance for AC.

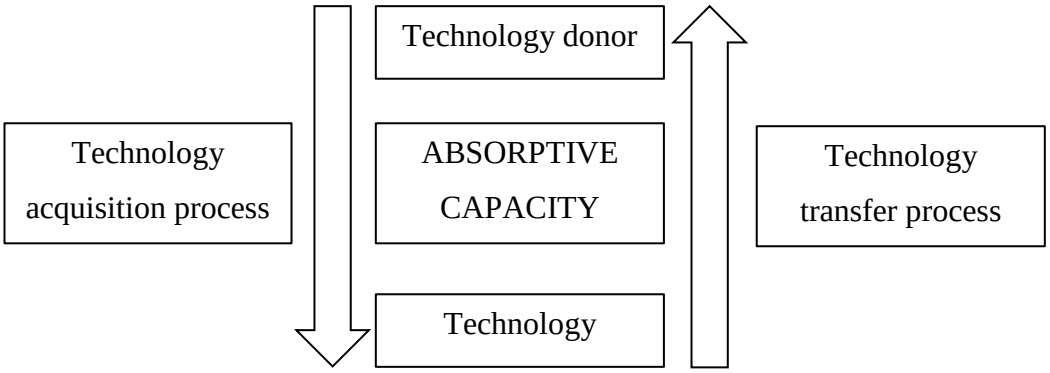

Figure 1.2 Absorptive capacity balance

1.7 Research Assumptions

This research arrives from the assumption that the answers provided by the respondents of the designed and widely circulated questionnaire were given in good faith and that the respondents had no hidden agenda's or ulterior motives that may have influenced their replies. Similarly, in the conducted one-on-one in-depth interviews with individuals in the commercial, governmental and academic Malaysian, Southeast Asian and global aerospace organizations, it was assumed that they have answered the questions truthfully. However, it could be that for reasons of confidentiality; competition; financial; commercial and social interests, they did not reveal the actual situation within their respective organizations. It is assessed that the risk for answers influenced by ulterior motives is more likely within the group of questionnaire respondents since participants of the one-on-one interviews were fully aware that they are guaranteed to remain anonymous as an essential part of the Delphi iterations.

1.8 Limitations of this Research

No limitations to the research in terms of access to library resources to carry out the detailed literature review, nor in access to internet facilities for the study of all the various aerospace organizations existed. The response to the detailed questionnaire circulated globally and specifically in Malaysia and the wider Southeast Asian region took much longer than initially anticipated, as it was the intention to collect a sufficient number of replies in order to be able to carry out a detailed statistical analysis. Finally, a total of 42 replies were received (n = 42) out of 310 approached organizations and individuals, which equals to a 13.54% response return. This percentage is more than sufficient to carry out the detailed statistical analysis. This was further supported by the 31 in-depth one-on-one interviews carried out utilizing the Delphi survey method.

However, from a statistical perspective n = 42 with a confidence level of 95% in this context translates to a confidence interval of 14.08. This is perceived as a research limitation. The confidence interval and implications for the analysis of the questionnaire results are further elaborated in Chapter 3. In the context of this research, a larger number of respondents would have resulted in a smaller confidence interval, thus contributing to a higher accuracy of the answers provided in the questionnaire. Because of the inevitable time limitations of this research, the collection effort had to be cut off at 42 respondents in order to process the statistical analysis and comply with the research schedule. Ideally, more time would have elapsed to obtain more responses, thus increasing the sample size and lowering the confidence interval.

1.9 Expected Contributions

This research is expected to advance the existing scientific body of knowledge in the field of ITT, AC and education and training. By means of publishing the results of this research in top international Science Citation Indexed (SCI) journals, with high Impact Factors (IF), the research will ensure wide circulation of the results. This statement is supported by the fact that one Invited Review Paper has already been published in June 2015 by Elsevier's Progress in Aerospace Sciences, 2014 IF 2.540, see Appendix A. In addition, two conference papers were submitted to the 36th Asian Conference on Remote Sensing (ACRS), *Fostering Resilient Growth in Asia* (19-23 October 2015, Quezon City, Metro Manila, Philippines) entitled: *'Remote sensing technology transfer and absorptive capacity in Asia'* and *'The role of education and training in remote sensing technology transfer'*. Both have been accepted and were orally presented during the conference (Appendices B and C respectively). Another journal paper on "Necessitated absorptive capacity and metaroutines in international technology transfer: A new model" is currently under review at the Journal of Engineering and Technology Management (August 2015, IF 2.060).

Furthermore, the research results are expected to contribute to the Malaysian aerospace sector by means of improving the AC, education and training aspects and by removing the existing barriers to technology transfer. Lastly, the research findings could conceivably benefit other high-technology sectors of the Malaysian economy and society.

1.10 Significance of this Research

The research will make a significant contribution to the existing body of knowledge on ITT and AC related studies in Malaysia. The research will identify the main barriers to ITT and AC and propose ways to overcome these. Through vigorous theoretical and empirical scrutiny of persistent barriers to AC, the research will contribute to the lack of comprehensive empirically based studies in this area and enriched the current body of literature on the subject. Furthermore, this research will contribute substantially by underlining the importance of education and training to AC in general and to the Malaysian aerospace sector in particular, benefiting university staff working in aerospace faculties in designing improved courses.

The research findings are of equal importance to a wide range of actors in the Malaysian aerospace arena including the Malaysian government and policy-makers, Malaysian aerospace companies, universities, national institutes and professionals in the field whom frequently deal with ITT-projects. The various identified barriers and the new necessitated AC model this research proposes, provide managers in commercial firms a template to translate the research findings and recommendations into a set of concrete actions and adjustments in pursuit of the organization's strategic goals. The results exhibit intrinsic value for academia, governmental organizations, commercial enterprises and professionals, practitioners and researchers in ITT and AC fields.

1.11 Research Design

In order to answer the research questions, meet the research objectives and confirm the research hypotheses, a detailed research design was developed, which will be fully explained in Chapter 3 Methodology. At this stage it suffices to indicate that the research design consists of four steps: (i) Detailed literature study on topics including the nature of technology, conceptualizations of technology transfer (TT) and its international equivalent and AC, aerospace technology, the identification of existing barriers to AC and the role of education and training. (ii) Internet research into aerospace organizations (governmental, commercial and academic). (iii) Design and data collection through the questionnaire. (iv) In-depth one-on-one interviews as part of a Delphi survey with relevant individuals in the international and Malaysian aerospace realm.

1.12 Thesis Outline

Chapter 1 delivers the relevant background information for the thesis such as the contextual information to the research problem statement, research objectives, questions, hypotheses, assumptions, limitations, research design and expected contributions. Chapter 2 contains a detailed literature review. Chapter 3 explains and elaborates the research methodology developed and adopted for this study. Chapter 4 describes the data collection and analysis utilized for the questionnaire and the in-depth interviews. The results and findings of this research endeavour are compiled in Chapter 5 followed by the main conclusions and findings of this research (Chapter 6). This final chapter presents the recommendations to the Malaysian aerospace industry and relevant government and academic entities for overcoming the barriers and limitations to AC. In addition, it provides directions for future

research in this field. The thesis ends with five appendices providing details of the three accepted publications plus the abstract of another submitted full journal paper this research produced (Appendix A-C). Appendix D provides a schematic overview of the main international peer-reviewed journals consulted for the purpose of this research. Appendix E lists the original questionnaire as circulated internationally to 310 relevant organizations and individuals.

1.13 Chapter Summary

In this introductory chapter, the background to the research problem statement, research objectives and questions, hypotheses, assumptions, limitations and expected contributions was provided. Furthermore, an outline of the research design adopted to carry out the research has been given.

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