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Understanding Technology Transfer: An Extended Resource-Based View

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A thesis submitted for the degree of Doctor of Philosophy

School of Business, Economics and Informatics

Birkbeck, University of London

Author's Declaration

I hereby declare that this thesis entitled “Understanding Technology Transfer: An Extended Resource-Based View” is the result of my own work and includes nothing that is the outcome of work done in collaboration except, where specifically indicated in the text. The thesis has not been submitted, in whole or in part, for consideration for any other degree or qualification at this university or any other institute of learning and complies with Birkbeck, University of London guidelines on length and format.

Yiteng Chiang

Abstract of the thesis

With increased competition in the worldwide marketplace, technology transfer has helped organisations gain and sustain competitive advantage. However, theories such as Resource-based view cannot, in and of themselves, explain how companies gain competitive advantages from an environment where companies maintain frequent and multiple collaborative relationships with TT partners. Moreover, to review previous studies on mixed theories, far too little attention has been paid to overlaps and integration mechanisms.

This thesis integrates Resource-Based View (RBV) with Network Perspective as Extended Resource-Based View (ERBV) to understand the phenomenon of technology transfer. The whole thesis aims at answering how ERBV explains the mechanisms of technology transfer as well as applies to this research field.

In this thesis, as such, three individual papers are asking three research questions based on the main research question which are: 1) How can Technology Transfer be explained by an Extended Resource-Based View? 2) How do resources drive technology transfer in Taiwan? And, 3) What are the relationships between technology transfer capabilities and performance of Information Technology and Electronics industry in Taiwan.

Despite the abundant literature on technology transfer, a lack of consensus on conceptualisation and operationalisation of technology transfer remains. As such, chapter two develops a more comprehensive theoretical framework, ERBV perspective, to answer why it is in need and how it can be used to analyse and understand technology transfer. Chapter three engages the Case Study to know how resources drive technology transfer. Qualitative data will be acquired through in-depth interviews and field observations with industry experts and scholars. Subsequently, a structured questionnaire survey will be mailed to top executives (CEOs, Top-level Managers, or R&D directors) of Information Technology and Electronics industry in Taiwan to understand the actual conditions of these constructs. That means a total of 1000 questionnaires will be mailed to top 1000 Taiwanese information technology and electronic companies are listed in the China Credit Information Service Incorporation for investigating the questionnaire approach. To verify the research hypotheses, a structural model and measuring model will be established to test the causal

relationships among the variables. That is, chapter four adopts structural equation modelling (SEM) to justify the relationships between technology transfer capabilities and competitive advantages. After completing the above-mentioned research, chapter five will investigate and integrate them into a conceptual framework of technology management for information technology and electronics companies attempting to implement strategies of technological transfer.

In sum, this study reaches following conclusions: 1) this study will clarify the relationship among the constructs by investigating ERPV and determining the causal relationships among them; 2) This study will investigate the current conditions of Taiwan's information technology and electronics industry according to the constructs; 3) Conclusions, management implications, and suggestions for future research will be presented according to hypothesis verification results. 4) Through this research, we will assist businesses with understanding how and why organisations can utilise these constructs to create competitive advantages; 5) based on ERBV and literature, the present study will develop measurement items for each variable, with further consideration given to the suggestions of experts and scholars in in-depth interviews. 6) Where necessary, the questionnaire will be modified after conveying a pre-test with relevant businesses. 7) By developing specific measurement indicators for these constructs, this study will assist future researchers by clarifying the constructs and providing a means for measuring them.

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Chapter 1 Overview of the Thesis

1.1 Problem Awareness

Reviewing the real value-added that information technology and the electronics industry have created over the last years shows that the global recession changed that industrial sector. We are currently in the midst of a significant transformation as Industrial Revolution 4.0 strengthens awareness of smart and autonomous systems fuelled by data analysis and machine learning (Mohd aiman kamarul bahrin, Mohd fauzi othman, Nor hayati nor azli & Muhamad farihin talib, 2016).

However, many organisations might still be struggling to find the talent or the knowledge to best adapt for their unique use cases or denying how IR 4.0 could impact their business.

A close look at our society and current digital trends cannot help but reveal the nine focuses of IR 4.0 affecting the knowledge-intensive Information Technology and Electronics industries: 1) Autonomous robots; 2) Additive manufacturing; 3) Augmented reality; 4) Big data; 5) Cybersecurity; 6) Cloud computing; 7) Internet of things; 8) Simulation; 9) System integration.

Moreover, with increased competition in the worldwide marketplace, technology transfer (TT) has helped organisations in Information Technology and Electronics to gain and sustain competitive advantage (Daghfous, 2004; Daniel Smith, Maryann Feldman & Gary Anderson, 2018; Dirk Meissner & Natalia Shmatko, 2019).

While IR 4.0 is still evolving, we remain clueless about the complete picture. Why do Information Technology and Electronics companies transfer technologies? Will performing technology transfer move them far away from their traditional business focus? What are the ways to profit from technology transfer? Furthermore, conventional business-management philosophy stresses that companies must own or adequately control strategic resources to create value, an idea that applies to how technology-transfer knowledge loss disadvantages companies. What is the answer to this controversial phenomenon? Is general business-management philosophy wrong? Will companies tend to transfer technologies that are outdated or irrelevant by the time they do? How are companies making a profit from technology transfer? How could technology transfer assist in 1) preventing mistakes from costing business opportunities,

2) enabling rapid market entry, 3) satisfying market demand for technologies, 4) considerably reducing investment in internal R&D projects, 5) saving R&D workforce and time, 6) enhancing technology, 7) enabling effective resource management and 8) increasing productivity and competitiveness?

So many questions related to this phenomenon of technology transfer deserve attention. Companies adopting it should realise that IR 4.0's impact is causing shifts in the Information Technology and Electronics industries. Accordingly, this thesis analyses this phenomenon to discover a better explanation concerning transfer-technology mechanisms, starting with a theoretical framework that incorporates the interrelationships among its critical factors. It finally offers guidelines for management and organisational structures and implementation strategies applicable to companies attempting to transfer technologies.

1.2 Taiwan's Key Role in IR 4.0

Strategic reasons for companies in developed countries to transfer world-class production methods and technology to developing countries emphasise the importance of the management aspects of technology transfer (Cusumano, M. & Elenkov, D, 1994; Liao, S. H., and Hu, T. C., 2007; Moreira, 2009; Wahab S. A., Rose R. C., and Osman S. I. W., 2012). Although Asia is a relatively new economic power in the world, Taiwan has experience in developing its own approach to becoming a newly industrialised country, having been called 'the Taiwan economic miracle' since the 1980s. Though rarely discussed, these experiences should have meaning for other emerging markets. Since the 1980s, Taiwan has taken a proactive approach to the development of emerging technologies. Although the history of manufacturing prowess defines the island of Taiwan, the economic revolution is still underway. Taiwan is in the midst of an innovation-driven economy, with hints of its high-tech excellence prevalent throughout its economy. The Global Competitiveness Report 2015–2016 from the World Economic Forum indicates that among 140 economies, Taiwan ranks 15th in overall GCI and 28th in technological readiness. In 2017, Taiwan ranked third out of 159 nations for broadband download speeds. Moreover, Taiwan produces 70% of the world's integrated circuits, as well as 90% of laptops sold all over the world. In short,

Taiwan operates at an advanced stage of technological development, given its position as a future-thinking hub of technology and engineering.

Taiwan is well-positioned to become a leader in the development and implementation of IR 4.0. With government initiatives spanning the Information Technology and Electronics industries, Taiwan is proving its readiness to take a leading role in this worldwide competition. Moreover, Taiwan possesses immensely valuable human capital, given the highly educated high-tech workforce. Taiwan is poised to become a key global player as the integration of intelligent technologies continues to evolve in the context of IR 4.0.

Accordingly, knowing Taiwan's technology-transfer activities is crucial, particularly as investigating its most representative industry, the Information Technology and Electronics sector, reveals. The Organisation for Economic Co-operation and Development (OECD) identifies the Information Technology and Electronics industry as comprising the following general areas: 1) Technology Software and Services—companies mainly developing software in various fields (the Internet, systems, applications, database management) or providing information technology consulting and services, as well as data processing and outsourced services; 2) Technology Hardware and Equipment—manufacturers and distributors of electronic equipment, computers and peripherals, communications equipment and related instruments; 3) Semiconductors and Semiconductor Equipment Manufacturers.

To summarise, due to IR 4.0's impact, the performance of the technology and the mechanisms and prerequisites of technology transfer have become crucial topics for investigation (Marius Tuft Mathisen & Einar Rasmussen , 2019). Also, the need becomes paramount in developing a new technology-transfer management system that enables all parties to cooperate to boost competitiveness and avoid the detrimental impact of changes in the external environment (Kasia Zalewska-Kurek, Klaudia Egedova, Peter A. Th. M. Geurts & Hans E. Roosendaal , 2018). Therefore, given that strategic importance and meaning that Taiwan's technology-transfer experiences show, Taiwan's Information Technology and Electronics industry (Technology Software and Services; Technology Hardware and Equipment; and Semiconductors and Semiconductor Equipment Manufacturers) is the research focus of this thesis.

1.3 Research Gaps

Having described awareness of the problem in the context of IR 4.0, the main concern of this thesis is with framing the discipline's research paradigms and theoretical perspectives, by exploring the literature on technology transfer in Taiwan's Information Technology and Electronics industry. As such, this section reviews previous studies to discover research gaps and reveals three significant gaps in the technology-transfer relevant research.

One deficiency of TT studies is that most lack sound theoretical frameworks, relying rather on empirical relationships. The importance of technology transfer as a research focus is visible in the continuously growing stream of related literature. However, each discipline using its own theoretical lens causes the lack of an integrative framework of TT to make sense of the varying research findings—particularly a lack of classification frameworks that consider theoretical perspectives (Sahin, F. and Robinson, E.P., 2002; Huang, G.Q., Lau, J.S.K. and Mak, K.L., 2003).

Theoretical perspectives are momentous; they can improve the explanation and description of complex phenomena (Halldorson, A. and Aastrup, J., 2003; Carter, C.R. and Rogers, D.S., 2008; Defee, C.C., Williams, B., Randall, W.S. and Thomas, R., 2010). According to recent empirical work, these studies focus on different research questions, such as those involving the motivation for TT alliance formation and management, the selection of partners, the identity of participating companies and alliance learning, dynamics and performance (B. Arya & Zhiang Lin, 2007; Arvanitis, S., Kubli, U. & Woerter, M., 2008; A. Comacchio, S. Bonesso, & C. Pizzi, 2012; Bianca B.M. Keers, Paul C. van Fenema, Henk Zijm., 2017).

However, applying a single theory or mixed theories to these studies shows that neither can fully explain the managerial phenomena. The reason is that theories such as the Resource-Based View (RBV) cannot, in and of themselves, explain how companies gain or sustain competitive advantage from the external environment, where they frequently maintain transferor-transferee relationships (Grant R. M., 1991; Wade, 2004; Wahab S. A., Rose R. C., and Osman S. I. W., 2012). Moreover, previous studies on mixed theories pay far too little attention to the explanation of integration and overlap mechanisms. Besides, the literature frequently discusses inter-firm networks as an antecedent to companies' performance, but largely ignores their role as an external

resource for technology transfer and its impact on companies' operations (MW Peng and Y Luo, 2000; SH Park and Y Luo, 2001).

Thus, the author proposes the first Research Question, 'How can we explain Technology Transfer from an Extended Resource-Based View (ERBV)?'

Second, the great number of published studies on the subject of technology-transfer strategy that exploits principal resources and competencies testifies to the importance of this issue but provides mostly fragmented and often contradictory evidence on the factors affecting such resources (Das, T.K., & Teng, B.S., 2003; Gerhard Kristandl & Nick Bontis, 2007; Lin, M. J. and Lai, S. B., 1993). Besides, from the transferee's perspective, most studies consider TT the most efficient method for introducing high-level technologies, making it crucial to the success of capital-intensive businesses. Through technology transfers from foreign partners, businesses can rapidly introduce and absorb new technologies that they require to develop and manufacture products for new markets, to enhance corporate performance (Gandenberger, 2015).

However, TT research neglects the transferors' perspective. The ability to transfer technologies depends on whether transferors are willing to turn that aspiration into a reality. Regardless of the scenarios, transferors always have the last word on how those blows will change them. In sum, previous studies focus primarily on the perspective of a transferee; how transferors employ and exploit resources in the process of technology transfer is rarely discussed (Lin M. J., 2001; Rothaermel, F.T., & Deeds, D.L., 2006; Brian Squire, Paul D. Cousins and Steve Brown, 2009; C. Battistella, A. De Toni, and R. Pillon, 2015; Gandenberger, 2015).

Thus, from the view of the transferor, the author engages the ERBV perspective and proposes the second research question: 'How do resources drive technology transfer?'

Third, TT is fundamentally changing the nature of the competitive environment that companies face in their global operations. TT is the optimal means of enhancing companies' capabilities to develop marketable products and facilitate entering new markets (Walsh, S. and Linton, D, 2002). Moreover, technology transfers can control existing markets or enable expansion into related markets, to obtain royalties and

thereby recover R&D cost (Lin, W. B. and Wu, W. I., 2006). Similarly, transfers can create partnerships to penetrate inaccessible foreign markets or modify their own technologies, according to transferee application specifics (Katerina Sideri & Andreas Panagopoulos, 2018). Tomas and Trevino (1993) note that the channels of technology transfer affect the frequency of interaction and level of mutual involvement between network members. Furthermore, network members who interact more frequently or are more experienced will strengthen motivations and more effectively eliminate uncertainty in a task environment, enhancing the overall performance of the TT partnership. Numerous modes of technology transfer are employed worldwide, yet little research adopts a comprehensive perspective on how technology transfer influences companies' competitiveness. A conceptual framework for technology-transfer capability and competitive advantage must be developed and tested empirically.

Also, the manifest variables cannot fully represent the constructs; applications of previous theories do not consider the integration mechanisms. Although several research studies on technology transfer relate to an RBV or a Network Perspective (NP), not enough empirical studies indicate manifest variables on adjusting resources, capabilities and network ties, for measuring firm performance or competitive advantage altogether.

Accordingly, the author adopts the ERBV perspective and proposes the third research question, 'What are the relationships between technology-transfer capability and performance of the Information Technology and Electronics industry in Taiwan?'

In sum, existing literature stops short of acknowledging 1) a better theoretical explanation of technology transfer; 2) how resources drive the technology transfer from the perspective of a transferor; 3) the effect of technology-transfer capability on competitive advantage.

1.4 Research Questions and Objectives

Based on the problem awareness and research gaps described above, the thesis's central concern is how ERBV explains technology transfer mechanisms and applies them to this research field.

The thesis aims to develop, present and demonstrate a theoretical framework that links with an apparently heterogeneous range of research activity on technology transfer, in situations that are the subject of decision-making and policy formulation in this business environment.

The following specific questions arise from this concern. This thesis comprises three individual papers asking three research questions in relation to technology transfer topics: 1) Extending Resource-Based View: A New Perspective on Technology Transfer (Theory Paper); 2) An Exploratory Study of Resources Driving Technology Transfer in Taiwan (Case Study): An Extended Resource-Based View; and 3) A Study on Technology Transfer Capabilities: An Extended Resource-Based View (SEM).

Table 1 Summary of this Research Concern

| Research Motivation | Research Intention | Research Question |
|--|--|---|
| <i>Ch3 Theory paper</i> The theory application and integration of this field deserves further study | Bridge the gaps of theories | How can An Extended Resource-Based View explain Technology Transfer? |
| <i>Ch4 Case study</i> The resources of transferring technology are worth further study | A Proposed framework will be adopted to its best application | How do resources drive technology transfer? |
| <i>Ch 5 SEM</i> The cooperative partnership model of technology transfer deserves further investigation | This study will clarify the relationship among the constructs and determine the causal relationships among them by investigating ERBV. | What are the relationships between technology transfer capability and performance of information technology and electronics industry in Taiwan? |

As such, the research objectives of this thesis are threefold. First, developing a theoretical framework—ERBV, which integrates RBV with a network perspective—provides a better understanding of the TT phenomenon. Second, this thesis develops a conceptual framework to explain how resources drive technology transfer in different technology-development contexts, by engaging a case study from the Information

Technology and Electronics industry. Third, by investigating ERPV, this thesis tests and clarifies the relationships among the constructs and determines the causal relationships among them.

As such, the research objectives of this thesis are threefold. First, a theoretical framework ERBV which is integrating RBV with Network perspective is developed to get a better understanding of phenomenon of TT. Second, this thesis develops a conceptual framework to understand how resources drive technology transfer in different technology development contexts by engaging a case study in the information technology and electronics industry. Third, this thesis tests and clarifies the relationships among the constructs by investigating ERPV and determining the causal relationships among them.

1.5 Research Method

This thesis aims to understand how ERBV explains technology transfer mechanisms and applies them to this research field. The following specific questions arise from this concern: 1) How can An Extended Resource-Based View explain Technology Transfer; 2) How do resources drive technology transfer; 3) What are the relationships between technology transfer capability and performance of information technology and electronics industry in Taiwan?

From the order of research questions, we learn the research performs qualitative methods in advance for answering the first two research questions. Once qualitative research has been completed, we can use these findings to inform our quantitative research. That means the thesis considers the possibility of employing other research philosophy. In other words, the research approaches should be mixed in ways that offer the best opportunities for answering these research questions.

What are the questions that can be addressed?

Exploring these two paradigms together allows for reflection on questions in relation to the chosen research article, as summarized in Table 2.

Table 2 Summary of this Research Concern

| Positivism (Quantitative) | Interpretivism (Qualitative) |
|---|--|
| ✓ What are the relationships between technology transfer capability and performance of information technology and electronics industry in Taiwan? | ✓ How can An Extended Resource-Based View explain Technology Transfer? ✓ How do resources drive technology transfer; |
| ✓ What are the constructs | ✓ Why are these constructs affected? |
| ✓ Relationships among | ✓ Why do they (these constructs) act this way? |
| ✓ Causes this effect | ✓ What is the lived experience? |
| ✓ Numbers speak for themselves | ✓ How are these constructs shaped by cultural contexts? |
| ✓ Formulated as | ✓ How do they inform people's actions? ✓ What meaning does the artefact or intervention have? ✓ How does subject understand? |

How to do the mixed method

Through the lens of Positivism and Interpretivism, the research process would be considered as in Figure 1: combining the advantages of these two paradigms into a better piece of research. In addition, the assumptions and key points of these two paradigms are summarized in Table 3.

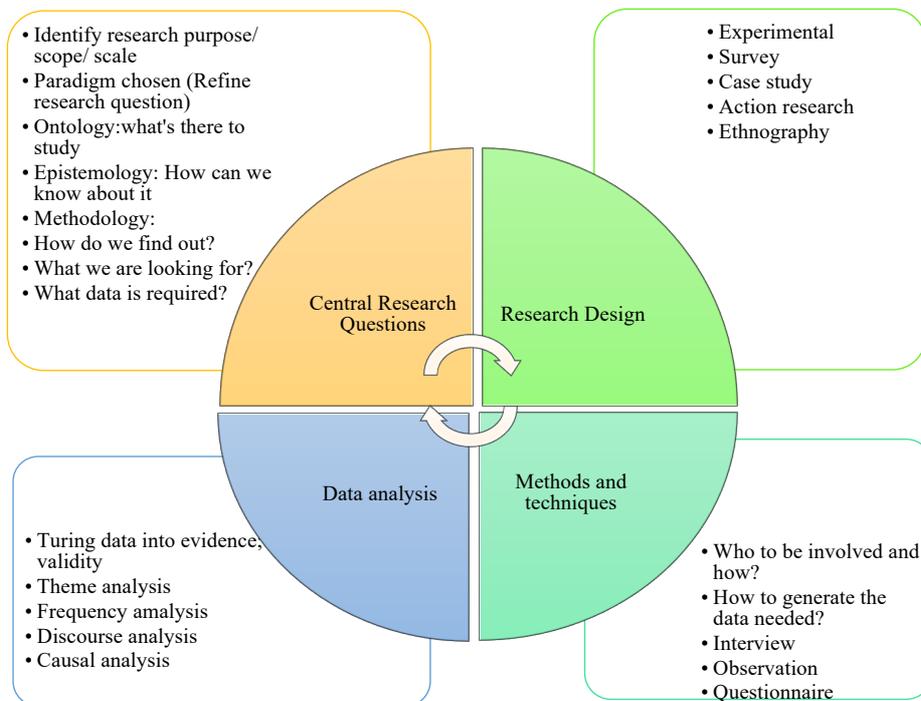


Figure 1 The research process of mixed method

Quantitative and qualitative research are complementary methods that work well together to provide insights that are both deep and wide. Regardless of the research objectives, now more than ever researchers have options and countless Quantitative /Qualitative tools to design projects that deliver more actionable insight.

Table 3 A summary of the two research paradigms

| Ontology | Positivist | Interpretivist |
|---|---|---|
| Nature of the world | Access to real world directly | Access to real world indirectly |
| Human interests | Should be irrelevant (Value-free) | Human interests drives science |
| Reality | Only one external reality (Unified realism) | No single external reality (Constructionism: multiple) |
| Concept | Can be operationalised and measured | shall merge stakeholder perspectives |
| Epistemology | - | - |
| 'Grounds' of knowledge/ relationship between reality and research | <ul style="list-style-type: none"> ✓ The world is perceived as external and objective ✓ Research focus on generalization and abstraction (universal and factual) ✓ Thought governed by hypotheses and stated theories ✓ Must demonstrate causality | <ul style="list-style-type: none"> ✓ The world is perceived to be socially constructed and subjective ✓ Research focuses on the specific and concrete ✓ Seeking to understand specific context ✓ Aim to increase general understanding of the situation |
| Methodology | | |
| Research focus | Focus on explanation & description | Focus on interpreting & understanding |
| Researcher role | <ul style="list-style-type: none"> ✓ Researcher is independent ✓ Concentrate on principles of cause and effect are searched ✓ Reduce phenomenon to the simplest elements (Reductionist) ✓ Aim to reveal external reality ✓ Deductive ✓ Strive to have a rational and logical approach ✓ Strive to maintain clear distinction between <ol style="list-style-type: none"> 1)facts and value judgments 2)reason and feeling 3)science and personal experience | <ul style="list-style-type: none"> ✓ Is part of what is being observed ✓ Researchers may experience what they are researching ✓ Concentrate on meanings ✓ Aim to understand the meanings of social phenomena. ✓ Ideas are developed by data induction ✓ Acceptable for <ol style="list-style-type: none"> 1)less clear distinction between facts and value judgments 2)Allow feeling and reason to govern actions 3)The influences of science and personal experience |
| Research progresses | Hypotheses and deductions | Gather rich data from which ideas are induced |
| Techniques been used | Statistical and mathematical methods (Deductive) | non-quantitative Thick description (Interpretive/ hermeneutic) |
| Methods | <ul style="list-style-type: none"> ✓ Experiment ✓ Survey ✓ Case study ✓ Questionnaire ✓ Action research ✓ Comparative analysis ✓ Concepts have to be operationalised ✓ Large numbers selected randomly ✓ Should be reduced to simplest terms | <ul style="list-style-type: none"> ✓ Grounded theory ✓ Ethnography ✓ Conversation analysis ✓ Narrative ✓ Small samples are analysed in depth for a long time |

Summary

Mixed methods research has become the most popular term used to describe this movement. It is important to keep in one's mind, however, that the word methods should be viewed broadly. Greene (2006) provided an excellent description of the way we viewed the word methods in this term (i.e., we see it as meaning "methodology" as conceived and outlined by Greene, 2006). We believe that a broad interpretation and use of the word methods (in mixed methods) allows inclusion of issues and strategies surrounding methods of data collection (e.g., questionnaires, interviews, observations), methods of research (e.g., experiments, ethnography), and related philosophical issues (e.g., ontology, epistemology, axiology). In our view, each of the three major approaches to research include assumptions, principles, and values about these kinds of methodology and practice-related issues as parts of the research paradigm (Johnson & Onwuegbuzie, 2004; Morgan, 2006).

Mixed methods research is the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroboration.

Qualitative dominant mixed methods research is the type of mixed research in which one relies on a qualitative, constructivist-poststructuralist-critical view of the research process, while concurrently recognizing that the addition of quantitative data and approaches are likely to benefit most research projects.

Quantitative dominant mixed methods research is the type of mixed research in which one relies on a quantitative, postpositivist view of the research process, while concurrently recognizing that the addition of qualitative data and approaches are likely to benefit most research projects.

In order to mix research in an effective manner, we first need to consider all of the relevant characteristics of quantitative and qualitative research. Our mixed methods research process model comprises eight distinct steps: 1) determine the research question; 2) determine whether a mixed design is appropriate; 3) select the mixed method or mixed-model research design; 4) collect the data; 5) analyse the data; 6)

interpret the data; 7) legitimate the data; and 8) draw conclusions and write the final report.

In sum, in this thesis, given the research questions, we engage qualitative methods in advance for answering the first two research questions. Once qualitative research has been completed, we use findings to inform our quantitative research. The reason is because qualitative research is primarily exploratory in nature, and helps a researcher better understand motivations, needs, processes, and rationale for behaviours. It provides deep insights into a situation and helps form ideas or hypotheses for potential quantitative research.

1.6 Research Design

Many possible theoretical perspectives and methods could have been used to conduct this research, based on the research question, data sources and time frame; thus, we should choose wisely and carefully. Therefore, this thesis adopts the integrative ERBV perspective, a suitable way to enhance our understanding of the mechanisms of technology transfer and an applicable perspective on this research field. The following procedure guided the research (Creswell, 2003).

- *Preparation:* The research questions and objectives point to a review of secondary data in the relevant literature and the analysis of the research context and current situations, to construct a conceptual framework.
- *Data collection:* Qualitative and quantitative methods were used to collect primary data. In-depth interviews and field observations with industry experts and scholars, aimed at clarifying the nature of transfer-transferee relationships in the Information Technology and Electronics industry and influences on them, collected qualitative data. The questionnaire was based on the literature review and interview findings. A structured questionnaire survey was mailed to top executives (CEOs, top-level managers, R&D directors) of information technology and electronics companies, whose information and insights were applied to understanding the actual conditions of these constructs.

Accordingly, this data collection comprised two stages:

In the first stage:

- A framework for the causal relationships among constructs was inferred from the perspective of ERBV and subjected to a thematic and path analysis.
- Face-to-face semi-structured formal interviews and general field notes (before or after interviews) were carried out.
- The data from interviews and field notes conducted in the first stage provided valuable contextual knowledge regarding technology-transfer strategic management.

In the second stage:

- In-depth interviews and field observations were conducted with experts and scholars, and results of interviews contributed to developing measurement items for each variable.
- A pre-test with relevant information technology companies was conducted to determine whether the items required modification. Subsequently, a structured questionnaire survey was mailed to CEOs, top-level managers or R&D directors, to acquire information for understanding the actual conditions of these constructs.
- The research hypotheses were tested to elucidate the interaction among the constructs. Also, the analysis results were examined to draw conclusions, discuss management implications and offer suggestions for future research.
- *Data analysis:* From the perspective of ERBV, this thesis engaged a case study to discover patterns in the data (interviews and observations from May 1st to December 31st, 2017). Based on the findings, this study develops strategies for technology transfer. Furthermore, a linear structural relations model was constructed, and AMOS Version 23.0 was used to conduct statistical analysis, based on the valid and reliable questionnaires (from February 28th to March 31st, 2019). The research hypotheses were tested and verified, based on whether the model achieves a good fit with the observational data.
- *Conclusions and suggestions:* This study developed and concluded a preliminary summary based on the analysis results. Next, we invited experts to participate in a focus seminar aimed at eliciting their opinions on the research topic. Finally, after compiling their opinions, the author drew conclusions, discussed management implications and offered suggestions for future research. In other words, in this

thesis, three individual papers ask three research questions in relation to technology transfer topics with tailoring methods:

- 1) Extending Resource-Based View: A New Perspective on Technology Transfer
 - Theory paper: theory integration and reframing
 - RQ: How can Technology Transfer be explained by An Extended Resource-Based View?
- 2) An exploratory study of resources driving technology transfer in Taiwan: An Extended Resource-Based View
 - Case Study: reframe the theoretical framework
 - RQ: How do resources drive technology transfer?
- 3) A Study on Technology Transfer Capabilities: An Extended Resource-Based View
 - Structural Equation Modelling: test and verify relationships among the constructs
 - RQ: What are the relationships between technology-transfer capabilities and performance of the Information Technology and Electronics industry in Taiwan?

1.7 Thesis Structure

The overall structure of this thesis takes the form of six chapters: 1) Overview of the Thesis; 2) Extending Resource-Based View: A New Perspective on Technology Transfer; 3) An exploratory study of resources driving technology transfer in Taiwan; 4) A Study on Technology Transfer Capabilities: An Extended Resource-Based View; and 5) Conclusions and Contributions.

The thesis starts from an overview (Chapter 1) that describes the problem awareness, identifies research gaps in the literature, presents research questions, details research methods for approaching the research questions, outlines the thesis, and summarises potential contributions. Despite the abundant literature on technology transfer, a lack of consensus remains on the conceptualisation and operationalisation of technology transfer. After that, Chapter 2 develops a more comprehensive theoretical framework, the ERBV perspective, to answer the question of how to use it to analyse and understand the phenomenon of technology transfer. Chapter 3 engages the Case

Study to study how resources drive technology transfer. To test this theoretical framework, Chapter 4 adopts structural equation modelling (SEM) to justify the relationships between technology transfer capabilities and performance. After completing the research, the thesis investigates and concludes in Chapter 5 recommendations for information technology companies attempting to implement strategies of technological transfer.

1.8 Potential contribution

This thesis aims to understand the phenomenon of TT by developing a theoretical framework, ERBV, for integrating RBV with Network Perspective. Hence, the thesis will contribute to the existing literature in three ways. First, this thesis not only finds the missing link to mechanisms of TT but also contributes to theory development in technology-transfer research. This new understanding of technology transfer the first contribution to theory. Second, this thesis proposes the conceptual framework for technology transfer from the perspective of a transferor, contributing to theory development using a case study. Third, it theoretically and empirically assesses how technology-transfer capability affects performance, via a questionnaire survey.

Moreover, this thesis uses qualitative and quantitative methodologies to test the theoretical framework. These applications helped in refining the framework and showed that its applicability and use. Especially for researchers on theory integration, the ERBV perspective, TT strategy can gain important benefits from this study's potential contributions.

In sum, this study anticipates the following outcomes based on the research objectives:

- 1) Based on ERBV and relevant literature, this thesis explains the TT mechanism, proposes a theoretical framework, then develops measurement items for each variable, with further consideration of suggestions from experts and scholars in-depth interviews.
- 2) This thesis reviews the literature for examples of operationalisation of the constructs. Through the literature review and suggestions of experts and scholars, this thesis clarifies the relevant constructs for future researchers.

- 3) Where necessary, the questionnaire was modified after conducting a pre-test with relevant companies. By developing specific measurement indicators for these constructs, this study will assist future researchers by clarifying the constructs and providing a means for measuring them.
- 4) This thesis theoretically infers the causal relationships among the constructs. A framework for a path analysis was established according to the proposed theoretical model. This study clarifies the relationship among the constructs by investigating relevant theories and determining the causal relationships among them.
- 5) This thesis investigates the current conditions of Taiwan's Information Technology and Electronics industry and establishes a model to simultaneously determine the relationships among the research constructs. In addition, a confirmatory factor analysis was performed to further verify the causal relations among the constructs.
- 6) Conclusions, management implications and suggestions for future research are presented with hypothesis verification results. This research assists businesses in understanding how to utilise these constructs to create competitive advantages.
- 7) Practitioners, such as decision-makers or process managers, should make use of the results in this framework, to understand and structure their technology transfer activities.

Chapter 2 Extending Resource-Based View: A New Perspective on Technology Transfer

As the perspective of Resource-Based View (RBV) cannot be engaged and explained the mechanisms between transferors and transferees thoroughly. As such, this chapter aims at knowing how to address this specific phenomenon in the information technology and electronics industry through reframing to have a holistic understanding of Technology Transfer's nature and implications. This chapter, therefore, elaborates on the RBV and Network perspective respectively and then discusses why Network perspective should be considered and be integrated to RBV.

Accordingly, this chapter develops a comprehensive theoretical model, the extended resource-based view (ERBV), and explains how it can be used to analyse and understand the interactions between transferors and transferees in technology transfer (TT) research. The chapter untangles the interfirm mechanism underlying technology transfer networks to describe how the ERBV perspective explains transferor-transferee relationships. We propose that the RBV and Network perspective (NP) can extend and refine each other's traditional frames of analysis in the context of TT. Finally, we posit a set of research directions designed to enable scholars to further comprehend ERBV from the perspectives of both theory-driven practise management and problem-driven theory development.

2.1 Introduction

In response to this complex and dynamic business environment, companies in the Taiwanese's information technology and electronics industry are adopting various interfirm strategies. As this business environment is not invariable but evolving with the time, prior success probably will not be successful in the future (R.R. Gillies, S.M. Shortell & G.J. Young, , 1997). Since information technology and electronics companies proliferate through industry networks, scholars have recognised networks as critical advantages that companies use to create value and improve performance (Thielst, 2007). TT partnerships can be defined as collaborative arrangements among independent companies that involve sharing, exchange and co-development activities designed to reach companies' strategic goals (Khalil, 2000). TT takes different forms, including joint marketing initiatives, research consortia, joint ventures and so on (Daghfous, 2004). TT refers to interactions between two or more companies during which technology is transferred. TT usually takes place at the firm level between a transferor and a transferee. Much of TT research attempts to deal with thorny conceptual problems. Recent studies have focused on questions such as those involving the motivation for TT partnership formation, the management of TT partnership, the selection of partners, the identity of companies participating in TT partnership, learning and dynamics in network, and the performance of TT partnership (B. Arya & Zhiang Lin, 2007; Arvanitis, S., Kubli, U. & Woerter, M., 2008; A. Comacchio, S. Bonesso, & C. Pizzi, 2012; Bianca B.M. Keers, Paul C. van Fenema, Henk Zijm., 2017).

However, these studies lack sound theoretical framework and have been examined by a single theory or mixed theories which both cannot fully explain the TT managerial phenomena (Eisenhardt, K. M., & Schoonhoven, C. B., 1996). The reason is that, for example, theories such as the Resource-Based View (RBV) cannot, in and of themselves, explain how companies gain or sustain competitive advantages from the external environment where they maintain frequent in the transferor-transferee relationships (Grant R. M., 1991; Wade, 2004; Wahab S. A., Rose R. C., and Osman S. I. W., 2012). In addition, most studies have exclusively relied upon only one of these lenses when researching transferor-transferee networks, leading to the blurring of underlying mechanisms that drive the performance effects of these networks (George, G., Zahra, S. & Wood, D.R. , 2002; Minbaeva, 2007).

Moreover, to review previous studies on mixed theories, far too little attention has been paid to the explanation of integration and overlaps mechanisms. Besides, although inter-firm networks have been frequently discussed in literature as an antecedent to companies' performance, its role as an external resource of transfer and its impact on these companies' operations, both in has been largely ignored (MW Peng and Y Luo, 2000; SH Park and Y Luo, 2001). Besides, although interfirm networks have been frequently discussed in the literature as an antecedent to companies' performance (MW Peng and Y Luo, 2000; SH Park and Y Luo, 2001), their role as an external resource of the transferor and their impact on firm operations have been largely ignored.

This chapter seeks to fulfil this gap via extending RBV to offer a systematic theoretical analysis (Whetten, 1989). Many studies have been published on the status, evolution, and trends of the RBV (Barney, 1986; Barney, J. B., 1991; Collis, D. J. & Montgomery, C. A., 1995; F. Acedo, C. Barroso, and J. Galan, 2006; Gerhard Kristandl & Nick Bontis, 2007). Also, there are ongoing attempts to extend the RBV within theories of the company (Silverman, 1999; Lo, 2012; Yang Yang, Fu Jia, Zhiduan Xu, 2019). For example, Lavie (2006) extends the RBV to incorporate the network resources of interconnected companies, describing how an interconnected firm can extract value from resources that are not fully owned or controlled by its internal organisation. Based on this discussion, Lavie (2006) develop a model for estimating different types of rent that companies generate by relying on resources distributed across their alliance networks. Nevertheless, he explains neither the overlaps and integration mechanisms between the RBV and Network Perspective (NP) nor the theoretical implications of TT for theories of the company.

Therefore, this chapter follows the applicability of RBV's assumptions to integrate Network perspective. That is, we describe a reformulated version of RBV that takes into consideration the impact of the network resource. In other words, companies acquire resources both through internal processes and by obtaining them from partners within their network. Therefore, while developing an interfirm TT strategy, it is necessary for a company to differentiate the advantages cultivated within the company from those obtained from its partners within transferor-transferee network (Staikarn,

2001). Consequently, we propose an integrated conceptual framework, ERBV, that classifies strategic resources as internal or external. Both types of strategic resources are firm level resources, but the former (Internal resources) means that the advantages are inherent to the transferor, reside within its boundary and are cultivated and accumulated by the company. The latter (External resources) means that the transferor's advantages are acquired through the transferor–transferee networks and reside within the inter-organisational ties that the transferor is embedded in.

In sum, to review research of TT, this chapter finds that the perspective of RBV cannot be engaged and explains the mechanisms between transferors and transferees. As such, this paper aims to address this specific phenomenon by reframing RBV to allow a holistic understanding of TT's nature and implications. In terms of TT research, this chapter elaborates Network perspective and discusses why and how it should be considered and be integrated into RBV. Accordingly, this chapter develops a comprehensive theoretical model, ERBV, to show how it can be used to analyse and understand the mechanisms between transferors and transferees in TT research.

2.2 Theoretical Foundation

We will begin our discussion by exploring the assumptions, boundaries and limitations of RBV and NP and their application to TT research, with a focus on the interaction of these two theories. Next, we describe how to bridge the research gaps between the interactions and mechanisms of RBV and NP. As part of this discussion, this chapter will propose a new theoretical framework, ERBV, to explain TT based on the interaction of RBV and NP.

2.2.1 The natural resource-based view as the theoretical-methodological foundation

What is Resource-Based View

RBV is a strategic theory for understanding why some companies outperform others. It attempts to explain competitive heterogeneity between companies. Also, it is a widely adopted analytical tool for assessing companies' internal strengths and weaknesses (Eisenhardt, Oct., 1989; J. Galende, & J. Fuente, 2003). RBV claims that a company's competitive advantage rests on its unique combination of resources,

capabilities and competences. Hamel et al. (1989) note capabilities that are fundamental to an organisation's strategy and performance.

Proponents of RBV emphasise the competitive advantage that the single organisation generates from capabilities and competences that are housed within the company. Therefore, companies generate a competitive advantage over competing companies when they accumulate resources and capabilities that are 1) valuable, 2) imperfectly substitutable, 3) rare, and 4) imperfectly imitable (Barney, J. B., 1991). Furthermore, Peteraf (1993) elucidated the link between economic rents and resources by identifying four conditions for sustainable competitive advantage: 1) resource heterogeneity, 2) imperfect resource mobility, 3) ex-post limits to competition, and 4) ex-ante limits to competition. These studies did not emphasise on appropriability issues, and implicitly assumed that the appropriability of rents requires ownership of the rent-generating resources. However, RBV has established a strong foothold in the strategic management literature despite these limitations (Barney, J. B., 1991).

Barney (1991) defined firm advantages as “all assets, capabilities, organisational processes, firm attributes, information, knowledge, etc. controlled by a firm that enable the firm to conceive of and implement strategies that improve its efficiency and effectiveness” and as “firm attributes that may enable companies to conceive of and implement value-creating strategies.”

RBV emphasises that companies are continuously heterogeneous in terms of their resource base, which then leads to economic rents. Thus, companies' specific advantages positively affect performance (Barney, 1986; Das, T. K., & Teng, B. S., 2000; Zahra, S. A., Sapienza, H. J. & Davidsson, P., 2006). As such, the basic assumption of the RBV is that companies are heterogeneous in terms of assets and capabilities (Peteraf, 1993).

Accordingly, resources can be a source of sustained competitive advantage under certain conditions. In essence, the central theme of the RBV is the role of organisations in developing and deploying scarce resource capabilities that cannot be easily imitated (Wernerfelt, 1984; Galende, J., & Fuente, J. M. de la, 2003). Companies are heterogeneous with respect to their resources, capabilities, and endowments because they are constrained by their historical past, existing resources, and accumulated capabilities (Mahoney, 2001). The development of capabilities takes time

and is likely to be influenced by an organisation's existing capabilities, including its absorptive capability. Therefore, the differences in companies' performances reflect differences in their organisational resources, capabilities, and endowments (Del Canto, J. G., & Gonzalez, I. S., 1999).

RBV's relevant research in TT

RBV has recently been applied to studies of TT, including issues such as the governance structure, rationale for partnership formation, and performance (Bilge A., & Leonidas C. L., 2015; Bozeman, 2000; Carter, C.R. and Rogers, D.S., 2008; Douglas Thomas & Anand Kandaswamy, 2019). Substantial progress has been made in motivating alliance formation with resource-based logic. For example, Eisenhardt and Schoonhoven (1996) suggested that when resource exchange through market transactions is inefficient, companies will form alliances for accessing complementary resources that are not internally available. The combination of complementary resources through alliances may create value and motivate alliance formation (Jeffrey H. Dyer & Harbir Singh, 1998). Moreover, TT partnerships might be preferable to mergers and acquisitions when those desired resources are only needed temporarily, they can be efficiently separated, and their ownership is unnecessary or prevented (Das, T. K., & Teng, B. S., 2000; Henhart, 1988). Aside from TT alliance formation, RBV can inform theories of governance structure and performance. For example, Das and Teng (2000) offered a framework in which the type of resource (e.g., tangible versus intangible) and its characteristics (valuable, imperfectly substitutable, rare, and imperfectly imitable) explain the mode of an alliance. On the other hand, the similarity between the partners' resources affects the alliance's performance. Das and Teng (2000) suggested that RBV targets on companies' internal aspects and, following Barney's (1991) arguments, noted that the strategic model based on the industry and environment has made its assumptions unrealistic. Companies must emphasise on internal resources to achieve sustainable competitive advantage. In other words, RBV assumes that a firm's outstanding performance comes from the rents accruing to the owners of scarce firm-specific resources rather than the economic profits from products' market positioning (Szulanski, 1996; Steensma, H. K. and Corley K. G, 2001). These

contributions retained the fundamental assumptions of the traditional RBV, conforming to principles that may be inconsistent with the nature of interconnected companies.

As such, in the light of RBV, organisations are considered to engage in an effort to find a resource boundary via those valuable resources. In the specific research area of our study, RBV makes a significant contribution to the strategic alliance, as a firm's competitive advantage is determined by a set of unique internal resources. That is, the RBV focuses on how to maximise organisational value via the utilisation and pooling of valuable resources.

The limitations of RBV

Nevertheless, RBV has two main limitations. Firstly, the RBV proposes that the limits on a firm's activities are controllable resources. However, if companies themselves are unable to fully understand the nature of their applicable resources or the extent of their valuable resources, their capability will be limited.

Secondly, RBV does not capture all the types of competitive advantage among companies, as it emphasises on companies' internal resources but neglects to look beyond the properties of resources and resource markets to explain enduring firm heterogeneity. In particular, RBV doesn't examine the social context within which resource-selection decisions are embedded (e.g. network ties) and how this context might affect sustainable firm differences.

2.2.2 The role of Network perspective

What is Network perspective

Network Perspective (NP) is grounded in theories of resource dependence, power, and social exchange. This perspective is concerned with actions that result from membership in social networks and has been used to investigate strategic alliance issues that are related to resource exchange (Zheng Jane Zhao & Jaideep Aanand, 2009; Xaver Neumeyer, Susana C. Santos & Michael H. Morris, 2019). Throughout the previous studies, it is often seen as an analytical tool illustrating relationships among actors, including individuals, groups and organisations (Culpan, R., 2009; Francisco Javier Miranda, Antonio Chamorro & Sergio Rubio, 2018).

Granovetter (1985) noted NP emphasises the effect of actors' relationships and the structure of the overall network of relationships on strategic actions and outcomes (Granovetter, M., 1985). He further argued that interpersonal relationships limit opportunism and thus reduce the need to establish hierarchical management systems. The network perspective is rooted in the open system view in sociological theory and suggests that economic actions are embedded in social networks (Demsetz, 1988). This social network of external contacts comprises a critical element of organisational activities (Ahuja G., 2000). In terms of the open system view, Scott (1992) supported argued that organisations could be considered as loosely coupled systems, with no clear distinction between a company and its environment.

Network perspective can demonstrate the interplay of a company and its environment. This perspective accordingly can be used to help uncover the relational aspects of strategic alliances related to the relationships between actors and among member organisations (Yoshino, M.Y., and Rangan, S., 1995; Rothaermel, F. T., & Deeds, D.L., 2004).

Companies are forced to seek joint alliances and partnerships to respond to markets and maintain market share because there is no way for any single company to accomplish core competences in all functions (Sher, 2004; Rajeev K. Goel & Devrim Göktepe-Hultén, 2018). Thus, social networks help companies to influence the efficiency of economic actions when they fail to attain economic objectives or potential exchange partners through market mechanisms, (Rangan, S., 2000; Rafael Biermann, 2008). Social networks based on personal relationships not only help to foster strategic alliances but also accelerate learning and make alliances more effective (Huber, 1991; Lambert, D. and Knemeyer, M., 2004). TT partnerships have assumed an increasingly prominent role in the strategy of leading companies as the cooperative relationships can help companies gain new competencies, conserve resources and share risks, move more quickly into new markets, and create attractive options for future investments (Wiig, 1997; Soobrayana, 2003).

In short, NP provides a good foundation for arguments related to partnerships that involve other theoretical approaches. It relies on assumptions about how the social structure of relationships around a person, group, or organisation affects beliefs or behaviours (R. E. Miles, & C. C. Snow, 1986; Candace Jones, William S. Hesterly, and

Stephen P. Borgatti, 1997; Snow, C. C , Miles, R. E., & Goleman, H. J., Jr., 1992). A TT partnership is a social network as well as a social structure made up of a set of social actors, sets of dyadic ties, and other social interactions between actors. NP emphasises on the role of social relationships in transmitting information, channelling personal or media influence, and enabling attitudinal or behavioural change. The assumptions and components of NP are summarised in Table 4.

Table 4 The Assumptions of Network Perspective

| Principle | Assumptions |
|---|---|
| Behaviour is interpreted in terms of external activities within actors (transferors and transferees) | Actors (transferors and transferees) and their actions are considered as interdependent units |
| The analysis focus is on the relationships between actors (transferors and transferees) | Relational ties between actors (transferors and transferees) are channels for the transfer of resources |
| Concerned with how the network structure of relationships around network members affect their beliefs or behaviours | Network models focus on individuals view the network structure as providing opportunities for and constraints on individual actions |
| Analytical methods cope with the patterned relational nature of the network structure directly | Network models conceptualise structure as enduring patterns of relations among actors (transferors and transferees) |

NP's relevant research in TT

Given the network perspective, network resources are not public goods but rather private goods (Black, J. A. & Boal, K., 1994; Gulati, R., Nohria, N., & Zaheer, A., 2000). Roberts and O'Reilly (1979) claimed that the company's position in the network affects the resources it can observe. Occupying a central position allows a company to access information and other resources (Ahuja G., 2000). A central position refers to the position or status of an individual actor in the network, and denotes the extent to which the focal actor occupies a strategic position in the network by virtue of being involved in many significant ties (Martin Kilduff, Wenpin Tsai & Ralph Hanke, 2006). That shows that transferors can acquire network-based advantage if they occupy the central position in networks. In other words, transferors benefit greatly from controlling resources if they are advantageously positioned within the transferor-transferee network (Gulati, 1998).

As we know, a social network is a social structure made up of a set of social actors (such as individuals or organisations), sets of dyadic ties, and other social interactions between actors. In essence, NP can help to explain not only knowledge access, but also a certain type of resource that influences TT partnership formation and that is concentrated in research and development (R&D) actors (Brumagim, 1994; Contractor, F. J., & Lorange, P., 1988).

The formation of this TT activity can be transferor–transferee new product development, technology collaboration, a contractual agreement (franchising, cross-licensing, outsourcing agreement), joint resources, joint venture, shared manufacturing and common distribution agreements across selling arrangement and franchising (Calabrese, 1997; Berry, M. A. and Rondinelli, D. A, 1998; Aubert, B.B., Rivard, S., & Patry, M., 1996; Inkpen, A. C., and Dinur, A., 1998; Ioanna Kastelli, Aggelos Tsakanikas & Yannis Caloghirou, 2018). Therefore, several distinct forms of strategic TT partnerships can be explained in terms of companies' access to certain resources owned by partners under specific terms and conditions: 1) Sourcing agreement: a. Companies exchange financial resources and manufacturing resources (facilities and equipment). b. Manufacturing service is consigned to partners who provide the companies with finished/ semi-finished products subject to the specification designated by the companies; 2) Joint R&D: a. Two or more companies combine technological (including research talent, intellectual property, development experience, etc.) and financial resources. b. Companies aim to realise shared benefits while spreading the risks and costs across multiple partners. c. Companies jointly develop certain technologies or products under a mutually agreed specification goal and schedule. 3) Technology licensing: a. Companies are given the right to use other partners' proprietary technologies for their own use. b. By doing so, companies exchange technological and financial resources. 4) Joint venture: Companies combine technological, manufacturing, distribution and financial resources. 5) Mergers and acquisitions (M&A): Companies combine resources and assets.

In sum, Das and Teng (1998) defined strategic alliances as inter-firm cooperative arrangements between two or more partners that aim to achieve the strategic objectives of involved partners. Gulati (2004) further defined it as voluntary arrangements between companies (transferors and transferees) involving sharing,

exchange, or co-development of technologies, products, or services. Due to the pressure of global competition, companies no longer encounter the classic choice of “buy or make” because it is replaced by the “make or cooperate” decision (Davidson, W. H. & McFetridge, D. G, 1985; Culpan, R., 2009; Emilio Bellini, Giuseppe Piroli & Luca Pennacchio, 2019). In strategic TT alliances, there is no single company with complete authority. The incomplete contracts between actors are governed via negotiation (Berger, 1994; Davenport, T H. & Prusak, L., 1998; Cousins, P.D., Lawson, B. and Squire, B., 2006). The unification of power will not be complete unless the TT partnership becomes a full merger. Companies can be interconnected via economic relationships. Joint ventures involve transferor and transferees creating a new entity where equity is shared and the hierarchical governance structures of organisations are replicated. Regardless of forms of strategic TT partnership, trust is essential in both actors (transferors and transferees). Moreover, from the Network perspective, technology is considered as the most strategically significant resource of the company, where productive integration of knowledge resources and derivative decision-making capabilities influence companies’ future growth (Grant R. M., 1996; Inkpen, 2000; Jiaming Jiang, Rajeev K. Goel & Xingyuan Zhang , 2019). The combination of different strategic resources at the firm level through TT activities will influence companies’ competitive advantage (Collis, 1994; Collis, D. J. & Montgomery, C. A. , 1995; Robert E. Hoskisson, Lorraine Eden, Chung Ming Lau & Mike Wright, 2000).

The limitations of NP

Network perspective cannot fully explain how companies’ resources work within TT partnerships in the context of TT activities. NP focuses on companies’ use of external networks and social relations to capture useful information or opportunities, but in reality, companies apply such external strategies in conjunction with internal resources. That means transferees provide opportunities and information that may be beneficial to the central player (transferor) in the transferor- transferee network. However, transferors might not be able to utilise this information or opportunities because NP research has neglected companies’ internal resources and capabilities.

2.3 Linking RBV and NP: A framework for analysis

This section explains why Network perspective can be integrated into RBV, describing the two perspectives overlaps and integration mechanisms. Then, we revise the theoretical framework from the conventional RBV to the ERBV.

2.3.1 The conceptual integration of RBV and NP in the technology transfer context From RBV inside-out perspective

The traditional RBV assigns a limited role to network resources, assuming that resources confer a competitive advantage are confined by the firm's boundaries. This assumption is anchored in resource definitions, the principles of strategic asset idiosyncrasy and imperfect resource mobility and the notions of resource-position barriers and isolating mechanisms.

In spite of the diverse definitions used by different scholars, RBV's assumption of ownership and control is embedded in its resource definitions. For instance, Wernerfelt (1984) defined resources as tangible and intangible assets which are tied semi-permanently to the company. Barney (1991) described resources as all assets, capabilities, organisational processes, company attributes, information, knowledge and so on that are controlled by the company that enable the company to conceive of and implement strategies that improve its efficiency and effectiveness. Last but not least, Amit and Schoemaker (1993) defined resources as stocks of available factors that are owned or controlled by the company. This proprietary assumption is not only limited to resource definitions but rather concerns the core idea that companies secure rents by imposing resource-position barriers that protect their proprietary resources from competitors.

When RBV was first formulated, the proprietary assumption might have resulted from the popularity of competitive strategies (Wernerfelt, 1984). Porter (1980) claimed that RBV followed the industry analysis framework that conceptualised 1) entrants, 2) incumbents, 3) substitutes, 4) suppliers and 5) customers as entities seeking to compete away the company's rents, and which therefore need to be deterred by entry and mobility barriers. In particular, RBV developed its own conception of resource-position barriers designed to protect the company's resources from imitation and substitution (Barney, J. B. & E. J. Zajac, 1994). Traditional RBV therefore has assumed

that value-creating resources are owned or controlled by the focal firm (Barney, J. B., 1991; Amit, R. & Schoemaker, P. J., 1993).

Nevertheless, we notice that firstly the proprietary assumption of RBV is not important to the extent that the competitive environment is populated by independent companies. In recent years, evidence however has accumulated in support of the network perspective, suggesting that TT partner resources that are transferred through direct interfirm interactions have a considerable impact on company performance (Dyer & Singh, 1998). These TT partnership resources can be considered as network resources and extend the opportunity set of the company (Gulati, 1999). In support of this notion, Saxton (1997) noted that companies benefited from their TT partners' reputation. Stuart et al. (1999) indicated that the IPO performance of new ventures was affected by the technological and commercial prominence of their TT partners. Afuah (2000) claimed that exogenous technological changes that adversely influenced suppliers' capabilities in the information technology industry influenced the competitive advantage of their customers. Stuart (2000) found that partners' technological capabilities contributed to sales growth and innovation in semiconductor companies. Rothaermel (2001) showed that in the biopharmaceutical industry incumbents achieved higher performance while leveraging the complementary resources of new technology providers. In sum, these studies suggest that the resources of TT partners affect the competitive advantage of interconnected firms (Nonaka, 1995; Winter, 2003; Wright, 2005). Second, RBV's proprietary assumption prevents an accurate evaluation of a company's competitive advantage. Following the rationale of RBV, a company should be valued based only on the contribution of its internal resources. Nevertheless, empirical evidence examining the market value of companies entering alliances, and especially joint ventures, detects abnormal stock market returns in response to alliance announcements (Chan et al., 1997; Das et al., 1998; Reuer & Koza, 2000). Finally, RBV accordingly may have been correct when arguing that valuable resources are non-tradeable and imperfectly mobile but has failed to acknowledge the direct sharing of resources and the indirect transferability of their associated benefits. In other words, RBV's fundamental assumption that companies must own or at least fully control resources that confer a competitive advantage turns

out to be incorrect. The ownership and control of resources are not necessary conditions for competitive advantage. The weaker condition of resource accessibility, which establishes the right to utilise and employ resources or enjoy their associated benefits, may suffice. This idea is akin to Porter's (1985) suggestion that it is the services that resources provide rather than the resources themselves that generate value for companies. Hence, the accessibility of rare and valuable resources, whether owned internally by the company or available through its TT network, influences the company's competitive advantage. To the extent that the company establishes exclusive access to such resources, the value-creation impact of resource accessibility is equivalent to that of complete ownership or control. However, even resources that are shared with other TT partners may confer a competitive advantage as long as they are not available to all competing companies in the industry, in which case the rarity condition is not met.

These results demonstrate that company valuation should be based not only on its internal resources but also on the resource endowments of its TT partners. In spite of the mounting evidence that TT partners contribute to the competitive advantage of companies, most of the past studies were epiphenomenal and provided no overarching theoretical framework to explain how the resources of TT partners influence the competitive advantage of interconnected firms (Tushman, M. L. and Nadler, D. A. , 1978; Tsang, 1997; Zorn, T. E. & Ruccio, S., 1998; Radosevic, 1999).

From Network Perspective outside-in perspective

Network Perspective has set a milestone in the study of network resources by arguing that this critical resources might span company boundaries (Liker, J. K., and Choi, T. Y, 2004). Furthermore, Network perspective argues that companies earn relational rents that are jointly generated with strategic TT partners. Such relational rents derive from the specific assets that companies dedicate to TT partnerships and from complementarities between their resources and the resources of their partners (Timothy J. Rowley, 1997). The establishment of an effective alliance governance structure and the evolution of interfirm routines that facilitate knowledge and information sharing within the boundaries of the TT partnerships also play a role in generating relational rents. Based on the definition, it elaborates on issues of joint value

creation since relational rents accrue at the alliance level and cannot provide private benefits (Khanna, T., Gulati, R., & Nohria, N., 1998; Ranjay Gulati, Dovev Lavie, & Ravindranath Madhavan, 2011). Unlike studies that acknowledge the role of both private and common benefits, the relational rents emphasise common benefits that TT partners cannot generate independently.

In addition to relational rents, NP emphasise structural variables and analyse enduring patterns of relationships among interacting social actors (Timothy J. Rowley, 1997). The consideration of the broader structure of the company's TT network is rooted in NP that have been recently applied to research the impact of interfirm relationships on firm-level outcomes (Pine, 1993; Nonaka, 1995; Thomas, J. B. and Trevino L. k, 1993). Such relationships form a significant element in the company's organisational environment, but are not regarded as an inherent characteristic of any individual company (Dovev Lavie, 2006; Fujun Lai, Min Zhang, Denis M. S. Lee, and Xiande Zhao, 2012).

Social network researchers analyse interfirm relationship structures and examine the impact of network-level cooperation, learning, communication and imitation on a company's actions and performance (Gulati, R., Nohria, N., & Zaheer, A., 2000). Moreover, some researchers have incorporated social network approaches in the study of company performance. For instance, Baum et al. (2000) demonstrated that the composition of TT networks explains differences in the performance of start-up companies. Ahuja (2000) examined how direct/indirect ties and structural holes in a firm's ego-network influence innovation output. Lee (2019) found that the number of ties to venture capital companies was associated with the sales growth of start-up companies and that strong ties differed from weak ties in terms of their effect on company performance. Social network research has provided important contributions to the study of interconnected companies, but it has oversimplified the contribution of network resources by considering predominantly structural measures that hardly capture the heterogeneity of the resource endowments of specific TT partners (Long, C. and Vickers-Koch, M, 1995; Mowery, D. C., Oxley, J. E., and Silverman, B. S., 1996; Petroni, 1996).

Summary

As such, in order to better explain how interconnected companies combine network resources and internal resource endowments to achieve competitive advantage, we notice that NP offers important insights that the current research incorporates by extending RBV and advancing a comprehensive theoretical framework (Lin T. C., 1999; Mei Cao and Qingyu Zhang , 2012). The development of this theory, ERBV, requires a major adjustment of RBV to relax the proprietary assumption of this traditional perspective. Whereas the unit of accrual remains the company and the basic unit of analysis remains the resource, the theory developed here acknowledges the contribution of resources distributed across the ego-network to the competitive advantage of the focal firm.

2.3.2 Reformulation of a new paradigm for technology transfer

We follow Barney's (1991) explanations of RBV that 1) formulation of the RBV, which refers to the broad definition of resources as all types of assets, organisational processes, knowledge, capabilities, and other potential sources of competitive advantage that are owned or controlled by the focal firm and 2) two preconditions for competitive advantage: Resource heterogeneity requires that not all companies possess the same amounts and kinds of resources, whereas imperfect mobility entails that resources are non-tradeable or less valuable to users besides the company that owns them.

In general, the company possesses a set of resources that can produce a positive, neutral or negative impact on its overall competitive advantage (Teece, D. J., Pisano, G. & Shuen, A, 1997). This impact depends on the value and rarity of each resource (Peteraf, 1993). In addition, the company's competitive advantage is affected by interactions, combinations, and complementarities across the resources of the company (Amit, R. & Schoemaker, P. J., 1993; Joakim Kembro, Kostas Selviaridis & Dag Näslund, 2014). That is, the competitive advantage of the company can be viewed as a function of the combined value and rarity of all company resources and resource interactions.

To reformulate RBV, we take into account if the resource heterogeneity and imperfect mobility conditions hold in the transferor–transferee context and found that strategic TT partnership do not enhance their competitive advantage by contributing to resource heterogeneity. Conversely, strategic TT partnership may contribute to resource homogeneity by facilitating asset flows. Moreover, under conditions of pure resource homogeneity (the intersection of shared resource sets is substantial), alliances will be formed solely for collusive purposes (M&A), rather than gaining access to complementary resources. Also, the imperfect mobility condition is also relevant for interconnected companies. Under conditions of perfect mobility, resources can be traded and accessed without forming alliances. However, alliances can serve as means for mobilising resources that have been traditionally considered immobile. That is, TT partnerships enable the transfer of benefits associated with such resources and thus weaken the imperfect mobility condition even if resources cannot be mobilised.

The theoretical model ERBV is developed by formulating the competitive advantage of an interconnected company participating in a single dyadic alliance TT relationship. To relax the proprietary assumption of RBV, we now allow for the resources of the partner to influence the competitive advantage of the focal company. When a strategic TT partnership is formed, different degrees of convergence may exist between the resources of the focal company (transferors) and the resources of its partner (transferees). Moreover, transferors and transferees endow a subset of their resources to this alliance, expecting to generate common benefits from the shared resources of both parties. Each company, therefore, possesses a subset of shared/ non-shared resources that together form the company's complete set of resources.

Within this strategic TT partnership, NP can help to uncover the nature of networks. In contrast to the RBV, NP does not primarily focus on the individual organisation. The relevance of NP for strategic TT alliance analysis arises from the fact that organisational members are influenced by the social context in which they are embedded. In this thesis, a connection of the RBV with the NP will also be developed on some key issues associated with TT. NP will be used to explain that an organisation's critical resources may extend beyond the boundaries of a single organisation and, indeed, may be embedded in inter-organisational processes and routines. We therefore use NP to examine the relational characteristics of networks, with a focus on the

relationships between transferors and transferees. NP can aid the understanding of the sources of inter-organisational competitive advantage and can provide hints for effective governance (Paul D. Cousins, Benn Lawson, & Brian Squire, 2008).

This review shows that while the emerging field of strategic knowledge-based theories of the firm has made significant strides in understanding the critical components of RBV, the theories are often individually incomplete and collectively contradictory. They do not address all of the requirements of a theory of the company and do not elucidate the mechanisms of the link between the resources of TT partners and the competitive advantage of the interconnected firm. To integrate and clarify many of the issues debated in the literature into a coherent picture, we propose ERBV (Fig. 1), which describes the strategic resources that companies extract from the internal and external resources of a dyadic alliance. That is, traditional RBV focuses on internal rents. However, when considering an interconnected firm, we need to incorporate both intra- and interfirm resource complementarities. Hence, the resource-based competitive advantage of a focal firm participating in the TT alliance can be categorised into two elements corresponding to two different types of resources: internal resources and external resources. The collaboration between transferors and transferees accumulates strategic resources to form TT capability and then develop a sustainable competitive advantage. From this perspective, it can be argued that TT partners (transferors) can serve as the most important sources of new ideas that lead to innovation and learning.

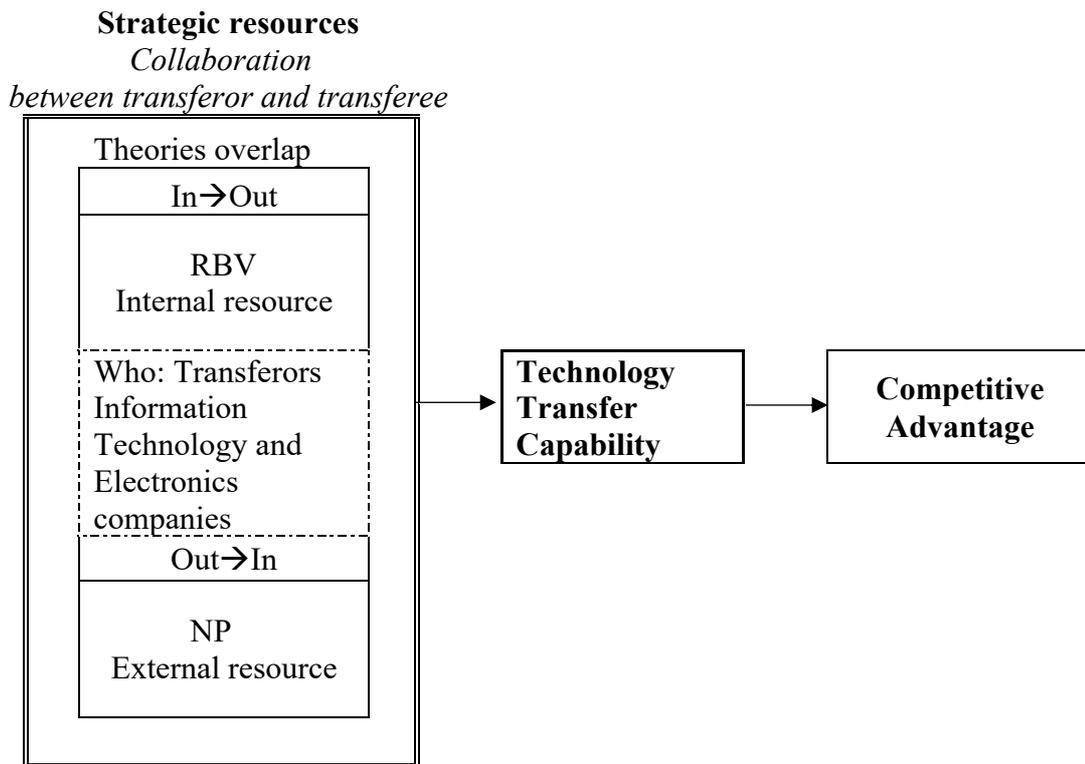


Figure 2. A New Conceptual Theoretical Framework.

2.3.3 ERBV in the TT context

Dubin (1978) claimed a complete theory can explain the relationships between the variables or constructs in this theory hold true that must contain four essential elements 1) boundary, 2) whom, 3) where and 4) when. In this chapter, we argue that the RBV and NP both have contextual boundaries. As they explain companies' behaviour, they overlap with respect to 'who,' both describing transferors (we consider transferors as information technology and electronics companies) (Dubin, 1978). Also, ERBV perspective has to underscore the interactions between three major questions: why cooperate, who cooperates, and with whom do they cooperate.

As such, ERBV represents the overlap between these theories (RBV and NP) and is utilised to discuss various aspects of TT from the transferor's perspective. Furthermore, ERBV emerges as a response to the development of competitive advantage in situations where resources and capability are held beyond the boundary of the company. Since TT occurs through a set of dyadic ties between a transferor and

a transferee, we discuss boundary conditions which must be satisfied with the integration of the ERBV.

Firstly, the theory (ERBV) helps managers choose strategies only as long as they operate in a relatively stable environment. If a firm's threats and opportunities change in a rapid and unpredictable manner, the firm will not be able to maintain a sustained competitive advantage. Secondly, since ERBV relies on the concepts of value, rarity, imperfect substitutability, and imperfect imitability, we assume that a manager's influence on creating sustained advantage is limited. That is because the more the managers have the ability to develop or acquire core capabilities, the less likely these capabilities are to provide a sustainable advantage due to the ease of imitation. Thirdly, some resources are causally ambiguous because the link between the resource and firm performance is quite difficult to understand. Last but not least, network resources are embedded in complex social systems.

The foregoing review indicates that the RBV and NP make different assumptions about companies' behaviour. An integrative perspective enhances understanding of TT for two key reasons. First, although NP and the RBV have each contributed to the advancement of theory, each perspective provides only a partial account of competitive advantage. The two theoretical lenses are concerned with similar phenomena, but their underlying assumptions and boundary conditions are different. For example, although NP may influence managers' willingness to transfer technology, they may not be able to do so without the necessary resources. Similarly, the RBV does not explicitly address how companies evaluate external resources. Managers may not be able to make decisions. Differences in TT that do not result from variations in resources are particularly intriguing because they cannot be explained by the RBV's reasoning. Thus, the two theoretical lenses are complementary, even though the forces associated with each are often competing. Secondly and more importantly, the two perspectives are interdependent; network ties interact with and influence resource-based constructs and vice versa.

Accordingly, this chapter combines NP and RBV, focusing on integrative mechanisms that remain largely unknown but are particularly suitable for explaining the strategic TT behaviour of information technology companies. We propose the following as the underlying perspective of the ERBV in the TT context: sustainable

competitive advantage is generated by companies' strategic resources (internal and external resources) while building capabilities. To be precise, the ERBV presents the most recent interpretation of the classic RBV, with the addition that the structure and function of a relationship relate to the specificity of resources to be transferred.

Following this, we develop a new conceptual theoretical framework. In particular, we extend the existing theory by arguing that constructs of NP and the RBV interact with each other. In addition, we offer guidelines for management and organisational structures and implementation strategies that are applicable to companies attempting to transfer technologies.

As mentioned previously, this paper points out the limits of the RBV and engages NP to create a new conceptual theoretical framework that better explains companies performing TT. In other words, we offer an analytical framework for understanding why and how technology is transferred, describing both the impacts and actors involved in TT.

To further investigate this new conceptual theoretical framework, ERBV, we consider network perspective as a supplementary explanation to the RBV while examining the sources of competitive advantages. The contributions of the proposed theoretical framework are summarised in Table 5, which compares the traditional RBV and NP to the ERBV in the context of TT.

Table 5 A Comparison of Theories Applying to Technology Transfer

| Items | RBV perspective | ERBV perspective | Network perspective |
|----------------------------|---|--|---|
| - | Internal resources | Dyadic resources | Network resources |
| Assumption | Resource heterogeneity/ value/ rarity/ imperfect substitutability/ imperfect imitability | - Resource accumulation through transferor– transferee relationship - Resources are value, rarity, imperfect substitutability, and imperfect imitability - Tractability - Accessibility - Nature of relationships - Network structure | Relationships, network structure |
| Competitive advantage | Isolation mechanism (firm-level imitation barriers) | Isolation mechanism (network-level imitation barriers) | Isolation mechanism (network-level imitation barriers) |
| Interaction | Competition | Cooperation | Cooperation |
| Where is value determined? | Owned or controlled resources | In a dyadic relationship, the interconnected firms would combine external as well as internal resources towards the development of the competitive advantage of the focal firm. | - Accessible resources - Shared and non-shared resources |

2.4 Proposition Development

In the section that follows, the author elaborates the developments of propositions and the links to the following chapters.

Proposition 1

Previous studies suggest that the resources of TT partners affect the competitive advantage of interconnected firms. It means alliance partner resources that are transferred through direct interfirm interactions have a considerable impact on company performance (Fransman, 1986; Porter, 1985; Lee, 2019). A company can leverage the value of its own resources by accessing the resources of an alliance partner. Stuart et al. (1999) demonstrated that the reputation of start-up companies' prominent TT partners reflects on their own reputation, resulting in enhanced IPO performance. Johnson and Johnson (2003) conducted a meta-analysis of empirical research and found that cooperation better facilitates new insights, innovation and productivity than the competition. Deutsch (2003) viewed cooperation as a form of social interdependence by which people share information and work together to accomplish agreed-upon goals.

The formation of strategic TT alliance, however, is driven by a variety of objectives, including the need to spread the costs and economies of scale, risk of innovation, access to new markets and the acquisition of new skills or capabilities from TT partners (Winter, 2003; Yang Yang, Fu Jia, Zhiduan Xu, 2019). Also, every organisation has a different base of resources, including knowledge and level of experience, and therefore it develops a varying competence level. Moreover, in this transferor- transferee's dyadic tie, the interaction of two parties matters. The relationship itself does not entail a direct advantage but acts as an interface to develop new resources or enhance existing capabilities. As such, the organising module is based on interdependence even if strategic alliances are characterised by formal independence. Throughout this thesis, we argue that interdependence is a necessary condition for the success of strategic alliances.

ERBV, therefore, gives structure to the idea of an ongoing collaboration between organisations across the wider networks that stimulate resource accumulation and development based on complex interactions and inter-organisational relationships. Transferors might experience different obstacles or pursue different goals while they

strategically and actively develop their networks with transferees (Drucker, 1993; Dickson, 1996). According to this need, different types of networks and customised network support are established. As such, the author proposes the proposition 1 and then argues in detail in Chapter 3 that the transferor–transferee relationship formulates different kinds of resources under certain network which will leverage transferors’ TT strategies and competitive advantages.

Proposition 1: Within the strategic transferor–transferee relationship, strategic resources moderate TT strategy and competitive advantages.

Proposition 2

TT managerial choices are guided by economic rationality and by motives of efficiency, effectiveness and profitability (Conner, 1991). Given the factor market imperfections (barriers to acquisition, imitation, and substantiation of the key resources of inputs) resource selection and deployment result in enduring variation across companies (Amit, R. & Schoemaker, P. J., 1993; Barney, J. B., 1991). That is, imperfect or incomplete strategic factor markets create barriers to resource mobility and unequal distribution of resources across competing companies (Barney, J. B., 1991). These barriers inhibit competitors’ abilities to obtain or duplicate critical resources and lead to long-run differences among companies in their abilities to generate rents (Tece, D. J., Pisano, G. & Shuen, A, 1997). In turn, resource market characteristics shape resource characteristics and the rent potential of resources, and affect if the resources are value, rarity, imperfect substitutability, and imperfect imitability (Amit, R. & Schoemaker, P. J., 1993; Barney, J. B., 1991; Mahoney, 2001; Peteraf, 1993).

In addition, Dyer and Singh (1998) claimed relational rent as a common benefit that accrues to TT partners through the combination, exchange and co-development of idiosyncratic resources. This type of rent cannot be generated individually by either alliance partner and is therefore overlooked by the traditional RBV. Relational rents are extracted from knowledge-sharing routines, relation-specific assets, effective governance mechanisms and complementary resources. Relational rents accrue only due to resources that are intentionally committed and jointly possessed by the TT

partners (transferors and transferees) and thus involve the shared resources of the focal firm (transferors) and its partner (transferees).

As such, a company benefits from not only its own resources but also the shared resources of TT partners. Oliver (1997) argued that companies' resource selection and accumulation are a function of both within-firm decision-making and external strategic factors. Rent-generating resource traits develop not only from factor market imperfections but also from specialised capabilities (Yang Yang, Fu Jia, Zhiduan Xu, 2019). Firm-specific, partner-specific and relation-specific factors determine the type and magnitude of rents extracted from the internal resources of the focal firm and the external resources of TT partners (Dehui Xu, Baofeng Huo, and Linyan Sun, 2014). This formulation of the ERBV suggests that the competitive advantage of an interconnected company based on the combination of internal and external resources is either greater or smaller than its competitive advantage as evaluated only by its internal resources. The author accordingly proposes that TT capability reflects the combination and accumulation of strategic resources (internal and external resources) on companies' competitive advantage (performance) and then discusses this proposition in detail in Chapter 4.

Proposition 2: Transferors combine external and internal resources towards the development of capability as well as competitive advantages in a dyadic relationship.

2.5 Discussion and Conclusion

The real business world is complex. Most companies will fall somewhere in between inside-out and outside-in thinking. The best companies skilfully employ both approaches. They are mindful of where their strengths and gaps are while using their capability to scan and detect threats and opportunities. That is companies should have known that the most effective business strategies need to consider both internal practicalities and external shifts in a loosely coupled way.

Theories such as the RBV cannot, in and of themselves, explain how companies that maintain frequent and multiple collaborative relationships with TT partners gain competitive advantages (Barney, 1991). The integrated contribution of internal and external sources of competitive advantage to firm performance deserves more attention although the alliance literature has provided sufficient tools for evaluating value

creation and appropriation at the dyad or network level (Hitt, 1985; Hall, 1992; Hsieh, 1993; Grant R. M., 1996).

Following the general convention of RBV research, according to which industry structure effects are embedded in the static value of resources (Barney, 2001), the overall impact of network resources on the interconnected firm's competitive advantage can be conceptualised as the combination of internal and external resources. On the one hand, the internal perspective focuses on resources and capabilities as internal sources of uniqueness that allow companies to beat the competition. On the other hand, the external perspective focuses on the structure of the industry and how companies can position themselves within them for competitive advantage. The ERBV bridges the internal and external perspectives, providing a third perspective of competitive advantage. This perspective helps to explain how resources leverage TT strategy and competitive advantages within the strategic transferor–transferee relationship.

The ERBV explains that TT occurs when companies need additional resources that are available from partners. It is different from the traditional strategic alliance concept and can be considered an alternative to internalisation. The ERBV provides a better and deeper way to illustrate this phenomenon with transferees. As the variation of firm-specific capabilities across organisations is related to collaboration between transferor and transferee, we propose that intangible resources should include network resources, which are shown in Figure 1. With this framework, we know that competitive advantages derive from companies possessing and using these varying strategic resource combinations (internal and external resources).

Throughout this thesis, TT has been considered as the conglomeration of separate processes and mutually dependent relationships. Through collaboration “relational rent” might be derived through the joint efforts of all the TT partners as well as sharing of complementary and additional resources. This would facilitate a better competitive scenario for the focal firm as well as its partners relative to the other competitors in the industry. In addition, given the relationship-based attributes (joint knowledge sharing and joint investments), individual gains would then convert to mutual benefits in the form of collaborative advantage. Perception about better incentives due to accelerated growth through the utilization of collaborative activities

would also enhance the efficiency and effectiveness of the TT partners. ERBV perspective (resource-based approach and the network perspective) helps describe how internal resources and external resources (partnerships and networks among companies) are sources of competitive advantage. The interplay of ERBV perspective helps to go beyond Porter's notion of competitive advantage, which provides insight into the skill-building competition among companies. Strategic TT partnerships will not lead to mediocrity as long as they constitute a device of learning and skill-building. This standpoint has been taken up by several authors (e.g. Hamel et al., 1989; Dyer, 1996; Powell et al., 1996; Dyer & Singh, 1998; Dyer & Nobeoka, 2000; Gulati et al., 2000, Ahuja, 2000; Hamel, 2004).

The proposed theoretic framework overcomes a limitation of traditional RBV, which has focused on resources that are owned or controlled by a single company. It incorporates the notion of external resources that play a role not only in the evolution of TT networks but also in shaping the competitive advantage of interconnected companies. Moreover, the framework extends prior research on joint value creation. It also proposes mechanisms of value creation in dyadic alliances, and that the value of internal resources is affected by interactions, combinations, and complementarities across the resources of the company. Overall, participation in strategic TT partnerships can either benefit or impair a firm's quest for resources. By extending the RBV, this study advances an ego-network perspective and sheds light on the competitive advantage of interconnected companies.

Furthermore, the author proposes that ERBV represents the overlap between these theories (RBV and NP) and is utilised to discuss various aspects of TT from the transferor's perspective. ERBV, therefore, emerges as a response to the development of competitive advantage in situations where resources and capability are held beyond the boundary of the company. Since TT occurs through a set of dyadic ties between a transferor and a transferee, we discuss boundary conditions which must be satisfied with the integration of the ERBV. This chapter hence lists boundary conditions associated with the theory. First, the theory can be applied to a stable environment; second, managers' influence on creating sustained advantage is limited; third, causally ambiguous resources are quite difficult to understand. Last but not least, network resources are embedded in complex social systems.

Based on the new theoretical framework, we have a better understanding of how to interpret practices between transferor and transferee. Also, this author develops two propositions which will be discussed in the following chapters.

The contribution of this study is to extend RBV with NP and thus to move beyond the traditional perspective that provides a limited account of a company's competitive advantage in the strategic TT alliances. Instead of applying traditional RBV research to offer a theoretical explanation of strategic TT alliance networks, we revisit the theoretical underpinnings of the RBV by considering such networks' implications. This reveals how an interconnected firm can extract value from strategic resources that are not fully owned or controlled by its internal organisation. We develop a theoretic framework that allows for the estimation of the various types of rent that a company generates by relying on strategic resources distributed across its TT network. By integrating and elaborating previous studies, firm-specific, partner-specific and relation-specific factors determine the type and magnitude of rents extracted from the internal resources of the focal firm and the external resources of TT partners. The chapter concludes with a discussion that positions the current study within the broad RBV research agenda and highlights the role of the network configuration.

ERBV, which served as the main theoretical perspective of this thesis, suffers from some limitations regarding the static value of resources. Future research may incorporate dynamic perspectives in order for addressing these limitations in the context of complex and networked environments. For instance, this thesis's constraints could be relaxed by conducting a dynamic approach rather than focusing on dyadic interactions. Finally, previous studies have provided ample evidence of the contribution of TT partners to company performance. Those studies, however, have not focused on a comprehensive investigation of ERBV. As such, future research should test the extended model and identify the contingencies associated with the various sources of competitive advantage.

Chapter 3 An exploratory study of resources driving technology transfer in Taiwan: An Extended Resource-Based View

This chapter investigates how resources drive technology transfer in the transferor-transferee relationship from a transferor's point of view. The research relies on interviews with experienced Top executives (CEOs, Top-level Managers, or R&D directors). The criteria for the selection of the 12 case companies are that they must be leading companies (Top 5) in their sector and have experiences of transferring technologies more five times in the past three years.

The findings of this research are: 1) from the ERBV perspective, this research has identified four different types of TT across twelve cases: Transaction (LRLI)/ Instruction (HRLI)/ Cooperation (LRHI)/ Co-Prosperity (HRHI) and suggests that when making an assessment of the TT strategy, transferors should take into account its relationship with transferees, how much transferors feel like to authorise and involve, and the ability of transferees. a) While transferees with poor abilities, transferors will opt for either Transaction (LRLI) or Instruction (HRLI) for enhancing its operational performance. b) On the contrary, transferors will root for Cooperation (LRHI)/ Co-Prosperity (HRHI) in order for gaining strategic performance. c) The previous ones (LRLI/ HRLI) are much of a contracted relationship, transferor tends to fulfil his obligation without deep involvement while the latter ones (LRHI/ HRHI) have frequent interactions. 2) in this competition and a short product life cycle environment, effective TT requires companies to combine and integrate internal and external resources. In order to create value via TT activities, transferors should be able to a) gain transferees' trust and confidence; b) understand the needs of the transferees, then adjust his transfer method to meet those needs; c) solve problems; and d) evaluate the abilities of the transferees and then apply the right strategy to co-work with transferees.

3.1 Introduction

Have you ever wondered why information technology companies choose to transfer technologies? Will that be difficult to make a profit? What are the factors motivating them? Many implications arise from how Taiwan's companies transfer technologies in the information technology and electronics industry.

Based on the literature review, we notice that existing studies of academic engagement have a number of shortcomings. First, that most of TT studies lack sound theoretical frameworks (Cunningham, J.A., Menter, M. & Young, C., 2016). Second, many studies adopt quantitative methods to show only the explanation of one side of the collaboration (Arvanitis et al., 2008; D'Este and Perkmann, 2011). Final, past studies have been proved that technology transfer activities have a positive impact for companies' development. Nevertheless, there is still a dilemma for organisations to decide how they involve in the TT network (D'Este and Perkmann, 2011).

Accordingly, this chapter uses ERBV theoretic framework built in Chapter 2 to study transferor-transferee relationship and to discover how resources drive technology transfer in the information technology and electronics industry in Taiwan. This approach follows on the Proposition 1 of Chapter 3. As such, in this research, a case study approach which offsets the bias towards quantitative studies and contributes a more vibrant picture of the study terrain. In addition to studying how strategic resources leverage TT strategy and competitive advantages within the strategic transferor-transferee relationship, we investigate the outcomes of their collaborative relationships.

3.2 Literature Review

In the section that follows, the author elaborates definition of Technology Transfer and the explanation concerning Effects of collaboration on Technology transfer capability and competitive advantages.

3.2.1 Definition of Technology transfer

TT is a famous phrase within the scientific community, especially in the information technology and electronics industry. There have been definitions of technology transfer from different perspectives.

As early as 1970, Cooper (1971) explained the mechanisms of transferring technology provides a means for making available to a production enterprise, thereby transferring technical knowledge which may be unavailable in the domestic economy. Technology transfer is also defined as the transfer of objective knowledge on its own or with other enabling factors that allow others to add value to their resources. The point is that it is not affected by the transmission of information, but by the transfer of know-how (Owen, 1984). In addition, scholars further defined that TT can be considered as the process of movement of technology from one entity to another (Souder et al. 1990; Ramanathan 1994). In a quite restrictive sense, where technology is considered as information, technology transfer is sometimes defined as the application of knowledge into use (Gibson & Rogers 1994).

Technology transfer is a proactive process to disseminate or acquire knowledge, experience and related artefacts (Hameri 1996). Mittleman and Pasha (1997) claimed that TT is the movement of knowledge, skill, values, and capital from the point of generation to the site of adaptation and application. Dosi (1988) analysed TT based on the properties of general knowledge, focusing mainly on variables that relate to product design. Bozeman (2000) noted that such movement may involve know-how, technical knowledge, and physical assets. TT has also been used to refer to movements of technology from the laboratory to industry, developed to developing countries, or from one application to another domain (Philips 2002). Lundquist (2003) pointed out that in certain situations TT may be confined to relocating and exchanging of personnel or the movement of a specific set of capabilities.

Since 2005, an analytical definition of TT which emphasises a two-way business transaction held by the majority of scholars. They believe that flows of technology running in one direction are matched by the counter-flows of commercial returns sought by the owners of the technology (Liao, S. H., and Hu, T. C., 2007; Mei Cao and Qingyu Zhang , 2012; C. Battistella, A. De Toni, and R. Pillon, 2015; Marius Tuft Mathisen & Einar Rasmussen , 2019). Furthermore, TT is intentional and goal-oriented but not a free process (Kasia Zalewska-Kurek, Klaudia Egedova, Peter A. Th. M. Geurts & Hans E. Roosendaal , 2018). Transfer also presupposes agreement and therefore involves an agreement (Dirk Meissner & Natalia Shmatko, 2019).

The author, therefore, stresses “Technology transfer is the process of transferring scientific findings from one company to another for further development or commercialisation. This process is an interactive process of knowledge development among the transferor and the transferee.

3.2.2 Effects of collaboration on Technology transfer capability and competitive advantage

To further investigate TT, it encompasses many different types of transactions between companies. Scholars have argued that strategic TT alliance are defined in the literature as voluntary arrangements between companies involving sharing, exchange, or co-development of products/ technologies/ services (Gulati, 1998), or purposive strategic relationship between independent companies (transferors and transferees) that strive for mutual benefits, share compatible goals, and acknowledge a high level of mutual dependence (Zheng Jane Zhao & Jaideep Aanand, 2009; Mei Cao and Qingyu Zhang , 2012). That is, a strategic TT alliance acts as a mechanism for competitive advantage where partners (transferors and transferees) mutually aspire to meet the individual and collective objective of the relationship (Inkpen, 2000).

Effects of collaboration on Technology transfer capability

Companies present substantial differences, and they interact in many ways, which implies different levels of commitment and risk by the parts (Prahalad, C. K. and Hamel, G., 1990; Michael A. H., Javier G., & Robert E. H., 1998). From the decision-maker (transferor) perspective, the TT alliance should be made only if an impact of the TT alliance is valuable, especially concerning technology transfer process, so as to consider the factors that determine the success of value creation within the industry alliances (Anatan, 2013). It can be concluded that the decision regarding strategic TT alliance choice might affect both the ease of knowledge flow and the incentives to transfer technology.

Past studies have suggested that inter-firm knowledge and capabilities transfer depends on the choice of alliance structure such as licensing agreements, joint venture (JV), R&D partnerships, distribution and supply agreement or technical exchanges (Inkpen, A. C., and Dinur, A., 1998). Freeman and Hagedoorn (1994) consider joint

R&D pacts, cross-licensing agreements, second sourcing agreements, R&D corporations, research contracts, minority joint ventures and joint ventures with shared R&D resources as means of inter-firm strategic technology partnerships. Hence, we can conclude that in this strategic TT alliance context, TT offers organisations learning opportunity to the partners through several organisational arrangements such as JVs, licensing agreements, distribution and supply agreements, research and development partnerships and technical exchanges (Inkpen, 2000). Also, when it comes to partner selection, transferors should ensure that organisational goals are aligned and nurture growth and consider evaluating and balancing criteria such as characteristics, alliance history, experience and skills, reputation, and assets. Synergies can be nurtured if an appropriate foundation is established in accordance with common goals, controlled and governed by agreed mechanisms, and symmetrical information flows are carefully managed.

Effects of Technology Transfer Capability on Competitive Advantage

Every organisation has a different base of resources, including knowledge and level of experience, and therefore it develops a varying competence level. When it comes to establishing technology transfer activities, the role of organisations' competitive advantages arising from resources and capabilities becomes particularly important (Ounjian, M.L. and Carne, E.B, 1987; Capron, 1999; X. Huang, M. M. Kristal, and R. G. Schroeder, 2010). This scenario raises a dilemma for organisations to decide their involvement within the strategic TT alliance. On the one hand, the organisation is willing to get the benefits through the TT alliance. On the other hand, the organisation has a fear that what has been done through TT alliance did not match expectations (Lin & Chen, 2002).

These concerns lead to the debate whether technology transfer activities within industry alliances will give positive, negative, or no impact on the organisational and alliance performance. This condition leads to the need for costs and benefits analysis in the industry alliance (Closs, L., Ferreira, G., Brasil, V., Sampaio, C., & Perin, M., 2013; Christopher S. Hayter, Andrew J. Nelson, Stephanie Zayed & Alan C. O'Connor, 2018). A related stream of research has viewed the network as a form of social capital.

This research emphasizes the “ability of actors to secure benefits by virtue of membership in social networks or other social structures” (Portes, 1998).

Burt (1992) stressed that networks generate informational advantages that can in turn steer actors toward beneficial actions. Others have argued that social capital enhances organizational performance by nurturing intellectual capital and by enhancing innovation, technology transfer, access to information, network efficiency, and diversity (Nahapiet & Ghoshal, 1998; Tsai & Ghoshal, 1998; Baum, Calabrese, & Silverman, 2000; Ahuja, 2000; Burt, 2000; Lin, 2001; Koka & Prescott, 2002; Inkpen & Tsang, 2005).

Within TT networks, transferors’ capabilities are important in order for optimising management of partnerships, projects and performance. Capabilities are developed through a mixture of company specific material and generalized alliance knowledge as companies strive to improve their alliance performance (Wassmer, 2010). To further explore capabilities in the context of TT network formation, Haider & Mariotti (2016) found that a primary motivator was the realization that there are alternative uses for existing capabilities which could be facilitated by a new TT alliance.

As such, this author follows the conceptual theoretical framework of Chapter 2 and proposes the strategic resources generated by collaboration between a transferor and a transferee have a positive impact on technology transfer capacity and then on competitive advantage as shown in the Figure 2. ERBV, therefore, gives structure to the idea of an ongoing collaboration between organisations across the more extensive networks which stimulate resource accumulation and development based on complex interactions and inter-organisational relationships.

*Collaboration
between transferor and transferee*

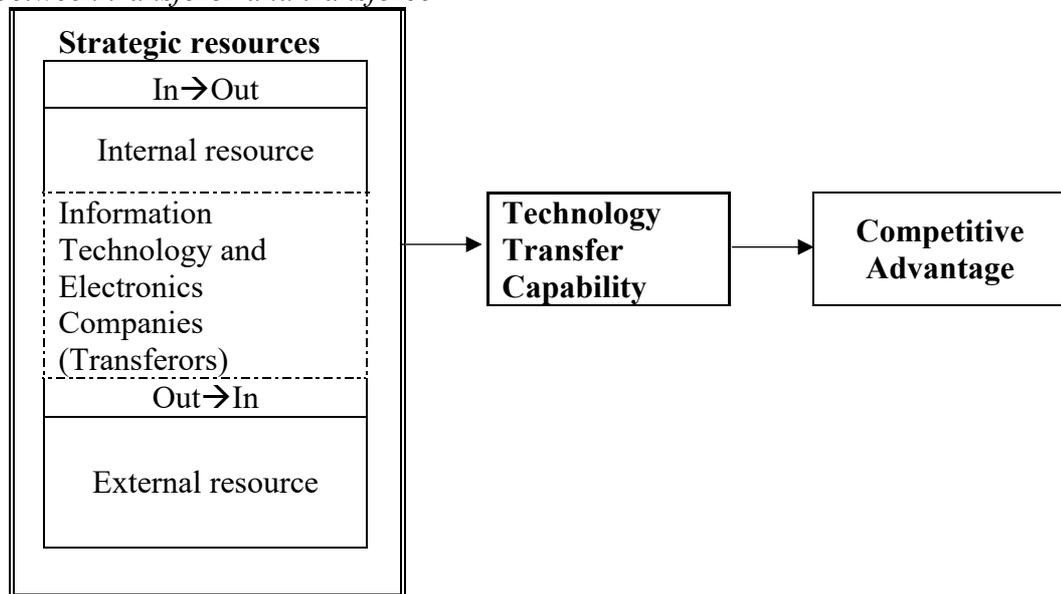


Figure 3 Theoretical Framework of Technology Transfer Capability

3.3 Method

3.3.1 Data Selection

In terms of business practices, the economic and political changes are fundamentally changing the nature of the competitive environment companies face in their global operations. Consequently, many high-tech companies are rethinking their strategies for operating production facilities in developing countries or emerging markets (Lin M. J., 2001).

Strategic reasons for high-tech companies in developed countries to transfer world-class production methods and technology to developing countries are discussed and the importance of the management aspects of technology transfer are emphasized. Nevertheless, as Asia is a new economic power in the world, Taiwan has experiences to develop its own approach to become the newly industrial country and be called “The Taiwan economic miracle” since the 1980s. These experiences should have some meanings for the other emerging markets and have rarely been discussed. (Lin M. J., 2001).

Certain statistics suggest that Taiwan is a developed country; however, some indicators suggest that Taiwan is not a developed country. The FTSE classifies Taiwan

as an advanced emerging market. Moreover, a Forbes article highlights building construction issues, lack of green space, weak law enforcement, quality of life, and human relations as further indicators that Taiwan is an emerging market. As such, this author stresses that Taiwan is an advanced emerging market worth exploring and investing. In addition, Taiwan is undoubtedly on its way of becoming a developed country.

In conformity with a World Economic Forum report, Taiwan is in the midst of an innovation-driven economy. Hints of this high-tech excellence are prevalent throughout the Taiwanese economy. Moreover, the Global Competitiveness Report 2015–2016 from world economic forum indicates in all 140 economies, Taiwan is ranked 15th in the overall GCI and 28th in the technological readiness indicator. Taiwan ranked third out of 159 nations for broadband download speeds in 2017. Moreover, Taiwan produces 70% of the world's integrated circuits as well as 90% of laptops sold all over the world. These findings show that Taiwan can be considered at the advanced stage of technological development given its position as a future-thinking hub of technology and engineering.

Taiwan is well-positioned to become a leader in the development and implementation of Industry 4.0. With government initiatives spanning in information technology and electronics industry, Taiwan is proving it's ready for taking a leading role in this worldwide competition. Moreover, Taiwan possesses immensely valuable human capital given the highly educated high-tech workforce. Accordingly, Taiwan is poised to become a key global player as the integration of intelligent technologies continues to evolve within the context of Industry 4.0.

Hence, knowing Taiwan's technology transfer activities is crucial. We further choose the most representative industry, information technology and electronics industry, to investigate. The organization for Economic Co-operation and Development (OECD) identifies that Information Technology and Electronics industry covers the following general areas: 1) Technology Software and Services: Companies mainly develop software in various fields (the Internet, systems, applications, databases management) or provide information technology consulting and services, as well as data processing and outsourced services; 2) Technology Hardware and Equipment: Manufacturers and distributors of electronic equipment, computers and peripherals,

communications equipment and related instruments; and 3) Semiconductors and Semiconductor Equipment Manufacturers.

Data selection will be acquired through in-depth interviews and field observations with industry experts and scholars (Vargas-Hernandez, 2011). As such, this thesis applies purposive sampling for field observations and interviews which are four companies for each sector. The role of the researcher in this study was an “Insider” in both Interviews (Actor-observer) and Field observations (Complete observer) which allowed the researcher to get as close as possible to the data (Gioia, D., Thomas, J. Clark, S. & Chittipeddi, K., 1994; George AL, & Bennett A, 2005; Patton, 2014). The criteria for the selection of the 12 case companies (3 sectors* 4 companies) are that they have to be leading companies (Top 10) in their sector and have experiences of transferring technologies more 5 times in the past 3 years.

To sum up, technology transfer has helped companies in Information Technology and Electronics industry (Technology Software & Services; Technology Hardware & Equipment; Semiconductors & Semiconductor Equipment Manufacturers) to gain and sustain competitive advantage. Whether technology transfer can effectively and rapidly assist with establishing a competitive advantage is also a key concern among companies in Taiwan. Taiwan’s technology transfer experiences show strategic importance and meanings. How do companies in Taiwan gain competitive advantages via technology transfer? The need to develop a new management system, to cooperate all parties to boost competitiveness, and to avoid detrimental impact from changes in the external environment become paramount. Consequently, the performance of technology transfer, the mechanisms of technology transfer, and the prerequisites of technology transfer have become crucial topics for investigation. In short, for the reason outlined above, Taiwan has become a priority country for the research focus.

3.3.2 Data Analysis Method

As the research question is how resources drive technology transfer in the information technology and electronics industry in Taiwan, to better understand this phenomenon, the author interviewed scholars and managers from May 1st to December 31st, 2017. The interviews focus on the collaboration of information technology and electronics industry in relation to TT activities in Taiwan. In this way, we can have a

better understanding of this phenomenon, including identification of missing voices and in-depth answers to interview questions (Michael A. H., Javier G., & Robert E. H., 1998; Vargas-Hernandez, 2011).

Many possible methods could have been used to conduct this research, based on the research question (phenomenon), data sources (Interview and Field notes) and time frame (Cross-sectional). Thus, we should choose them wisely and carefully.

The constructivist perspective argues that humans generate knowledge and meaning from an interaction between their experiences and their ideas which is appropriate to address this research question (Soobrayana, 2003). After reviewing all approaches, this study will use inductive, semantic, latent and constructionist methods in order to explore the research question in light of data sources (Miles, M. B., & Huberman, A. M., 1994; Meyer, 2001). By doing all of these approaches, the analysis method of this study is “Thematic analysis method” which is one of a cluster of methods that focus on identifying patterned meanings across a dataset (Braun, V., & Clarke, V., 2006). Also, as Owen (1984) and Hammersley et al (1995) noted, thematic analysis focuses on identifiable themes and patterns of lifestyle and talk and aims to generate descriptions of strategies and behaviours.

To identify the interviews and field notes over a given time period, manual methods were used to search the title, context of cases and stated keywords of cases across a variety of terms (Stake, 1995). By starting with one case study and to compare the findings with the theoretical model shown in Figure 2, we can formulate possible explanations of this research question and have propositions to illustrate the relationships among variables. It is possible that we find the hypothesis does not fit the facts, either the hypothesis is reformulated or the phenomenon to be explained is re-defined so that the case is excluded. For purposes of proof, once a universal relationship is established, cases outside the area circumscribed by the definition are examined to determine whether or not the final hypothesis applies to them (Green J, & Thorogood N, 2009). In short, by doing so, we can do the comparison between extant theories with typical cases to extend or refine the existing theoretical framework (Yin, 2009; Hamel, J., Dufour, S., & Fortin, D, 1993).

3.3.3 Data Coding

Data were coded rigidly using typical content analysis procedure (Lincoln & Guba, 1985). Firstly, notes and reflection related to initial ideas will be written after reviewing interview transcripts and field notes. Secondly, this exciting feature of the data set will be coded. The third stage involves verifying that themes work concerning the coded extracts and allow for the construction of a thematic map of the analysis. The last stage consists of the revision of the entire process to figure out whether it is appropriate for the research aims. And, within the revision of the entire process, if data collected from different sources were inconsistent, this research reconciled differences either with additional sources of data or through verification by the original respondent. In the quoted interview data, we use corresponding codes (C1 to C12) to indicate each case.

3.4 Results

The cases were analysed one by one in an incremental manner. Also, the logic of analytic induction was strictly followed. Due to space limitations, this chapter reports the final revision of the results only.

The perspective of ERBV help to explain that in a dyadic relationship the interconnected firms would combine external as well as intrinsic resources towards the development of the competitive advantage of the focal firm. To be more precisely, transferors transfer technology to help transferees would be able to create a bundle of resources that are unavailable to competitors because they can have information advantages, sharing of complementary and additional resources from TT alliances.

Thus, according to ERBV perspective, this chapter builds up four themes (Transaction/ Instruction/ Cooperation/ Co-prosperity) based on the in-depth interview data from Twelve companies to describe how transferor-transferee relationship works in the technology transfer field. Each of these four transferor-transferee relationships and the corresponding situations will be discussed in detail in the following section.

3.4.1 Collaboration between transferor and transferee

Based on the theoretical framework built in Chapter 3 and the results of interviews, this chapter discusses the fundamental mechanisms that drive the

performance effects of transferor-transferee networks, and discuss their interactions and implications.

Broadly, ERBV perspective is the application of how resources are used to create value and in managing transferor-transferee relationship. The proposed framework allows us to highlight specific connections among these issues and implication. We focus on the major components that show how strategic resources are leveraged via TT process to deliver superior value that results in competitive advantages (superior performance). This value extraction in turn results in superior resources that can nurture assets and capabilities in the future as shown in Table 6.

Table 6 ERBV Perspective Illustration

| Issues | ERBV Perspective |
|--|---|
| Where is value determined? | Resources are the source of value. Companies must utilise resources to create outputs in order to be valued by the transferor- transferee network. Through collaboration, strategic resources might be derived through the joint efforts of all the TT partners as well as sharing of complementary and additional resources. Accordingly, value is subject to choices made by the interaction with external actor(transferees) and multiple sources of external change |
| What is the source of value? | Direct causal links between a resource with the desired attributes and the value they give rise to for transferees needs tractability and accessibility |
| When is value identified? | Strategy requires some a priori projection of the value to be created for transferees, and in return, transferors will receive complementary resources from transferees |
| What is the source of resources? | A transferor benefits from not only its own resources but also the shared resources of TT partners. Therefore, the creation of resources is fundamental to TT aspect of strategy development and execution |
| To what extent are Resource interaction effects pursued? | Transferors combine external as well as intrinsic resources towards the development of the competitive advantage. Hence, TT entails commingling of assets and capabilities |
| Marketplace (demand and supply/resource) heterogeneity | Competitive advantages can be generated by targeting different market segments and/or different competitors by leveraging different transferees |
| Market (customer and competitor) information and uncertainty | Information is essential for competing in short-cycle, heterogeneous (fragmented) markets. External information is needed to navigate markets and to run operations both efficiently and effectively |
| Organisation learning | It is how these resources are leveraged by TT embedded in capabilities |

This value accordingly leads to Technology transfer capability is derived not only from individual resources belonging to or deployed by transferees but also from the various combinations of these strategic resources. Hence, the value is so-called Technology transfer capability.

“C4: Taiwan is somehow in emerging economies. As you know, such economies may have high levels of uncertainty especially in the information technology and electronic industry. So, regardless of informal or formal relationships both play an important role when it comes to solving problems in inter-firm cooperation”... “C12: As we and transferees may experience different challenges or pursue different goals, we tend to strategically establish different types of networks and network support with transferees.”... “C8: Literally, the assets, resources, capability and knowledge of a partner can be valuable resources to increase our competitive advantage.” ... “C2: Transferees' characteristics influence the way of doing technology transfer.”... “C2: TT allows external partners (transferees) to be involved in the provision and management of the necessary IT resources. It is quite risky if those transferees have poor abilities.”

In accordance with the ERBV perspective and results of interviews, two dimensions (relationship with transferees and the degree of transferor’s involvement) represent different aspects of TT activities and have different effects on network actors as shown in Figure 3.

| | | |
|--|---|---|
| | <i>Transferee with Poor ability</i> | <i>Transferee with mediocre/ better ability</i> |
| <i>High Relationship with transferees</i> | <i>HRLI- Instruction</i> Technology licensing | <i>HRHI- Co-prosperity</i> Joint venture or M&A |
| | <i>LRLI- Transaction</i> Sourcing Agreement | <i>LRHI- Cooperation</i> Joint R&D |
| Low | | High |
| | <i>The level of transferor’s involvement</i> | |

Figure 4 Matrix of Technology Transfer’s Strategy

Across the 12 cases, this study identified four themes (Transaction, Instruction, cooperation, and co-prosperity) regarding how transferors (companies) perform TT activates according to the specific recourses and its relationship with transferees.

Transaction (LRLI)

"C1: Under this situation, the main function demanded as a transferor is to lead and make decisions for those transferees with poor abilities."... "C2: In order to successfully transfer technology in the transferor-transferee network, it is essential that the instructions we (transferor) give to transferees are clear and concise." ... " C4: We (transferor) must ensure that transferees know what they have to do at the very beginning of TT task. It sets off a chain reaction once you make a wrong move. As the old saying goes that small goals are easier to achieve on a regular basis, which means we can set them more often, build off them, and constantly see ourselves."

In this transferor-transferee network (LRLI: Low relationship standards and Low-involvement), we consider it the contracted relationship only which can be viewed as involving one-way or reciprocal information exchanges, learning, or knowledge exchange. In addition, such the contracted relationship may be contractual or equity as in the exchange for control. This type of relationship, therefore, can be controlled by the formal mechanisms. In this transferor-transferee network, the transferor will fulfil his obligations to tell a transferee what to do and how to do. In this scenario, transferors tend to engage in the “sourcing agreement” without deep involvement which is 1) Companies exchange manufacturing resources (facilities and equipment) and financial resources; 2) Manufacturing service is consigned to partners who provide the companies with finished (or semi-finished) products subject to the specification designated by the companies.

Instruction (HRLI)

"C7: There is another case that because we might successfully co-work with transferees before, we will offer either formal or informal ways of interaction. However, I have to admit that since their ability (transferees) is poor, during this stage, we

(transferors) will be passively awaiting their feedback and then have improvements and new ideas that may contribute to the project.”

In this transferor-transferee network (HRLI: High relationship standards and Low-involvement), it involves a closer relationship, but transferees lack the specific skills required for the job in hand. In this scenario, transferor tends to engage in “Technology licensing” without deep involvement. Transferees are given the right to use transferor’s proprietary technologies for their use (manufacturing, development, sales and other activities). By doing so, companies exchange technological and financial resources.

Cooperation (LRHI)

“C9: actually, we (transferors) like to encourage and facilitate transferees as this is the only way to get the best out of them.” ... “C10: we will make sure that they have received guidance and motivation towards the same objective. it feels like we (transferors) provide opportunities for the TT team to discuss and exchange views, thus enriching the collaborative process.”

In this transferor-transferee network (LRHI: Low relationship standards and High-involvement), transferors may benefit much more so they tend to have a deep involvement with capable transferees. Usually, this type of network is under a mutually agreed specification goal and schedule to develop specific technologies or products such as “Joint R&D”. While spreading the costs and risks across multiple partners, both of transferors and transferees aim to realise shared benefits by combining financial and technological resources (including intellectual property, development experience, research talent, etc.).

Co-Prosperity (HRHI)

“C12: To us, as a transferor, it is essential that we know how to assign tasks to transferees.” ... “C11: Both of us are mature enough to know what our roles are, how to work together and to make this project go well, and what is expected of us as we have been working closely. We trust each other. Therefore, we discuss on and off. “...

"C12: We respect their way of carrying out the TT tasks and entrust the decisions they make."

In this Transferor-transferee relationship (HRHI: High relationship standards and High-involvement), since transferors are close with transferees, they are willing to make most of the decisions and take most of the responsibility for what happens together. Moreover, in this scenario, transferors tend to engage in "Joint venture or M&A" with deep involvement to combine technological, manufacturing, distribution and financial resources if transferees are experienced and able to do the task.

Summary

"C10: We (Transferors) gain power through relationships with transferees."... "C5: Given the relationships with transferees and transferees' abilities, we (Transferors) have different involvement and come up with different strategic TT alliance such as research agreements and technology development, sharing arrangements and so on."... "C3: Transferees' abilities have more opportunities to make a mistake. We, therefore, have different ways of approaching them. For instance, a transferee with poor abilities might benefit from a style that emphasizes order, rules, and clearly defined roles. A transferee with mediocre/ better abilities might benefit from a more democratic style that allows everyone to participate in this transfer task, to work independently and to have input in decisions."

Given transferee's abilities and relationships, transferors come up with different strategies of doing technology transfer.

On the one hand, for those transferees with poor abilities, transferors tend to use contracts. In this scenario, it is compulsory for transferees to sign contracts in order to obtain rights to know-how and patents. There are three types of licensing contracts: 1) early licensing: it is signed before the technology is developed, 2) prototype licensing: it is signed after the technology is developed, and 3) cross-licensing: it enables two entities to share patent rights to develop new products.

“C2 has transferred one technology to five companies before it was developed (early licensing agreement)” ... “C3 was licensed (Prototype licensing agreements) one technology to 6 companies.” ... “C5 and another firm have had cross-licensing agreements for specific technology development projects.”

On the other hand, in the case that transferors are not close to those transferees with mediocre/ better abilities, they tend to engage in joint development. They sign a joint development contract and contribute their specific technology. When the technology is developed, the parties share the intellectual property according to the portion of R&D each has contributed. The four types of joint development activities are: 1) custom design, 2) joint specification definition, 3) joint R&D projects, and 4) subcontracts.

“C9: Joint specification definition is an initial step before joint projects are undertaken. Take one project for example, we contracted with integrated circuit (IC) factories and allied companies then undertook the joint R&D project. The first thing to do was to clarify and finalise the definition of the joint specification.”

In addition, in the case that transferors work with transferees with mediocre/ better abilities closely well, they might consider 1) Joint venture, 2) M&A, or 3) Spinoffs.

“C12 used to transfer technologies along with technicians resulted in the start-up of new companies.”

In sum, this chapter summarises three key contextual factors that Transferors must be aware of when making an assessment of the TT strategy: 1) Relationship with Transferees: A transferor needs to take into account its relationship with transferees; 2) The Ability of Transferee: Transferors shall be able to know exactly transferees' abilities as it allows transferors to choose the best TT activity to help transferees accomplish their goals; and 3) The Level of Involvement: TT tasks can range from simple to complex. In order to determine if it has been successfully and competently

accomplished, transferors need to have a clear picture of how deep they intend to involve in. Hereby we conclude that the transferor-transferee relationship, transferees' abilities and transferors' involvement can help transferors develop TT capability which leads to the following proposition:

Proposition 1 Strategic resources and TT capability are likely to be inhibited by Transferees' abilities and Transferors' involvement

3.4.2 Technology Transfer Capability and Competitive advantage

The perspective of ERBV help to explain that in a dyadic relationship the interconnected firms would combine external as well as intrinsic resources towards the development of the competitive advantage of the focal firm. To be more precisely, transferors transfer technology to help transferees would be able to create a bundle of resources that are unavailable to competitors because they can have information advantages, sharing of complementary and additional resources from TT alliances. Also, transferors might absorb and utilise the transferee's resource, knowledge, and capabilities all of which might be primary sources of competitive advantage. Moreover, this transferor-transferee relationship can help the transferors develop managerial capabilities associated with forming new alliances which in turn enhance network resources.

Every organisation has a different base of resources, and thus develops a varying core competence. To achieve a specific goal, organisations will choose to perform technology transfer for receiving their complementary resources. In other words, complementary resources are one of the motives for doing technology transfer, gaining superior performance and forming competitive advantage (Harrigan, 1986; Harrigan, K. R., 1988).

To review results of interviews with regard to TT activities, we found some patterns from formation of the transfer, decision of transfer, transfer kick off, and achievement of satisfaction performance and summarize them as shown in Table 7.

Table 7 Technology Transfer's Activities and Outcomes

| Antecedents | Process | Outcomes |
|--|---|---|
| <ul style="list-style-type: none"> • Relationship governance (C10) • Mutual dependence (C9) • Partner complementarity (C5) • Business strategy (C2) • Top management commitment & incentives (C8) • Transferor's leadership (C1/C2/C6) • Collaboration (C9/ C11) • Organizational culture (C12) • Access to resources (C10) | <ul style="list-style-type: none"> • Target setting (C1/ C2/ C7/ C8/ C9/ C12) • Task implementation (C8) • Evaluation (C1/C2/C3/ C9) • Improvement of relational embeddedness (C10/ C12) • Development of alliance structures (C9/ C10/ C12) | <ul style="list-style-type: none"> • Long-term relationship (C1) • Value creation (C11) • Joint action (C9) • New opportunity (C10) • Complementary resources (C2) • Learning and innovation (C3) • Reputation (C6) • Lower the risk (C11) • Market performance (C9) • Innovation and improvement (C2) • Profitability (C7) • Better quality (C3) |

Value itself can be considered in terms of creation and capture. While value creation for stakeholders is the primary objective of all organisations, value capture refers to the retention of some value of every organisational transaction (for example marketing, finance, relational) (Gassmann, Zeschky, Wolff, & Stahl, 2010; Kauppila, 2015; Swoboda et al., 2011). The value created can be tangible and/or intangible and its extent is dependent on the transferor-transferee relationship and their capabilities (Hillebrand, Driessen, & Koll, 2015; Reypens, Lievens, & Blazevic, 2016). Accordingly, it can range from narrow specificity to a broader development of capability. In terms of TT capability, it is used to develop a collection of value-creating resources that a company cannot create independently while transferring technology to transferees (Iansiti, M. and Clark, K. B, 1994; Eisenhardt, K. M. & Martin, J. A., 2000).

Hill and Jones (2007) proposed that the implementation of strategies involves the use of an organisational design that allows the use of available resources taking into account the organisational structure, control systems and organizational culture in search of a successful business model. This structure enables superior performance in the so-called "building blocks or constellations of competitive advantage elements" which are defined by the efficiency of the processes, the quality of the product or service, the organizational responsiveness in terms of customer satisfaction and the levels of innovation involved in the system. In this sense, a model of evaluation of competitive advantage involves at this stage the key performance indicators (KPI) for its assessment.

Therefore, in accordance with four themes (Transaction, Instruction, Cooperation, and Co-prosperity) developed from previous section, we further explore relationship between TT capability and Competitive advantage (Strategic performance and Operational performance).

Operational performance: Transaction (LRLI)/ Instruction (HRLI)

“C1: Because we need to utilise the transferee’s resource, knowledge, and capabilities and become ours we monitor many indicators while transferring technology.”... “C7: We have our own business purposes while interacting with transferees through the TT network. Mainly, we aim to have their complementary resources. We actually benefit a lot through the utilisation of collaborative activities. Therefore, we have a system to check and trace reality measurements such as transferee satisfaction, product, financial performance, and profitability.” ... “C6: we have a platform with transferees that we can check hourly data. It is to make sure that the products can be on schedule.”

The use of external knowledge within Transferor-transferee relationship is rarely straightforward. As noted, it is a contracted relationship which can be viewed as involving one-way or reciprocal information exchanges, knowledge exchange, or learning.

The level of involvement reflects how important or interested you are in transferring technology and how much information you need to make a decision. In this scenario of low-involvement, the Transferor-transferee relationship might be contractual or equity as in the exchange for control as the transferors. Transferees may not only be subject to Intellectual Property restrictions that may retard its use by the firm, it is also often sticky to the context in which it was developed. In turn, transferors will be limited by the engagement of complementary recourses.

Therefore, transferors are seeking to get closer to reality measurement, so they can assess operational performance regarding what’s actually happening in the business on an hourly, daily, weekly and monthly basis. There are also various measures for alliance success; for example, partner satisfaction, product, market and financial performance, profitability, and innovation.

Strategic performance: Cooperation (LRHI)/ Co-Prosperity (HRHI)

“C10: To know the market value of specific scientific can help us to evaluate the commercial potential of new technology. Therefore, we need the knowledge of customer demands and customer preferences. For us, knowledge regarding product development and marketing is valuable.”... “C9: We (Transferors) do not want to spend too much time in search of potential transferees, and thus we utilise strong ties to co-work with transferees. So, the thing you brought up, I believe the structural hole is getting less. Also, when reaching this stage, it seems like there is no need to work on TT actives as the improvement of organisational capabilities is limited even though the social capital gets increased.” ... “C3: It depends on how you co-work with Transferees as they can be of help and provide us with strategic opportunities with less risk and cost.” ... “C11: Basically, KPIs evaluate not only my company but also external partners. For example, my company has KPIs that involve faster implementing time from my end, less operation cost (from transferee's end) and so on, all can potentially contribute to the performance with less risk and cost in the long run.”... “C6: The transferor- transferee alliance often could not achieve the established goals, and many have failed to achieve it. It is because transferors and their transferees are not on the same page. So, it is important to do the right thing and do the thing right”

The interaction of external activities and technologies becomes important in sustaining strategic advantages in global competitive battles in information technology and electronics industry. If transferors interact continuously and closely with their transferees, they obtain better intelligence about the transferee's requirements and the competitors' moves.

With high involvement of the transfer activities, transferors will design interfirm routines that facilitate information-sharing and increase socio-technical interactions over time. Various interaction modes such as on-site visits, product concept reviews, technical meetings and joint training programs are encouraged to improve the quality of relationships and facilitate knowledge acquisition. The transfer of tacit knowledge is very communication-intensive, involving several months of frequent interactions between TT partners. Subramaniam and Venkatraman (2001) also indicate that rich information- processing mechanisms such as face-to-face contact with

managers will increase the effectiveness of transferring and deploying tacit resources. Therefore, the interaction between different value-added functions will encourage strategic performance.

Summary

In this chapter, we focus on processes related to TT capability. In the practice of strategic alliances, a variety of processes and activities (such as, *inter alia*, inter-organizational steering group meetings, relationship scorecard, bonding, and knowledge articulation) facilitate the utilization of resources to benefit TT partners. TT has become a new additional strategic option for the strategic apex. TT has become more popular, especially within the context of high technology. Information technology and electronics industry is characterized by a high rate of innovation and technological change, an increased number of R&D personnel and amount of R&D expenses, high degrees of risk and uncertainty, and a high level of market fragmentation and globalization. Under such conditions, TT is often viewed as the only viable option to acquiring unique resources (Downs, 2000; Esther de Wit-de Vries, Wilfred A. Dolfsma, Henny J. van der Windt & M. P. Gerkema, 2019).

Wang and Rajagopalan (2015) note that “partnering companies have the opportunity to create value by leveraging complementary assets and learning from each other while dealing with the challenges posed by conflicts, unexpected contingencies, and moral hazards”. Transferring best practices and core competencies can create value (Hameri, 1996; Lall, 2006). This form of synergy is important in the ERBV of competitive advantage. According to this view, one reason for helping another company would be to absorb and assimilate the target’s resource, knowledge, and capabilities all of which might be primary sources of competitive advantage. When companies combine resources and capabilities through TT, they may be able to create a bundle of resources that are unavailable to competitors. If the combined resources and capabilities are complementary, the competitive advantage might be long-term. If the combination is valuable and rare, the transferor may be able to generate profits greater than the sum of the two companies’ individual profits (Jones, 1983; Katerina Sideri & Andreas Panagopoulos, 2018).

Capabilities are acquired through either internal sources or alliances where organisations learn to cooperate and work with each other (Rosenkopf & Almeida, 2003; Tsang, 2002; Zollo, Reuer, & Singh, 2002), and are developed through the provision of opportunities and new knowledge (Kavusan, Noorderhaven, & Duysters, 2016). Heimeriks, Klijn, and Reuer (2009) suggest that as companies develop their alliance management skills, their capabilities also improve, therefore embedding critical alliance knowledge in a progressively cyclical manner (Nelson & Winter, 1982).

Thus, in order to create value via TT activities, there are a few lists that transferors should be able to meet when it comes to technology transfer. 1) transferor must be able to gain transferees' trust and confidence; 2) transferor must be able to understand the needs of the transferees, then adjust his transfer method to meet those needs; 3) transferor must be able to solve problems, such as how to get a task done using the best transfer style available; 4) transferor must be able to evaluate the abilities of the transferees and then apply the right strategy to co-work with transferees.

Also, from the analysis of the interview data, we notice how technology transfer capabilities were engaged in the network and then gain superior performance. Globalization in the information technology and electronics industry has culminated in the concept of "global production network" that captures the spread of the broader systems of international production which cut across different stages of the value chain (Gandenberger, 2015). The main purpose is to exploit complementarities, and the participation in these networks may enhance the migration of knowledge across firm boundaries and national borders (Ernst, 2000). Most companies participate in global production networks and greatly enhance their capabilities through repeated interactions and the acquisition of skills between companies in the networks (Bianca B.M. Keers, Paul C. van Fenema, Henk Zijm,, 2017). Over time, the transferors accumulate knowledge and evolve toward greater independence because of an increase in the scope of their product design activities in the network. This continuous learning leads to improvement in capabilities and enhancement of the companies' positions in the network (Brian Squire, Paul D. Cousins and Steve Brown, 2009). Moreover, as shown in the figure 4, to those transferees with poor abilities, transferors are aiming for enhancing operational performance. Conversely, if transferees with mediocre/ better

abilities, transferors will be after strategic performance. This leads to the following proposition:

Proposition 2 Within the strategic transferor-transferee relationship, Technology transfer capability has a positive impact on competitive advantage

| | | |
|--|---|---|
| | <i>Transferee with Poor ability; Transferor will focus on operational performance</i> | <i>Transferee with mediocre/ better ability; Transferor will focus on Strategic performance</i> |
| High <i>Relationship with transferees</i> | <i>HRLI- Instruction</i> Technology licensing | <i>HRHI- Co-prosperity</i> Joint venture or M&A |
| | <i>LRLI- Transaction</i> Sourcing Agreement | <i>LRHI- Cooperation</i> Joint R&D |
| Low | Low | High |

The degree of transferor's involvement

Figure 5 Matrix of Technology Transfer's Strategy with Performance

3.4.3 Toward an integrative framework

In emerging markets such as Taiwan, most of the companies with greater R&D capabilities are in the information technology and electronics industry. The competition for this industry is keen. This chapter argues that companies that have invested more resources in building R&D capabilities are less likely to adopt a high level of industry diversification strategy as building innovation ability is an expensive process (Argyres, 1996). Also, the product life cycle in this industry is short (Lukas and Bell, 2000; Plepys, 2002). Therefore, TT has become a new additional strategic option for the strategic apex.

Across the 12 cases, this study identified four themes (Transaction, Instruction, cooperation, and co-prosperity) regarding how transferors (companies) perform TT activates according to the strategic recourses, its relationship with transferees, and transferees' abilities. To be specific, considering transferee's abilities and relationships, transferors have these four strategies (Transaction, Instruction, cooperation, and co-prosperity) of doing technology transfer and then determine the level of transferor's involvement. Moreover, as noted earlier, strategic resources and TT capability are

likely to be inhibited by transferees' abilities and transferors' involvement. Transferors have to take into account 1) Relationship with Transferees; 2) the Ability of Transferees; 3) the Level of Involvement when assessing the TT strategy.

Transferring best practices and core competencies can create value. According to ERBV, through collaboration, strategic resources might be derived through the joint efforts of all the TT partners as well as sharing of complementary and additional resources. Therefore, when companies combine resources and capabilities through TT activities, they may be able to create a bundle of resources that are unavailable to competitors.

Figure 5 depicts an integrative model of technology transfer capability. By deploying a case study across 12 transferors (cases), this research develops a new theoretical model and suggests that antecedent of technology transfer capability, the level of transferor's involvement, leverages the strategic resources and technology transfer capability. Also, technology transfer capability is positively related to competitive advantage.

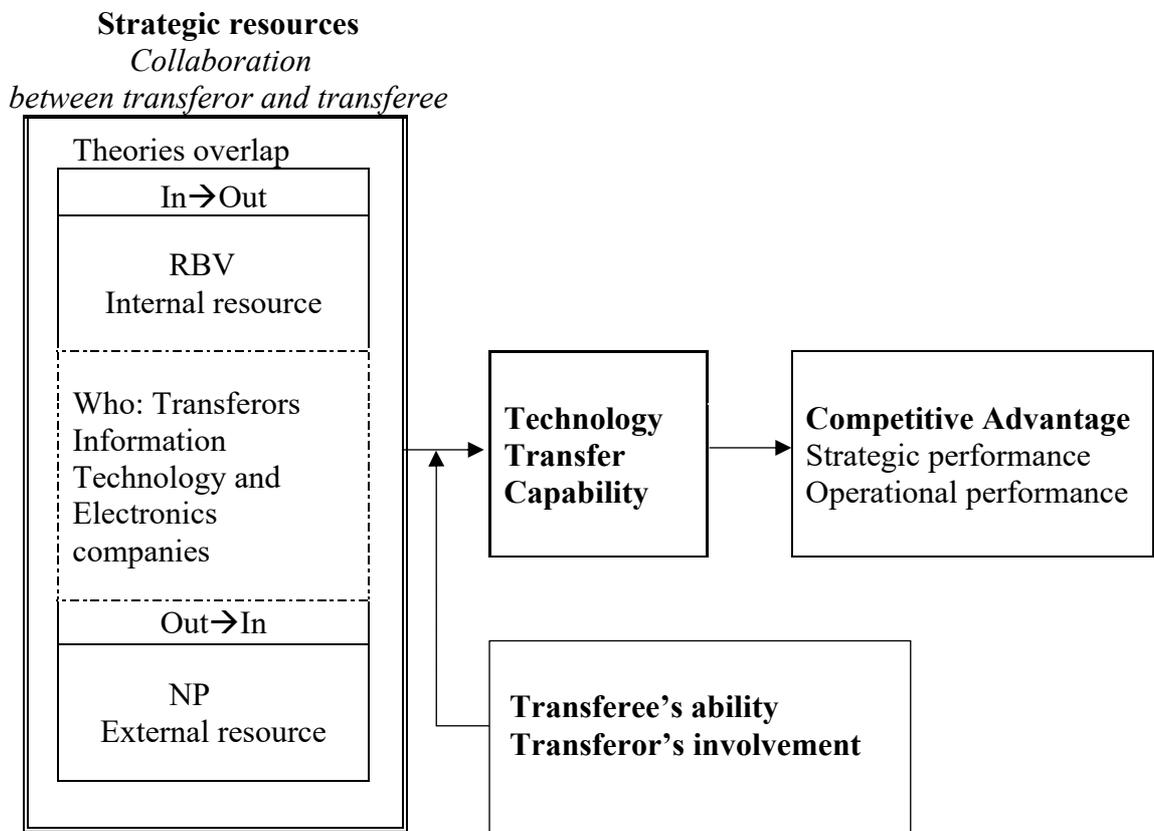


Figure 6. An Integrative Framework of Technology Transfer Capability

3.5 Discussion and Conclusions

As a way of responding to the research question, this study looks at the two tasks of fieldwork and interviews as ways of sketching out a few craft-like rules for “how do resources drive technology transfer” within the umbrella of thematic analysis and perspective of ERBV.

We divide the article into four parts. First, we examine the rationale for entering into technology transfer this type of strategic alliances from the ERBV perspective. We then identify the level of transferors’ involvement and transferees’ abilities that are the antecedents of technology transfer capability. Third, we discuss structural preferences for technology transfer, as determined by the transferor-transferee relationship. Finally, we develop a typology of interfirm resource alignments and explore the effects of these resource alignments on technology transfer performance. The four parts of the article set out the four essential components of ERBV of TT: rationale, formation, structure, and performance. These four components are integral to a general theory of alliances, because they have been the main focus of alliance research. What has been lacking in the literature thus far is the fact that none of these aspects has been adequately examined from the resource-based perspective. Taken together, the four aspects contribute toward a comprehensive and integrated theory of TT from the ERBV viewpoint.

As Creswell (2003) claims, reliability is a measurement of the consistency and stability of measurement results. To ensure reliability, we check whether there are glaring mistakes in transcripts and field notes and make sure there is no drift in definitions of codes or applications of them during the coding process (Creswell, 2003). In regard to qualitative validity, we conduct reflections on transcripts and field notes and collect first-hand data. Besides, as an insider to observe and participate, it also carries further to impact the validities of external and internal positively.

To facilitate empirical testing of the ERBV theory of technology transfer presented here, we also develop a number of propositions. The evidence generated across the 12 case studies suggests within the strategic transferor-transferee relationship, transferors improve their competitive advantage by developing the capability of technology transfer. Also, the level of transferor’s involvement leverages the relationship between collaborative transferor-transferee relationships and technology transfer capability.

The findings of this research provide answers to the research question and organise as follows.

First, this research has identified four different types of TT across twelve cases and explores how “relationship between transferors and transferees” and “level of transferor’s involvement” change in these four TT contexts (Transaction (LRLI)/ Instruction (HRLI)/ Cooperation (LRHI)/ Co-Prosperity (HRHI)).

Technology transfer involves a two-way knowledge flow between the parties within the framework of an agreement especially designed for joint R&D for product or process improvement or development. Every organisation has a different base of resources, including level of experience and knowledge, and therefore it develops a varying competence level. To achieve a specific goal, organisations will choose a suitable way of performing technology transfer for receiving their complementary resources. Accordingly, in terms of transferor-transferee interaction, these four themes are varied concerning the relationship with transferees, transferees’ abilities, and the level of transferor’s involvement.

While transferees with poor abilities, transferors will opt for either Transaction (LRLI) or Instruction (HRLI) for enhancing its operational performance. On the contrary, transferors will root for Cooperation (LRHI)/ Co-Prosperity (HRHI) in order for gaining strategic performance. The previous ones (LRLI/ HRLI) are much of a contracted relationship, transferor tends to fulfil his obligation without deep involvement while the latter ones (LRHI/ HRHI) have frequent interactions. That is, when making an assessment of the TT strategy, transferors should take into account its relationship with transferees, how much you feel like to involve, and the ability of transferees.

Therefore, when a strategic TT alliance is formed, different degrees of convergence may exist between the resources of the focal company (transferors) and the resources of its partner (transferees). Moreover, transferors and transferees endow a subset of their resources to this alliance, expecting to generate common benefits from the shared resources of both parties. Each company, therefore, possesses a subset of shared/ non-shared resources that together form the company's complete set of resources. The arrangement can be considered a pooling alliance as the intersection of shared resource sets is substantial. Also, in this alliance, transferors and transferees pool

their resources together to achieve a greater scale and enhance their competitive position in their industry. In contrast, when this intersection is relatively small, the alliance can be described as a complementary alliance in which companies seek to achieve synergies by employing distinct resources that are difficult to accumulate for any individual company.

Second, in this competition and a short product life cycle environment, effective TT requires companies to combine and integrate internal and external knowledge. In order to create value via TT activities, transferors should be able to 1) gain transferees' trust and confidence; 2) understand the needs of the transferees, then adjust his transfer method to meet those needs; 3) solve problems; and 4) evaluate the abilities of the transferees and then apply the right strategy to co-work with transferees.

This research is carried out in an industry with a short product life cycle environment. The technology transfer capability is more sensitive to interactions between the two parties. Therefore, the research contexts may limit the generalizability of the research findings. Future research should examine the impact of Technology transfer on competitive advantages in a wider industrial context.

Theoretically, we add to the existing literature about the interaction between transferor and transferee by explicitly studying TT activities from the perspective of ERBV. We show that technology transfer activities can be beneficial to transferors. However, we might collect dyadic data in order to align the conceptualization and empirical investigation of TT. The perspective of transferee needs to be examined.

Lastly, the rich qualitative data and case study methods allow us to capture the unique complexities of the cases and then form indicators for constructs. However, as the goal of qualitative studies is not to generalize, the manifest variables cannot fully represent the constructs. It means although we have explained why relationships and the degree of transferors' involvement affect Technology transfer in different ways, we are unable to provide an insight into how significantly Technology transfer capability influences competitive advantage within the information technology and electronics industry. That is, we cannot learn from the study of the governance of one complex system for the governance of another complex system. Consequently, future research should further examine and test explicitly the relationship between Technology transfer capability and competitive advantage with a quantitative approach.

Chapter 4 A Study on Technology Transfer Capabilities: An Extended Resource-Based View

In the last decade, Taiwan has become a world-class supply source of information electronics products. Top companies maintain their success through networks. Unfortunately, empirical studies have rarely focused on internal as well as external capabilities altogether in Taiwan within technology transfer contexts. The objective of this study is to examine the relationships between technology transfer capability and competitive advantages of information technology and electronics industry in Taiwan utilising the Structural Equation Modelling (SEM) approach from the perspective of ERBV. Questionnaires will be distributed to the top executives of information technology and electronics companies. Moreover, a total of 1000 questionnaires will be mailed for investigating the questionnaire approach. The populations in this study are the top 1000 Taiwanese information electronics companies listed in the China Credit Information Service Incorporation. The analysis of received data verifies the hypothesis that companies improve their competitive advantage by developing the Technology Transfer capacity. The findings of this research can provide the information technology and electronics industry the reference to engage its technology transfer capability in order to achieve superior performance to satisfy its demand. The study reaches below conclusions: 1) Transfer capability and Management capability positively correlate with Strategic performance, while Network capability negatively correlates with Strategic performance; 2) Management capability positively correlates with operational performance; 3) Strategic performance positively correlates with Operational performance; 4) No significant relationship exists between Transfer capability and Operational performance; however, Transfer capability indirectly affects Operational performance through the mediating variable of Strategic performance; 5) Strategic performance partially mediates the relationship between Network capability and Operational performance.

4.1 Introduction

Technology is the products and services generated as a result of the application of technological inventions or innovations through commercialisation which create wealth. New products resulting from technology, in particular, have been the key to corporate prosperity. They also add considerably to the wealth of the country through taxes on the business income and employment resulting from technology application (Doyle, 1998). However, great technology alone is not sufficient to ensure a winning product. To survive and profit in the information technology and electronics industry, companies have adopted TT to reduce risks, have complementary resources, bridge gaps with other organisations (Lin, W. B. and Wu, W. I., 2006). TT is fundamentally changing the nature of the competitive environment companies face in their global operations because TT is the optimal means of enhancing technology to facilitate entering new markets and developing marketable products. Moreover, through TT, transfers can control existing markets or expand into related markets to obtain royalties and thereby recover the cost of R&D. Similarly, transfers can enter partnerships to penetrate inaccessible foreign markets or modify their own technologies according to the applications by transferees.

Previous studies (Agmon, T. & Von Glinow, M. A., 1991; Kohler, B. M., Rubenstein, A. H. and Douds, C. F., 1973; Hameri, 1996; Lin, M. J. and Lai, S. B., 1993; Lin M. J., 2001; Wang, C. L., & Ahmed, P. K., 2004) on technology transfer have focused primarily on the involved transfer modes and transfer performance, whereas technology transfer capability has rarely been discussed. Furthermore, although numerous modes of technology transfer are employed worldwide, little research has taken a comprehensive perspective to investigate how technology transfer influences companies' competitiveness. Therefore, a conceptual framework regarding technology transfer capability and competitive advantage needs to be developed and tested empirically. There have been several studies on technology transfer related to RBV or NP, but there are not enough empirical studies which clearly indicate manifest variables on adjusting resources, capabilities, as well as network ties, for measuring firm performance or competitive advantage altogether. Besides, although inter-firm networks have been frequently discussed in the literature as an antecedent to companies' performance (MW Peng and Y Luo, 2000; SH Park and Y Luo, 2001), its role as an

external resource of transferors and its impact on these companies' operations, has been largely ignored. It means that current manifest variables cannot fully represent the constructs as applications of theories do not take into account the integration mechanism.

In addition, researchers often use case study methods and rich qualitative data to analyse and understand their objects of study (Cunningham, J.A., Menter, M. & Young, C., 2016). These in-depth studies allow us to capture the unique complexities of the cases and then form indicators for constructs. Such studies, however, have a problem that they often lack generalizability. They tend to delve into the complexity of a particular case, which makes cases difficult to compare. In this situation, we cannot help but wonder how we can compare dissimilar cases or how we can learn from the study of the governance of one complex system for the governance of another complex system?

Moreover, it is necessary to construct a competitive advantage in the aspects of cost leadership, differentiation of products and services, and responsiveness to the needs of a specific group of customers. To be in accordance with the opportunities and obstacles of both internal and external environments of the organization, from ERBV perspective, businesses should analyse both internal and external factors pertaining to the business environment. However, this type of competitive advantage derives from traditional RBV perspective which cannot evaluate sustainability and survivability of the business as a result of effective management of internal and external resources. Hereby, we change the concept of competitive advantage to performance (strategic performance and operational performance) to illustrate the strategic technology transfer management and follow the definition of competitive advantage that attributes allow a company to produce cheaper or better quality products than its competitors. Namely, this chapter is aimed at investigating the correlations among technology transfer capability, strategic performance, and operational performance.

In sum, in accordance with the proposition 2 of Chapter 3, proposition 2 of Chapter 4 and the results of Chapter 4, the Chapter is aimed at addressing the question, "what are the relationships between technology transfer capability and performance of the information technology and electronics industry in Taiwan?" to further clarify the relationship among technology transfer capability and performance (strategic

performance and operational performance) from ERBV perspective and determining the causal relationships among them.

4.2 Conceptual Background and Development of Hypotheses

As this is a dyadic tie between transferor and transferee study, we thereby have three major reasons to engage the ERBV perspective to explain this research question. First, ERBV perspective emphasises the network aspect of interconnected companies by conceptualising how companies can reinforce their competitive advantage under strategic TT alliances. Second, ERBV perspective explains the gaining of competitive advantage (superior performance) in a more integrated manner. Third, ERBV posits that a dyadic network exists between transferor and transferee in the form of a strategic TT alliance specified by contractual agreements. In this way, we can have a better understanding of how transferors and transferees interact through strategic TT partnerships(external resources) and internal specific resources for their own business purposes.

Accordingly, this chapter adopts the ERBV perspective and seeks to identify the technology transfer capability that companies can resort to in the creation of superior performance (competitive advantages).

4.2.1 Effect of Technological Transfer Capabilities on Performance

Porter (1995) noted that due to today's fierce competition, no organisation could fully develop all the required competencies by itself. Scholars have argued that strategic TT alliance are defined in the literature as voluntary arrangements between companies involving sharing, exchange, or co-development of products/ technologies/ services (Gulati, 1998), or purposive strategic relationship between independent companies (transferors and transferees) that strive for mutual benefits, share compatible goals, and acknowledge a high level of mutual dependence (Zheng Jane Zhao & Jaideep Aanand, 2009; Mei Cao and Qingyu Zhang , 2012). Takeishi (2001) argued for the importance of internal knowledge and external collaboration. In order to be able to quickly evaluate and use new component technologies when available, companies work effectively with extensive internal effort and external investment. Aside from the overlapping knowledge, external collaboration also necessitates internal coordination. In essence,

these authors acknowledge the importance of a knowledge overlap between buyers and suppliers for knowledge integration as well as an ability to coordinate (Beecham and Cordey-Hayes, 1998, Takeishi, 2001, Takeishi, 2002, Tsai, 2009, Ulrich and Ellison, 2005; Koufteros, 2005).

Dutta et al. (1999) explained that capability refers to a company's ability to deploy its resources thereby to achieve its desired goals. Nath et al (2010) further stressed capability may be an intangible organizational process or an invisible resource which a firm builds over a period of period. Due to the importance of capability in both theory and practice, many studies have examined the effects of different organizational capabilities on performance (Hsiao and Chen, 2013). Some scholars have investigated the performance implications of different types of capability in terms of marketing capability (Chen et al., 2016; Day, 1994), R&D capability (Argyres, 1996; Mahmood et al., 2011) and operational capability (Tanriverdi and Venkatraman, 2005; Flynn et al., 2010; Mahmood et al., 2011; Ling et al., 2013). Rao (2002) found that helping strategic alliances leads to competitive edges, such as improvement in product quality, the betterment of environmental performances and reduction in product costs. Also, he stated that the better the cooperative relationship between buyer and seller, the stronger their competitive positions. Miller et al. (1994) proposed the framework for the exchanges of competences between buyer and seller from a resource-based perspective. They argued that the support and learning between buyer and seller enhance the competitive advantages of both parties. Previous studies have suggested that companies with superior capabilities enjoy superior financial performance (Chen et al., 2016; Mahmood et al., 2011; Tanriverdi, 2005), since they can efficiently convert their resources into valuable and difficult-to-imitate capabilities, thereby achieving a competitive advantage (Nath et al., 2010).

Walsh and Linton (2002) considered Technology transfer capability as a unique corporate competence. In recent years, core competencies (Prahalad & Hamel, 1990) have become a key concept for businesses seeking to develop their competitive advantages. Porter (1985) noted a business possesses a unique ability if its core competencies surpass those of its industry competitors. Successful businesses can integrate and effectively utilise resources and skills to facilitate organisational growth in new markets. Prahalad and Hamel (1990) considered core competence as the degree

to which businesses can integrate various technologies and skills into their operations through organisational learning and cross-organisational collaboration, the goal of which is to gain a competitive advantage. Therefore, a core competency can be viewed as any scarce, valuable, or inimitable ability that a business acquires after integrating technologies, skills, and techniques. Businesses with such abilities are in a position to create superior operational capabilities (Cutler, 1989; Hammersley, M., & Atkinson P., 1995; Hansen, N., T. Morten and Tiemey, T, 1999; Hedlund, 1994; Kathrin Bischoff, Christine K. Volkmann & David B. Audretsch, 2018). Wang and Rajagopalan (2015) claimed the range of alliance capabilities can be classified under three headings 1) Individual alliance capability: it refers to a company's ability to manage the alliance life cycle with particular emphasis on resource management throughout; 2) Alliance portfolio capabilities: it refers to a company's ability to develop and coordinate an alliance portfolio; and 3) Dyad specific capabilities: it refers to didactic relational capability. Agmon and Von Glinow (1991) and Cusumano and Elenkov (1994) have directly indicated that an organisation's technology transfer capability can influence its performance. Lin (2003) claims technology transfer (TT) should be conceptualized in terms of technological learning performance, organizational intelligence, causal ambiguity, firm specificity, complexity, maturity, employee qualification, and innovation orientation and further suggests that TT can be a significant source of competitive advantage for companies in developing countries with limited R&D resources. Moreover, companies' strategy level involves integrating and managing the diverse businesses and realizing synergy at the corporate level. The top management team is responsible for formulating the strategic TT alliance strategy which reflects the path toward attaining the vision of the focal company (transferors). When companies combine resources and capabilities through TT, they may be able to create a bundle of resources that are unavailable to competitors. If the combined resources and capabilities are complementary, the competitive advantage might be long-term. If the combination is valuable and rare, the transferor may be able to generate profits greater than the sum of the two companies' individual profits. This leads to the following hypothesis:

H1: Technology transfer capability is positively correlated with Strategic performance

Strategic TT partnerships can be defined as collaborative arrangements among independent companies that involve sharing, exchange and co-development activities designed to reach companies' strategic goals (Khalil, 2000). Strategic technical alliances (Technology transfer) take different forms, including joint marketing initiatives, research consortia, joint ventures and so on (Daghfous, 2004). Superior performance is much of competitive advantage elements and can be defined by the efficiency of the processes, the quality of the product or service, the organizational responsiveness in terms of customer satisfaction and the levels of innovation involved in the system. In this sense, a model of evaluation of competitive advantage involves at this stage the key performance indicators (KPI) for its assessment (Gupta, 2000). Several studies have also concluded that corporate core competitiveness, technology transfer capability (i.e., threshold, critical, and cutting-edge capabilities) affect performance (Agmon, T. and Von Glinow, M. A., 1991; Kohler, B. M., Rubenstein, A. H. and Douds, C. F., 1973; Hameri, 1996; Lin, M. J. and Lai, S. B., 1993; Lin M. J., 2001). Gulati (1999) suggests that resources may inhere in the networks in which companies are situated by providing them with valuable information that in turn provides strategic advantage by allowing them to act quicker than rivals.

Under the external pressures to take actions on industry 4.0, and the urge to boost their own competitiveness, companies have to collaborate closely with their transferees in a series of improvement initiatives to help their transferees. Transferring best practices and core competencies can create value. This form of synergy is important in the ERBV of competitive advantage. According to the view, one reason for helping another firm would be to absorb and assimilate the target's resource, knowledge, and capabilities all of which might be primary sources of competitive advantage. Therefore, many world-class companies are continually tracking operational performance factors that ultimately impact business success, such as order-to-delivery cycle time, throughput, inventory levels, operating expense and customer satisfaction (Bianca B.M. Keers, Paul C. van Fenema, Henk Zijm,, 2017). This leads to the following hypothesis:

H2: Technology transfer capability is positively correlated with Operational performance

4.2.2 Effect of strategic performance on operational performance

Prior studies suggest that companies with a high level of R&D capabilities benefit from accumulating knowledge of related industry operational experiences. Therefore, they are in a better position than their competitors to improve their products (Mahmood et al., 2011; Wang and Chen, 2010). In addition, business groups with better R&D capabilities are more likely to adopt a low diversification strategy by developing standardized forms, procedures, and performance (Kor and Leblebici, 2005). Hence, the discussion of competitive advantage generated by technology transfer capability is in critical.

However, to review previous research, competitive advantage is perhaps the most widely used term in strategic management, yet it remains poorly defined and operationalized (Ma, 2000). Generic sources of competitive advantage include ownership of assets or position; access to distribution and supply; as well as proficiency – knowledge, competence, and capability – in business operations. It has also been further argued that in order to achieve and sustain competitive advantage, a firm needs to creatively and proactively exploit the three generic sources, pre-empt rivals attempt at these sources, and/or pursue any combination of proactive and pre-emptive effort. Since competitive advantage is the basis for superior performance, understanding the anatomy of competitive advantage is of paramount importance to general managers who bear the ultimate responsibility for a firm's long-term survival and success. This chapter thereby intends to discuss superior performance from ERBV perspective.

Alternatively, examining organizational competitive advantage from the ERBV is indeed crucial as it can be used as a conceptual guideline for business organizations in particular to enhance their competitive advantage position and performance via application and manipulation of identified internal and external organizational resources, capabilities and systems (Volberda, H. W., Van Den Bosch, F. A. J. and Boer, D. M., 1999; Vega-Jurado, J., Gutiérrez-Gracia, A., Fernández-de-Lucio, I., and Manjarrés- Henríquez, L., 2008). Such a research can contribute to the body of knowledge by lending empirical support and further extending the understanding of competitive advantage by examining the relative magnitude of importance placed upon transferor-transferee relationship towards attaining competitive advantage and enhancing firm performance.

Viewing technology transfer performance, Teece (1997) considered that technology transfer performance could be determined based on the costs incurred during a technology transfer. To evaluate transfer efficacy, Capron (1999) recommended measuring technology transfer performance based on the extent to which technologies are adopted in new markets, transferred and absorbed within industries, diffused to other industries, and modified according to meet specific requirements. Berger (1994) proposed three indicators for measuring the effectiveness of technology transfer: technology transfer output, quantifiable technology transfer activities, and intermediate indicators of cultural change. Hsieh (1993) divided technology transfer performance into four types of performance: initial transfer performance, corporate enhancement performance, profitability performance, and new product development performance. In addition to using objective data and subjective perception, a business can measure its technology transfer performance according to the degree to which an introduced technology achieves or satisfies the target. According to Lin (1999), objective measurements for technology transfer performance primarily include sales, profitability, defect rate, unit product cost, successful transfer frequency, and production time, whereas subjective measurements tend to involve comparative performance evaluations and personal perceptions.

It is obvious that the manifest variables cannot fully represent the constructs as applications of previous theories do not take into account the integration mechanisms. Accordingly, this chapter firm performance and then adopt ERBV perspective to restructure this construct (competitive advantage).

Effective performance measurement is the compass that guides management in a direction that will produce meaningful results at the process level, results that will tie directly to your company's goals. Also, critical success factors at the strategic level (Vision/ Target) must be linked clearly to the operational level (Actions). Firm performance can be divided into strategic performance and operational performance which are both vital to an organisation's success. Strategic performance (Long term) outlines companies' mission, vision, and high-level goals for the next three to five years whereas operational performance (Short term) is the focus on the near future. Operational performance is set out with strategic objectives in mind and provide a

means for management and staff to break down a larger strategic goal into workable tasks.

Accordingly, as with strategic performance, the operational performance also should be measurable and specific, though its focus is narrower. Simply put, strategic plan shares the firm's vision for the future, while operational plan lays out how you'll get there on a daily to weekly basis. That is, to be successful companies develop and link strategic objectives to the operational objectives and then use appropriate measurements to measure how your business is doing against those (Porter, 1995). As such, the author proposes that better strategic performance can produce better operational performance as the following research hypothesis:

H3: Strategic performance is positively correlated with Operational performance

4.3 Methodology

4.3.1 Data

In the present chapter, we aimed at addressing the question what the relationships between technology transfer capability and performance of the information technology and electronics industry are in Taiwan. In order to achieve this goal and to validate the research topic, the questionnaire was piloted on 30 managers in this information technology and electronics industry to ensure that the wording of the questionnaire expression is idiomatic and that the respondents understand the meaning of the questions in the questionnaire correctly. Subsequently, a total of 1000 questionnaires were emailed to top 1000 Taiwanese information technology and electronics companies are listed in the China Credit Information Service Incorporation. CEOs (Owner or Co-owner), Top-level Managers, and R&D Directors/ Managers from the list were individually contacted and invited to collaborate with the research team by assisting the researcher in the process of the sample collection.

After obtaining permission from these managers, data collection was carried out by disseminating a link to an online survey created and hosted on google (<https://forms.gle/PnNQeacteBwmTMtE9>) containing the study's main psychometric instruments. The data collection period spanned from February 28th to March 31st, 2019. During the data collection stage, the link of the study's survey was advertised on a weekly basis using the emails in order to have managers (respondents) to take part in

the survey. After clicking on the survey's link, respondents were redirected to the study's questionnaire and briefed about their right to remain anonymous and confidential.

This study validates the causation relationship between constructs using Structural Equation Modelling (SEM) with AMOS 23 in the data analysis process. Moreover, participants' eligibility was initially verified by asking if 1) they are in the Information Technology and Electronics industry (Technology Software & Services; Technology Hardware & Equipment; Semiconductors & Semiconductor Equipment Manufacturers); 2) they have had experiences of transferring technologies more 5 times in the past 3 years; and 3) they are managers in the Company. Those participants answering "no" to these questions are removed from the analysis. As a result, a total of 189 valid responses were retrieved, with a retrieval rate of 18.9%.

This chapter engages this classification standard to research. Compared with other industries, transferring technology in the information technology and electronics industry is relatively more difficult and complex because such technologies are highly knowledge intensive. Therefore, in this study, we will adopt Taiwan's entire information technology and electronics industry as the research population and acquire sample data to fit into the distributions of three sectors: 1) Technology Software & Services; 2) Technology Hardware & Equipment; 3) Semiconductors & Semiconductor Equipment Manufacturers. In order to understand the profile of the respondents and assess the representativeness of the samples, this paper conducts a sample structural analysis. The comparison against the population in the information technology industry database shows that these distributions are largely similar to those of the population. Therefore, the retrieved samples should be fairly representative. This helps the generalisation of research results obtained in this study.

Table 8 presents a demographic description for respondents in this study. As shown in this table, the majority of respondents in this sample are from Technology Hardware & Equipment sector (44.4%). Technology Software & Services sector and Semiconductors & Semiconductor Equipment Manufacturers sector are 29.1% and 26.5% respectively. 100% respondents have had experiences of transferring technologies more 5 times in the past 3 years. Among the sampled managers, 66.7% of them are R&D managers, 27.5% respondents are Top-level Managers, and 5.8% are

CEOs, reflecting one important characteristic of transferring technology in the information technology and electronics industry.

The thesis was approved by the ethics committees of the research team's institutions, and electronic consent was obtained from all participants as a requirement to partake in the present study. Furthermore, all procedures were followed in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration of 1975, as revised in 2005.

Table 8 Sample Structural Analysis

| Items | Classification | N | Percentage |
|--|--|-----|------------|
| Business Type | Technology Software & Services | 55 | 29.1% |
| | Technology Hardware & Equipment | 84 | 44.4% |
| | Semiconductors & Semiconductor Equipment Manufacturers | 50 | 26.5% |
| Number of Technology transfer experience as a transferor in the last three years | More than five times | 189 | 100.0% |
| Position within the Company | Owner or Co-owner | 11 | 5.8% |
| | R&D Manager | 126 | 66.7% |
| | Top-level Manager | 52 | 27.5% |

4.3.2 Measures

This chapter adopts the ERBV perspective and seeks to identify technology transfer capability that companies can resort to in the creation of competitive advantages in their technology transfer activities.

This chapter divides Technology Transfer Capability into Transfer Capability, Network Capability and Management Capability, which forms a model for exploring the linear relationships among the three constructs “Technology Transfer Capability— Strategic Performance — Operational Performance”. In addition, this paper divides Performance into two components: Strategic Performance and Operational Performance. According to the abovementioned literature and theories, this paper infers that Technology Transfer Capability has positive effects on Strategic Performance and Operational Performance. Meanwhile, Strategic Performance also has positive effects on Operational Performance. Therefore, the research model in this paper is constructed as shown in Figure 6.

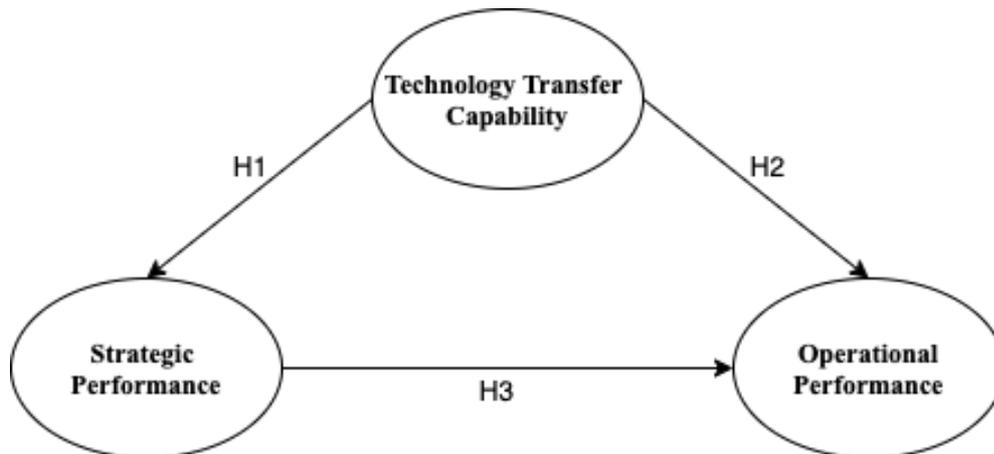


Figure 7 Conceptual Framework

This paper collects information using structured questionnaires designed with reference to relevant literature and the results of Chapter 3. After pre-tests and modifications, the questionnaire comes in three sections.

Section 1 measures Technology transfer capability with 14 questions.

As no consensus has been reached on the dimensions of TT capabilities, one way of deepening our understanding of this domain is to analyse the proposed or underlying dimensions of the identified TT capability constructs. We do so by examining the meanings attributed to TT capability constructs, including the related processes, in the analysed articles.

By examining content statements, three orientations can be identified: a management-oriented stream of research (coordination, control and management) (Draulans et al., 2003), a relationally oriented stream of research (structural and social integration focusing on interaction and trust) (Lorenzoni & Lipparini, 1999; Paulraj et al., 2008; Sivadas & Dwyer, 2000), and a transfer-oriented stream of research (alliance experience, training, and the learning process) (Berghman, Matthyssens, & Vandembemt, 2006; Kale & Singh, 2007).

Based on our review, we suggest that the available definitions and indicators cluster around three themes (Transfer capability, Network capability, Management capability), which we propose as the empirical research-based dimensions of Technology transfer capability. To assess the technology transfer capability, this

chapter adopted a scale consist of 14 items which adopted from interview results and the previous research by Rao (2002, 2004), Sarkis (1998) and Lamming et al. (1999)

The contents include the following:

- ***Transfer Capability:*** “In the process of scientific findings transfer, Transferors perform technology transfer for further development or commercialisation.” 1) My company creates compatible production philosophies and systems with transferees; 2) My company insists on accurate data collection with transferees; 3) My company hones core transferee’s technological capabilities; 4) My company builds transferee’s problem-solving skills; 5) My company develops a common lexicon with transferee; 6) My company uses rigid formats for sharing information with transferees. All these 6 items were rated on a scale ranging from 1 (strongly disagree) to 5 (strongly agree). The Cronbach’s alpha for the transfer capability measure was 0.950.
- ***Network Capability:*** “It refers to how close transferor- transferee relationship can be in the process of scientific findings transfer.” 1) My company has unofficial discussions and feedbacks with transferees pretty often; 2) My company goes to see how transferee’s work pretty often; 3) My company respects transferee’s capabilities; 4) My company commits to co-prosperity and exchanges best practices with transferees; 5) My company provides immediate and constant feedback for transferees. . All these 5 items were rated on a scale ranging from 1 (strongly disagree) to 5 (strongly agree). The Cronbach’s alpha for the network capability measure was 0.966.
- ***Management Capability:*** “It rrefers to transferors control and surprise ongoing training and development in the process of scientific findings transfer.” 1) My company has regular meetings with transferees; 2) My company sends monthly report cards to transferees; 3) My company has dedicated senior managers involved in solving problems with transferees. All these 3 items were rated on a scale ranging from 1 (strongly disagree) to 5 (strongly agree). The Cronbach’s alpha for the management capability measure was 0.933.

Section 2 measures Performance (Competitive advantage) with 10 questions

Performance can be viewed as unique and valuable resources that are owned by companies and cannot be duplicated (Barney, 1991; Coyne, 1986; Porter, 1985) because the competitive advantage of the firm can be understood as a function of the combined value and rarity of all firm resources and resource interactions. This paper further divides it into two components: Strategic performance (3 measurements) and Operational performance (4 measurements).

The questions are developed from interview results and the measurements of Hill and Jones (2001). The contents include the following:

- ***Strategic performance:*** “Strategic performance is generated by long-term organizational goals that help to convert a mission statement from a broad vision into more specific plans and projects.” 1) Compared with other companies in this industry, transfer technology can help my company have an advantage in client responses; 2) Compared with other companies in this industry, transfer technology can help my company have an advantage in Cost of Goods Manufactured; 3) Compared with other companies in this industry, transfer technology can help my company have an advantage in reputation. All these 3 items were rated on a scale ranging from 1 (strongly disagree) to 5 (strongly agree). The Cronbach’s alpha for the strategic performance measure was 0.940.
- ***Operational performance:*** “Operational performance is set out with strategic objectives in mind and provide a means for management and staff to break down a larger strategic goal into workable tasks (short term).”. 1) Compared with other companies in this industry, transfer technology can help to know better of our target customers and markets; 2) Compared with other companies in this industry, transfer technology can lower the risks; 3) Compared with other companies in this industry, transfer technology can have an advantage in innovation and improvement; 4) Compared with other companies in this industry, transfer technology can help to open up new business opportunities. All these 4 items were rated on a scale ranging from 1 (strongly disagree) to

5 (strongly agree). The Cronbach's alpha for the operational performance measure was 0.937.

4.4 Results

Structural equation model was used to analyse the survey data in this study. With respect to the data processing, the AMOS 23 software programme was used the conduction of the maximum likelihood estimation and data analysis. As the most widely adopted estimation approach in structural equation model, the maximum likelihood estimation was proved to be robust against violations of the multivariate normality assumption in parameter estimation (Iacobucci, 2009; Hair, Black, & Anderson, 2010).

A two-step procedure approach developed by Anderson and Gerbing (1988) was used in the data analysis process. This approach is concerned about conducting an estimation of the measurement model before the estimation of structural equation model. First of all, in order to test the discriminant validity of the measurement models, this study conducted confirmatory factor analysis on measurement models respectively. The results of confirmatory factor analysis indicated that measurement models fit the data well. Therefore, the series of confirmatory factor analysis supported the discriminant validity of measurement models. Further, this study conducted path analysis to examine the structural equation model empirically.

4.4.1 Measurement Validation

This paper conducts CFA to evaluate the reliability and validity of the measurements. Table 9 summarizes the results of the analysis. Three components were formed from the 14 items in the measurement scale of technology transfer capability. In terms of reliability of construct composites, Transfer Capability (0.950), Network Capability (0.966), Management Capability (0.933), Operational Performance (0.937), and Strategic performance (0.940) - all have ideal values greater than 0.7. Cronbach's alpha was used in the estimation of the internal reliability of each component. As discussed before, the Cronbach's alpha values of latent variables ranged between 0.933 and 0.966. And the exploratory factor analysis was conducted to examine the dimensionality of each component (Kishton & Widaman, 1994). The results of

exploratory factor analysis also provide support for the non-dimensionality of all the components. The ideal values of variance-extracted estimates of all the constructs are also greater than 50%. In terms of validity, all the t values of the estimated parameters in the measurement model are greater than 1.96, reaching the significant level of 0.05. This indicates that the measurements have good convergent validity. Moreover, this paper changes the free parameters of the constructs to restricted parameters in order to conduct Chi-square tests. The results show that the increase in Chi-square values of all the models are each far greater than the threshold value of 3.84. This shows that measurements all have good discrimination validity. Therefore, the research measurements have good construct effectiveness. In order to pursue robustness in a theoretical framework and empirical analysis, the measurements obtained by the questionnaires should carry sufficient reliability and validity. Reliability refers to the consistency or stability of the measured results. In the SEM analysis, indicator reliability, composite reliability and variance-extracted estimates are the indicators for reliability. Validity refers to the level with which measurement tools can effectively measure the items. Validity consists of content validity and construct validity. As this paper has made reference to the literature of relevant theories, expert interviews, and performed necessary modifications, it should carry content validity. Construct validity is examined using confirmatory factor analysis (CFA) by measuring the t value of factor loading of each question. If they are statistically significant, it means the questionnaire possesses construct validity. In sum, the research measurements in this paper have good reliability and internal consistency.

Table 9 Confirmatory Factor Analysis

| Item | Mean | Std. Deviation | Std. factor loading | C.R | P | Cronbach's alpha | Average variance extracted |
|--------------------------------|-------------|----------------|---------------------|-------|------------|------------------|----------------------------|
| Value | | | - | | | >0.7 | >0.5 |
| Technology Transfer Capability | 1.1 | 4.349 | 0.802 | 0.900 | 14.286 *** | 0.950 | 0.739 |
| | 1.2 | 4.392 | 0.606 | 0.830 | 13.086 *** | | |
| | 1.3 | 4.429 | 0.585 | 0.874 | 14.161 *** | | |
| | 1.4 | 4.206 | 0.789 | 0.916 | 14.19 *** | | |
| | 1.5 | 4.370 | 0.661 | 0.843 | 13.34 *** | | |
| | 1.6 | 4.318 | 0.656 | 0.789 | 12.08 *** | | |
| | 1.7 | 4.058 | 0.807 | 0.945 | 17.295 *** | 0.966 | 0.853 |
| | 1.8 | 4.042 | 0.778 | 0.934 | 16.976 *** | | |
| | 1.9 | 4.085 | 0.814 | 0.919 | 16.479 *** | | |
| | 1.10 | 4.074 | 0.782 | 0.932 | 16.832 *** | | |
| | 1.11 | 4.058 | 0.793 | 0.888 | 15.569 *** | | |
| | 1.12 | 4.143 | 0.689 | 0.850 | 14.35 *** | 0.933 | 0.827 |
| | 1.13 | 4.122 | 0.693 | 0.940 | 16.966 *** | | |
| | 1.14 | 4.206 | 0.672 | 0.935 | 16.806 *** | | |
| Competitive Advantage | 2.1 | 4.217 | 0.506 | 0.823 | 13.322 *** | 0.937 | 0.767 |
| | 2.2 | 4.191 | 0.641 | 0.857 | 14.236 *** | | |
| | 2.3 | 4.185 | 0.630 | 0.903 | 15.441 *** | | |
| | 2.4 | 4.143 | 0.606 | 0.918 | 15.877 *** | | |
| | 2.5 | 3.921 | 0.792 | 0.947 | 17.19 *** | 0.940 | 0.843 |
| | 2.6 | 4.058 | 0.766 | 0.865 | 14.765 *** | | |
| | 2.7 | 4.005 | 0.761 | 0.940 | 16.965 *** | | |

During CFA, convergent validity was indicated since all of the loading indicators shows significance (Hair et al., 2010). Also, the measurement model of Technology Transfer Capability rendered a good fit. To review the data, $\chi^2/df = 2.746$, p-value < 0.05, Goodness of Fit Index (GFI) = 0.893, Comparative Fit Index (CFI) = 0.964, and Root Mean Square Error of Approximation (RMSEA) = 0.096. Also, the measurement model of Competitive Advantage (strategic performance and operational performance) rendered a good fit as well. The result shows $\chi^2/df = 2.557$, p-value < 0.05, Goodness of Fit Index (GFI) = 0.952, Comparative Fit Index (CFI) = 0.985, and Root Mean Square Error of Approximation (RMSEA) = 0.091.

As shown in the Table 10, the CR values ranged from 0.929 to 0.967, meeting the standard minimum threshold of 0.70. To assess convergent validity, the AVE values must exceed 0.50. All the criteria were met during the study. Also, the goodness of fits from the overall measurement model was also indicated by the following indices: all of the loadings factors showed significance at p < 0.05, $\chi^2/df = 2.147$, and the Goodness

of Fit Index (GFI) = 0.864, Comparative Fit Index (CFI) = 0.959, and Root Mean Square Error of Approximation (RMSEA) = 0.078.

Finally, the correlations among the technology transfer capability (Transfer capability/ Network capability/ Management capability), Strategic performance, and Operational performance have a positive correlation.

The combination of these indices indicated a good fit of the measurement model since threshold values higher than 0.90 for the CFI and TLI and lower than 0.08 for the RMSEA indicate a good fit of the model. That is, the generated values were in the ranges of the acceptable thresholds and showed a good fit of the model to the data.

Table 10 Validity and Correlations of the Technology Transfer Capability (TTC) and Performance

| Factor | CR | AVE | Transfer Capability | Network Capability | Management Capability | Operational Performance | Strategic Performance |
|-------------------------|-------|-------|---------------------|--------------------|-----------------------|-------------------------|-----------------------|
| Transfer Capability | 0.944 | 0.739 | 0.8597 | | | | |
| Network Capability | 0.967 | 0.853 | 0.647 | 0.9236 | | | |
| Management Capability | 0.935 | 0.827 | 0.627 | 0.638 | 0.9094 | | |
| Operational Performance | 0.929 | 0.767 | 0.311 | 0.460 | 0.391 | 0.8758 | |
| Strategic Performance | 0.941 | 0.843 | 0.425 | 0.203 | 0.414 | 0.296 | 0.9182 |

Note: Chi-square= 360.736; DF=168; CFI=0.959; GFI= 0.864; AGFI= 0.814; TLI= 0.948; SRMR= 0.0542; RMSEA= 0.078 (90% CI=0.067~0.089); n=189

4.4.2 Structural Model Estimation

This chapter adopts the ERBV perspective and seeks to identify Technology Transfer Capability (TTC: Transfer Capability, Network Capability, and Management Capability) that companies can resort to in the creation of superior performance (Strategic Performance and Operational Performance) in their technology transfer activities. This chapter validates research hypotheses with SEM in order to examine the relationship of TTC with Strategic Performance, TTC with Operational Performance, and Strategic Performance with Operational Performance. The analysis results are shown in Table 11. The γ values are employed to validate the research hypotheses and t values are utilized to determine whether the relationships are significant. The model

fit is rather good (GFI = 0.864, AGFI = 0.814, $\chi^2 = 360.736$, df = 168, CFI = 0.959, RMSEA = 0.078).

Table 11 Correlation among Constructs

| Structural Path | Independent variable | Dependent variable | Std. factor loading | T-value | P-value | Acceptance/Rejection |
|-----------------|-----------------------|-------------------------|---------------------|---------|---------|----------------------|
| TC→OP | Transfer Capability | Operational Performance | -0.045 | -0.447 | 0.655 | Rejection |
| TC→SP | Transfer Capability | Strategic Performance | 0.389 | 3.883 | *** | Acceptance |
| NC→OP | Network Capability | Operational Performance | 0.373 | 3.627 | 0.073 | Rejection |
| NC→SP | Network Capability | Strategic performance | -0.341 | -3.3 | *** | Acceptance |
| MC→OP | Management Capability | Operational Performance | 0.181 | 1.793 | *** | Acceptance |
| MC→SP | Management Capability | Strategic performance | 0.305 | 3.074 | ** | Acceptance |
| SP→OP | Strategic performance | Operational Performance | 0.212 | 2.703 | ** | Acceptance |

Note: Chi-square= 360.736; DF=168; CFI=0.959; GFI= 0.864; AGFI= 0.814; TLI= 0.948; SRMR= 0.0542; RMSEA= 0.078 (90% CI=0.067~0.089); n=189

Further, figure 7 illustrates the path relationships of the research findings. The validation of the research hypotheses is as follows.

First, in respect of Hypothesis 1 Technology transfer capability is positively correlated with Strategic performance and Hypothesis 2 Technology transfer capability is positively correlated with Operational performance, this chapter analyses the relationship of Transfer capability with Performance and finds that there are 6 scenarios to illustrate Hypothesis 1 and Hypothesis 2.

The main reason to support the result is technology transfer capability is the various combinations of strategic resources formed by a transferor-transferee relationship. Therefore, we further explore the content and relationship between technology transfer capability and performance by dividing technology transfer capability into three components (transfer capability, network capability and management capability). Hence the data generates 6 scenarios between technology transfer capability and performance.

Transfer capability is positively correlated with Strategic Performance. Network capability is negatively correlated with Strategic Performance. Management capability is positively correlated with both Strategic Performance and Operational Performance.

In addition, concerning Hypothesis 3 Strategic performance is positively correlated with Operational performance, the result has been confirmed.

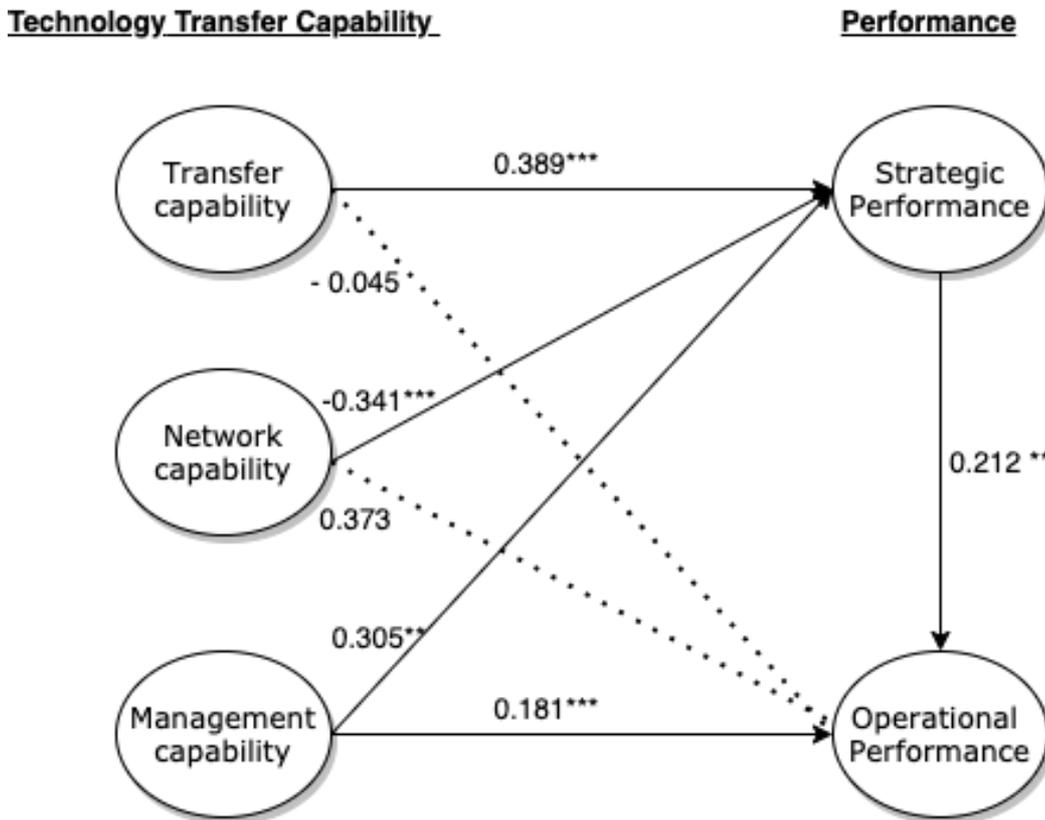


Figure 8 Conceptual Model Results

4.4.3 Test of Mediation Effects

In order to examine the mediating effect of Strategic Performance, three structural models were built in this chapter as Technology transfer capability has direct/ indirect/ partial impacts, three scenarios, (through Strategic performance) on Operational performance. Strategic performance, therefore, partially mediates the relationship between Technology transfer capability and Operational performance based on the capability of engaging in the process of technology transfer. The first model treats Strategic performance as a fully mediating role in the relationship between Transfer Capability and Operational performance. The Second model treats Strategic performance as a partially mediating role in the relationship between Network Capability and Operational performance. The third model shows there is no mediation effect among these three constructs (Strategic performance, Management Capability

and Operational performance). Therefore, hypotheses 1, 2 and 3 are supported and hypotheses 1, 2 could be argued that Technology transfer capability has different types of impacts on strategic performance and operational performance.

Table 12 Correlation among Constructs (Mediation Effects)

| Mediation Analysis | Std. factor loading | C.R | P | |
|--|---|---|-----------------|-------------------------|
| <i>TC→SP→OP Full Mediation</i> | | | | |
| TC→SP | 0.4 | 5.19 | *** | |
| TC→OP | 0.153 | 1.922 | 0.055 | |
| SP→OP | 0.204 | 2.529 | ** | |
| Mediation Analysis | Total Effect direct Beta without mediator | Direct effect-direct Beta with mediator | Indirect Beta | Mediation type observed |
| TC→SP→OP | 0.2340 0.008** | 0.1530 0.065 | 0.0820 0.01* | |
| Note: Chi-square= 147.185; DF=54; CFI=0.965; GFI= 0.893; AGFI= 0.820; TLI= 0.950; SRMR= 0.0703; RMSEA= 0.096 (90% CI=0.077~0.115); n=189 | | | | |
| <i>NC→SP→OP Partially Mediation</i> | | | | |
| NC→SP | 0.202 | 2.669 | * | |
| NC→OP | 0.365 | 4.933 | *** | |
| SP→OP | 0.194 | 2.728 | ** | |
| Mediation Analysis | Total Effect direct Beta without mediator | Direct effect-direct Beta with mediator | Indirect Beta | Mediation type observed |
| NC→SP→OP | 0.4040 0.001** | 0.3650 0.001** | 0.0390 0.01* | |
| Note: Chi-square= 84.755; DF=50; CFI=0.986; GFI= 0.931; AGFI= 0.893; TLI= 0.982; SRMR= 0.0578; RMSEA= 0.061 (90% CI=0.037~0.083); n=189 | | | | |
| <i>MC→SP→OP No Mediation</i> | | | | |
| Mediation Analysis | Std. factor loading | C.R | P | |
| MC→SP | 0.416 | 5.354 | *** | |
| MC→OP | 0.253 | 3.108 | ** | |
| SP→OP | 0.162 | 2.033 | * | |
| Mediation Analysis | Total Effect direct Beta without mediator | Direct effect-direct Beta with mediator | Indirect Beta | Mediation type observed |
| MC→SP→OP | 0.3210 0.001** | 0.2530 0.011* | 0.0680 0.05 | |
| Note: Chi-square= 59.666; DF=32; CFI=0.985; GFI= 0.937; AGFI= 0.893; TLI= 0.979; SRMR= 0.0509; RMSEA= 0.068 (90% CI=0.040~0.094); n=189 | | | | |

4.5 Discussion and Conclusions

Summary of findings

The resource-based strategic management philosophy of the firm has emerged in recent years as a popular theory of competitive advantage. Achieving a sustainable competitive advantage allows the firm to earn economic rents or above-average returns.

In turn, this focuses attention on how companies achieved and sustain advantages. From ERBV perspective, it emphasizes strategic choice, charging firm's management with the important tasks of identifying, developing and deploying key resources to maximize returns.

With a sample of listed companies in the Information technology and electronics industry in Taiwan, this study investigates the cause-effect relationship between elements of technology transfer capability and business performance (strategic performance and operational performance).

This chapter makes a number of contributions by extending the ERBV perspective to the field of Technology transfer. Previous studies on technology transfer have focused primarily on the involved transfer modes and transfer performance, whereas technology transfer capability has rarely been discussed. Furthermore, although numerous modes of technology transfer are employed worldwide, little research has taken a comprehensive perspective to investigate how technology transfer influences companies' competitiveness. Therefore, a conceptual framework regarding technology transfer capability and competitive advantages needs to be developed and tested empirically. Also, there are not enough empirical studies which clearly indicate manifest variables on adjusting resources, capabilities, as well as network ties, for measuring firm performance or competitive advantage altogether.

In sum, Technology transfer capability is the primary leading factor in which management should put the most effort. This study, showing how technology transfer capability affects business performance, provides some implications for management in Taiwan's information technology and electronics industry

This chapter develops research models and hypotheses on the basis of the literature review to explore the effects of technology transfer capability on business performance. This paper surveys information technology and electronics companies and validates the research models and assumptions with SEM analysis. The results of CFA show that the overall model fit is good. The measurements of all constructs have high reliability and validity.

This chapter validates the developed research hypotheses and finds the following: 1) Transfer capability and Management capability are positively correlated with Strategic performance, while Network capability is negatively correlated with

Strategic performance; 2) Management capability is positively correlated with operational performance; 3) Strategic performance is positively correlated with Operational performance; 4) There exists no significant relationship between Transfer capability and Operational performance. However, Transfer capability indirectly affects Operational performance through the mediating variable of Strategic performance; 5) Strategic performance partially mediated the relationship between Network capability and operational performance.

The analysis of validation on the causation relationship between constructs helps to shed light on the levels of impacts and paths among Technology transfer capability, Strategic performance and operational performance.

Management implications

The increasing demand for technology transfer is rapidly expanding throughout the global networks of supply and demand. In the future competition among various transferor-transferee relationship, at stake is their very survival. From the validation of the research hypotheses we gain the following knowledge:

First, the majority of previous studies argue that technology transfer capability helps to boost competitive advantages. However, such an argument is not entirely supported in this chapter. Rather, this chapter finds that since technology transfer capability is the various combinations of strategic resources formed by a transferor-transferee relationship, managers should utilise their transfer capability, network capability and management capability wisely to have superior performance.

Second, strategic performance management is a comprehensive approach to helping businesses achieve their goals. It begins with a company's strategic plan and goes from there all the way through to the operational plans. As Transfer capability can only be translated into operational performance through strategic performance, companies are unlikely to achieve workable operational objectives if they fail to effectively translate strategic objectives.

Third, this chapter has come up with this conclusion slightly different from previous studies. Most previous studies prove that in respect of network ties and competitive advantage, meeting customer needs on time, every time, is a significant route to achieving and sustaining competitive advantage, and training is a tool that

organizations should use to succeed at this. Also, most companies greatly enhance their capabilities through repeated interactions and the acquisition of skills between companies in the networks. However, we found that greater network capability does not directly contribute to the enhancement of operational performance. Rather, it indirectly affects the creation of operational performance through mediating variable strategic performance partially. In addition, as we know, strong ties are characterized by a greater degree of commitment and emotional attachment if a strong relationship connects transferors and transferees, the transferor is willing to spend more time and effort sharing what he knows with transferees. We, however, found the stronger network capability transferors have, the worse strategic performance will be. It means that TT cooperation can have counterproductive effects in the long term as strategic TT partnerships may contribute to resource homogeneity by facilitating asset flows. That explains why the greater network capability could hurt strategic performance.

Last but not least, being in a dynamic environment where technology changes constantly, the management of technology transfer requires not only knowledge for its core competency, but also the support of management knowledge in the relevant fields (Hansen, 1999). In particular, much of the current knowledge is highly correlated and interdependent, and the technology, the process, and the professionals involved, are more complex than before (Teece, 1998). Therefore, the possibility that managers take advantage of their management capability to manage the choice and achievement of resources during the design of the strategy and prior to its implementation is crucial. Under such circumstance, managers shall be able to establish the quantity and availability (access) of the resources both inside and outside the organization and then can establish the contribution to the improvement of the performance and the profitability. In that way, managers can utilise their management capability to evaluate strategic performance and operational performance in order for adjusting to best transfer way during the implementation of strategies. That is, if managers can properly manage, they will facilitate better collaboration with transferees. This will boost companies' competence in both strategic performance and operational performance. In other words, when companies work to enhance the management capability for their transferees, they can achieve better results in many ways.

To sum up, the most important element in the creation of superior performance is technology transfer capability. Therefore, companies nowadays increasingly involve transferees in the design process and technology development activities such as joint product development and joint technology sharing (Mol et al., 2005). These joint actions bind transferors to transferees. Transferors learn about the transferees' requests for products, culture, management practices and decision-making patterns, which enable them to adjust and apply their resources in the ways that have the greatest benefit (Vonderembse & Tracey, 1999). Relational capital not only facilitates learning through one-to-one interaction but also helps companies to balance the acquisition of new capabilities with the protection of proprietary assets between TT partners (Ghauri et al., 2005; Kale, Singh, & Perlmutter, 2000).

Contributions of this chapter

Based on the above research conclusions and management implications, this chapter makes the following contributions: 1) The development of reliable and valid measurements in the questionnaire on the basis of literature on theories; 2) The construction of the linear structural relationship model between constructs such as technology transfer capability and performance; 3) The survey on Taiwanese information technology and electronics companies who have transferred technology more than 5 times in the past 3 years, to validate research hypotheses in an empirical study; and 4) The research findings help companies understand how they should properly manage their technology transfer activities with external transferees to create superior performance.

Chapter 5 Conclusions and Contributions

This chapter summarises the main research findings, discusses their theoretical and managerial implications, acknowledges the research limitations and provides recommendations for future research.

5.1 Summary of Main Research Findings

Traditional RBV does not sufficiently explain the emerging use of TT in organisations. RBV assumes that the accumulated resources the firm owns and controls are the basis for the generation of competitive advantage. This proprietary assumption may result in an inaccurate evaluation of a firm's competitive advantage that externally delivered technology transfer has generated. Thus, researchers extended the resource boundary to external entities, to complement the limitation of traditional RBV. Compared with traditional RBV, ERBV can explain the gaining of competitive advantage in a more integrated manner. ERBV emphasises the network aspect of interconnected companies by conceptualising how companies can reinforce their competitive advantage in interorganisational settings. ERBV posits a dyadic network that exists between a focal firm and a partner, in the form of a strategic alliance or any other business relationship that contractual agreements specify.

Furthermore, going beyond such classic options as purchase and research and development, strategic alliances are a valuable means of acquiring new resources. Much of what is understood about technology transfer is based on communications and information-processing theory. However, despite the intuitive similarities, researchers have generally failed to explore the linkages in theory and process between 1) establishing and maintaining technology transfer and 2) acquiring competitive advantages. The purpose of this thesis was to develop a theoretical framework that permits exploration of the technology-transfer research field.

Technology transfer has helped companies in the Information Technology and Electronics industries (e.g. Technology Software and Services; Technology Hardware and Equipment; Semiconductors and Semiconductor Equipment Manufacturers) to gain and sustain competitive advantage. Whether technology transfer can effectively and rapidly assist with establishing competitive advantage is also a key concern among companies in Taiwan, whose technology transfer experiences reveal strategic

importance and meaning. How do companies in Taiwan gain competitive advantage via technology transfer? The need to develop a new management system, to cooperate with all parties to boost competitiveness and to avoid detrimental impacts from changes in the external environment becomes paramount. Consequently, the performance, mechanisms and prerequisites of technology transfer have become crucial topics for investigation.

Chapter 2 develops a more comprehensive theoretical framework from an ERBV perspective, explaining its importance and use in analysing and understanding technology transfer.

Following the general convention of RBV research, according to which industry structure effects are embedded in the static value of resources (Barney, 2001), the overall impact of network resources on the interconnected firm's competitive advantage can be conceptualised as the combination of internal and external resources. On the one hand, the internal perspective focuses on resources and capabilities as internal sources of uniqueness that allow companies to beat the competition. On the other hand, the external perspective focuses on the structure of the industry and how companies can position themselves within the industry for competitive advantage. The ERBV bridges the internal and external perspectives, providing a third perspective of competitive advantage, which helps to explain how resources leverage TT strategy and competitive advantages within the strategic transferor-transferee relationship.

Developing the theoretical model from ERBV proceeds by formulating the competitive advantage of an interconnected company participating in a single dyadic-alliance TT relationship. To relax the proprietary assumption of RBV, we allow the partner's resources to influence the competitive advantage of the focal company. When a strategic TT alliance is formed, different degrees of convergence may exist between the resources of the focal company (transferors) and those of its partner (transferees). Moreover, transferors and transferees endow this alliance with a subset of their resources, expecting to generate common benefits from the shared resources of both parties. Therefore, each company possesses a subset of shared/nonshared resources that together form the company's complete set of resources.

The proposed theoretical framework overcomes a limitation of traditional RBV with its focus on resources that a single company owns or controls. It incorporates the

notion of external resources that play a role not only in the evolution of TT networks but also in shaping the competitive advantage of interconnected companies. Moreover, the framework extends prior research on joint value creation and proposes mechanisms of value creation in dyadic alliances, in which interactions, combinations and complementarities across the resources of the company affect internal resources. Overall, participation in strategic TT partnership can either benefit or impede a firm's quest for resources. By extending the RBV, this study advances an ego-network perspective and sheds light on the competitive advantage of interconnected companies.

Furthermore, the author proposes that ERBV represents the overlap between these theories, (RBV and NP) utilised to discuss various aspects of TT from the transferor's perspective. Therefore, ERBV emerges in response to the development of competitive advantage in situations where resources and capability are held beyond the boundary of the company. Since TT occurs through a set of dyadic ties between a transferor and a transferee, this chapter lists and discusses boundary conditions that must be satisfied in the integration of the ERBV. First, the theory can apply to a stable environment; second, managers' influence on creating sustained advantage is limited; third, causally ambiguous resources are quite difficult to understand; last (but not least), network resources are embedded in complex social systems.

Chapter 3 adopts the Case Study method to illustrate how resources drive technology transfer. In-depth interviews and field observations with industry experts and scholars produce qualitative data. The evidence the 12 case studies generate suggests that within the strategic transferor-transferee relationship, transferors develop technology transfer capability to improve their competitive advantage. The level of transferor involvement leverages the relationship between collaborative transferor-transferee relationships and technology-transfer capability. The findings suggest that leveraging strategic resources via the TT process delivers superior value, resulting in competitive advantages and corporate performance.

Also, from the ERBV perspective, this research identifies four different types of TT across twelve cases and explores how the relationship and the level of transferor involvement change in these four TT contexts: Transaction (LRLI), Instruction (HRLI), Cooperation (LRHI), Co-Prosperity (HRHI). Every organisation has a different resource base, including knowledge and level of experience; therefore, it develops a

variable competence level. To achieve a specific goal, organisations choose to perform technology transfer for receiving their complementary resources.

In terms of transferor-transferee interaction, these four themes vary according to the relationship with transferees, transferees' abilities and the level of transferor's involvement. With transferees with poor abilities, a transferor can choose either Transaction (LRLI) or Instruction (HRLI). Conversely, a transferor can promote Cooperation (LRHI) and Co-Prosperity (HRHI). With those characterising a contracted relationship (LRLI and HRLI), a transferor tends to fulfil his obligation without deep involvement, while LRHI and HRHI have frequent interactions. That is, the transferor assessing the TT strategy should take into account its relationship with transferees, how much involvement to seek and the transferee's ability. Also, with those transferees with poor abilities, transferors aim to enhance operational performance. Conversely, with transferees with mediocre or better abilities, transferors will seek strategic performance.

Forming a strategic TT partnership involves different degrees of convergence between the resources of the focal company (transferors) and the resources of its partner (transferees). Moreover, transferors and transferees endow this partnership with a subset of their resources, expecting to generate common benefits from the shared resources of both parties. Therefore, each company possesses a subset of shared/ non-shared resources that together form the company's complete set of resources. The arrangement can be a pooling alliance with substantially intersecting shared resource sets, in which transferors and transferees pool their resources to achieve greater scale and enhance competitive position in their industry. In contrast, a relatively small intersection, the alliance signals a complementary alliance of companies seeking to achieve synergies, employing distinct resources difficult for any individual company to accumulate.

Also, in this competition and a short-product-life-cycle environment, effective TT requires companies to combine and integrate internal and external knowledge. To create value via TT activities, transferors should be able to 1) gain transferees' trust and confidence; 2) understand the transferees' needs and adjust the transfer method to meet those needs; 3) solve problems; 4) evaluate the transferees' abilities and apply the right strategy to co-work with them.

Chapter 4 reports on the structured questionnaire survey mailed to top executives (CEOs, Top-level managers or R&D directors) in Taiwan's Information Technology and Electronics industry, to acquire information to support understanding the actual conditions of these constructs and the relationships between technology transfer capabilities and competitive advantage. A total of 1,000 questionnaires were mailed to the top Taiwanese information technology companies listed in the China Credit Information Service Incorporation. To verify the research hypotheses, structural and measurement models were established to test the causal relationships among the variables. Hence, the chapter adopts structural equation modelling (SEM) to justify the relationships between technology-transfer capabilities and performance.

This chapter validates the research hypotheses and finds: 1) Transfer capability and Management capability positively correlate with Strategic performance, while Network capability negatively correlates with Strategic performance; 2) Management capability positively correlates with operational performance; 3) Strategic performance positively correlates with Operational performance; 4) No significant relationship exists between Transfer capability and Operational performance; however, Transfer capability indirectly affects Operational performance through the mediating variable of Strategic performance; 5) Strategic performance partially mediates the relationship between Network capability and Operational performance.

5.2 Theoretical Contribution and Implications

This thesis investigates and integrates previous work into a conceptual framework of industry technology transfer using technology-transfer strategies. The study's contribution rests in the extension of the RBV and the ability to move beyond the traditional perspective that provides a limited account of a firm's competitive advantage in networked environments. Instead of applying traditional RBV research in an attempt to provide a theoretical explanation of the phenomenon of Technology Transfer, this thesis revisits the theoretical underpinning of the RBV by considering the implications of TT networks. It reveals how interconnected companies can extract value from resources that transferors do not fully own or control. By integrating and elaborating previous studies, it identifies firm-specific, relation-specific and partner-specific factors that determine the capacity to appropriate resources.

This thesis also proposes the ERBV perspective to help explain that interconnected firms in a dyadic relationship would combine external as well as intrinsic resources in the development of focal-firm competitive advantage. More precisely, transferors transfer technology to help transferees create a bundle of resources unavailable to competitors because they have information advantages resulting from sharing complementary and additional resources through TT partnership. More importantly, we list boundary conditions associated with the theory. First, the theory requires a stable environment; second, the manager's influence on creating sustained advantage is limited; third, causally ambiguous resources are quite difficult to understand; last, network resources are embedded in complex social systems.

Moreover, we present quantitative and qualitative evidence on technology transfer within Taiwan's Information Technology and Electronics Industry. From a methodological perspective, the study employs a mixed method to explore complex interdependency among multiple technology-transfer mechanisms and demonstrates the asymmetric causality between transferor and transferee. More specifically, multiple configurations reveal the configurations of the elements constituting constructs and how these components contribute to construct development. Hence, the thesis provides a more holistic understanding of technology-transfer configurations.

In sum, the thesis contributes to the existing literature in three ways. First, it not only finds the missing link and mechanism of TT but also contributes to theory development in technology transfer research, by extending the RBV-NP perspective. This understanding of technology transfer is new and the first contribution to theory. Second, this thesis proposes this conceptual framework for technology transfer from the transferor's perspective, contributing to theory development via a case study. Third, it theoretically and empirically assesses the impact of technology-transfer capability on competitive advantage, via a questionnaire survey. This thesis uses qualitative and quantitative (mixed method) methodology to test this theoretical framework, refining the framework and showing its applicability and usefulness. Especially, researchers on theory integration, the perspectives of ERBV and TT strategy can gain important benefits from some of this study's potential contributions.

5.3 Management Implications

Given that Taiwan's technology transfer experiences show strategic importance and meanings, we consider Taiwan's Information Technology and Electronics industry (Technology Software and Services; Technology Hardware and Equipment; and Semiconductors and Semiconductor Equipment Manufacturers) as the research focus.

This research effort represents a significant step in addressing the impending issues within technology-transfer management. It proposes a critical theoretical framework that 1) draws on suitable theoretical perspectives, 2) describes the strategic resources that companies extract from the internal and external resources of a dyadic partnership and 3) clarifies the relationship among the constructs from an ERBV perspective and determining the causal relationships among them.

The proposed framework identifies corporate technology-transfer strategy, relationship with transferees and the level of transferor involvement as key driving forces for the successful development of technology-transfer management (TTM) practices and their subsequent impact on strategic and operational performance. Subsequently, the thesis identifies various propositions to facilitate future research efforts in this budding area of research.

By eliciting the underlying theoretical framework, this research project brings to light the corporate strategic direction and TTM practices that will lead to sustainable competitive advantage. The implications of this study are expected to significantly impact academicians as well as practitioners. In its entirety, this study will provide a better understanding of the various critical elements of TTM and their effect on corporate performance. The proposed framework will be of great value not only to readers who desire to extend their research avenues into this exciting area but also to those who have already investigated this topic in isolation or with limited scope.

Specifically, this study is expected to make many contributions of great interest to technology-transfer professionals and researchers, including 1) verifying the importance of corporate environmental orientation and its impact on TT strategy and TTM; 2) providing a better understanding of the relationship between strategic resources, transferor-transferee relationship, technology-transfer management and performance; 3) studying the importance of aligning technology-transfer strategy with business strategy; 4) providing an integrated research framework that will facilitate a

well-grounded and robust basis for theoretical development of alternative models, allowing researchers to test relationship validity among the various technology-transfer initiatives, along with their impact on strategic and operational performance.

5.4 Research Limitations and Future Research Recommendations

The main theoretical perspective of this thesis, ERBV, suffers from some limitations regarding the static value of resources. Future research may incorporate dynamic perspectives, to address these limitations in the context of complex and networked environments. For instance, relaxing this thesis's constraints could occur by taking a dynamic approach rather than focusing on dyadic interactions. Finally, previous studies provide ample evidence of the contribution of TT partners to company performance. However, those studies do not focus on a comprehensive investigation of ERBV. Thus, future research should test the extended model and identify the contingencies associated with the various sources of competitive advantage.

Theoretically, we add to the existing literature on the interaction between transferor and transferee, by explicitly studying TT activities from the perspective of ERBV. We show that technology-transfer activities can benefit transferors. However, we might collect dyadic data to align the conceptualisation and empirical investigation of TT. The transferee's perspective merits examination.

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Appendix 1 Research Ethics Form

Proposal form for ethical review of research projects

This form is designed to guide the ethics approval processes of research projects carried out by staff and PhD students in the Department of Management at Birkbeck. There is a separate form for students on undergraduate and taught Masters programmes. There is a separate form for the ethics approval processes of funding applications.

The purpose of this form is to make sure that you as a researcher, your research participants and the College are safeguarded. Please think carefully about each of the questions and give as much information as possible about what your research with human participants or data from human participants will involve.

If this is a joint research project across Departments / Schools within Birkbeck or with partners in another UK HEI, only the principal investigator is required to submit a form. If you are part of an international research team, please submit a form to your Departmental Ethics Officer.

No research with participants may begin before ethics approval has been granted.

Your details

| | |
|---|--|
| Name of researcher(s) | Yiteng Chiang |
| Contact email(s): | jitedison@gmail.com |
| Academic status (i.e. staff or PhD student) | PhD student |
| Name and contact email of supervisor (if you are a PhD student) | Dr Qian Guo q.guo@bbk.ac.uk Professor Xiaming Liu xiaming.liu@bbk.ac.uk |
| Proposed start date | 2017 Feb |
| Funding source (if any) | |

Your project

| | |
|--|--|
| Title of your project: Understanding Technology transfer: An Extended Resource-Based View | |
| What is your main research question (brief abstract of your project)? | |
| <p>This thesis integrates Resource-Based View (RBV) with Network Perspective (NP) as Extended Resource-Based View (ERBV) to understand the phenomenon of technology transfer. The whole thesis aims at answering how ERBV explains the mechanisms of technology transfer as well as applies to this research field.</p> | |
| How will you collect your data (e.g. questionnaires, interviews, group discussion, experiments, observations)? | |
| <p>Qualitative and quantitative methods will be employed to collect primary data.</p> <p>Qualitative data will be acquired through in-depth interviews with industry experts and scholars. The interviews will be aimed at clarifying the nature of transfer–transferee partnerships in the information technology and electronics industry and how such relationships are influenced. The questionnaire will be built up based on the literature reviews and findings of interviews. A structured questionnaire survey will be mailed to top executives (CEOs, Vice presidents of alliances, Top-level Managers, or R&D directors) of information technology and electronics companies to understand the actual conditions of these constructs.</p> | |
| Are you involving an external body (e.g. a company, charity or HE institution) in your data collection or for access to participants? | |
| Nope | |
| If this is an application for approving a modification, please provide the title and date of your initial application. | |
| Title: Yiteng Chiang BEI-Management ethics form MPhil PhD 0213 | |
| Date: 2017 Feb 13 th | |

Your participants

| | |
|------------------------------------|---|
| Who are your participants? | top executives (CEOs, Top-level Managers, or R&D directors) of information technology and electronics companies |
| How will participants be selected? | <p>This thesis will be composed of two stages: The data collected in the first stage, from interviews, complies with the criteria 1) must be a leading company (Top 10) in its sector; and 2) has experiences of transferring technologies more 5 times in the past 3 years. The data collected in the second stage, from a total of 1000 mailed questionnaires, is top 1000 Taiwanese information technology and electronics companies listed in the China Credit Information Service Incorporation.</p> |

| | |
|---|---|
| <p>How many participants are planned?</p> | <p>There are 12 case companies in the first stage and a total of 1000 companies in the second stage.</p> |
| <p>Are you involving staff or students of Birkbeck, or others closely related to Birkbeck, in your data collection?</p> | <p>Nope</p> |
| <p>Are you recruiting participants from the Internet?</p> | <p>All participants are from the firm lists of China Credit Information Service Incorporation. A face to face semi-structured interview will be carried out at the first stage of the study. The interview will be audio-recorded or note-taken. Regarding 2nd stage participants, they will receive an invitation email or message with an online survey link.</p> |
| <p>If, yes, does your Internet research take place in a private or public internet space?</p> | <p>For online survey forum, it's private for selected participants only</p> |
| <p>If, yes, have you considered relevant legislations around unsolicited contact?</p> | <p>All consequences have been taken into account. First of all, it's not against the laws in Taiwan. Second, all contact information is actually from the dataset of the China Credit Information Service Incorporation. Moreover, all participants will have a copy of an information sheet which clearly state the following: Information on the nature of the research (the purpose of the study, who is being invited to participate and why?), research procedures (the nature and length of the interview as well as the place and the time), possible risks and benefits of the research, level of anonymity and data confidentiality, contact information (details on whom to contact with questions about the research), withdrawal (the researcher will emphasize that participation is voluntary and that participants may withdraw at any time without giving any reason) and what will happen to the data that is supplied by the participant and how it will be protected. Also, respondents' contact details will not be passed onto anyone, nor used in the research. Aliases will be used in the final thesis to report on the findings. All data for analysis will be anonymised and will be accessed only by the research team (me, 1st and 2nd supervisors, translator (as the first language of the participants is Mandarin), PhD</p> |

| | |
|--|--|
| | examiners and a possible assistant in data coding) |
|--|--|

Briefly describe what participating in your study will involve:

My research is asking three research questions based on the main research question which are: 1) How can Technology Transfer be explained by an Extended Resource-Based View? 2) How do resources drive technology transfer in Taiwan? And, 3) What are the relationships between technology transfer capabilities and performance of Information Technology and electronics industry in Taiwan.

Are you using any forms, questionnaires, interview schedules or other materials to gather your data? If yes, please provide copies.

Informed consent

| | |
|---|------------|
| How will you explain to participants what will be involved in taking part in your study? | |
| - Information sheet distributed to each participant | YES |
| - Information sheet displayed on screen for all participants | YES |
| - Information included in header of questionnaire | YES |
| - Other (please provide details): | |
| Are you using any inducement or payment to take part in the study? YES | |
| If YES, please provide details. | |
| In order to encourage participation, £10-£20 vouchers will be offered to respondents, as incentives have been found to positively impact response rate and should not be viewed as problematic. | |
| Do your participants include minors (under the age of 16 years)? NO | |
| If YES, please provide details of how you will obtain informed consent from both the children and parents/guardians. | |
| Do your participants include vulnerable individuals or those with limited legal capacity? NO | |
| If YES, please provide details of who else will give informed consent. | |
| Will this study be conducted in a school or other institution where the researcher has a duty of care? NO | |
| If YES, please provide details of how you will obtain informed consent from parents or guardians. | |
| Does your project require institutional consent? NO | |
| If yes, please provide details on how you will obtain institutional consent. | |

Please provide copies of your information sheet(s) and consent form(s)

Confidentiality and anonymity

| |
|---|
| <p>Are you seeking to ensure confidentiality of information and the anonymity of your participants and their organisations?</p> <p style="text-align: center;">YES</p> |
| <p>If NO, provide details of what steps will be taken to ensure that participants understand and agree that their participation will not be kept confidential and the reasons why?</p> |
| <p>If YES, provide details of how will you ensure the confidentiality/anonymity of your participants:</p> <p>During data collection and analysis</p> <p>In the dissemination of your research (e.g. in essay, theses, talks, websites or research publications)</p> <p>There is a need for keeping data confidential as my research topic is related to technology transfer which could be sensitive to a certain case.</p> <p>Anonymity involves collecting research data in such a way that it is impossible to connect research data (e.g. responses, questionnaires) with the individual who provided the data. That is, personal identifiers are not collected.</p> <p>Interview data may not be collected anonymously but can be made anonymous after data collection. Therefore, all Interview data will be anonymised and will be accessed only by the research team (me, 1st and 2nd supervisors, translator (as the first language of the participants is Mandarin), PhD examiners and a possible assistant in data coding). That means I use interview dates and companies' names to code and save the recording files or notes on my laptop, google drive and a USB flash drive with passwords.</p> <p>Regarding online surveys for questionnaires data collection, participants will receive an invitation email or message with an online survey link. Also, they will be given an information sheet that they can keep and provided with an opportunity to ask questions about the project should they wish via emails or messages. Once they click the online survey link and fill out the questionnaire, that will be difficult to link personal information to subjects' responses.</p> |

Risk

| | |
|--|------------|
| Risk to the research participant/materials | |
| Does your research involve: | |
| - Sensitive topics (e.g. issues of discrimination, bullying and harassment, whistleblowing)? | NO |
| - Any procedure that might <i>inadvertently</i> cause distress? | NO |
| - Any procedure that could cause harm to the participant? | NO |
| - Unpleasant or emotionally difficult stimuli? | NO |
| - Unpleasant or emotionally difficult situations? | NO |
| - Actively misleading or deceiving the participants? | NO |
| - Withholding information about the nature or outcome of the study? | NO |
| If you answered YES to any of these questions please detail the steps you will take to additionally safeguard your participants. | |
| Does your research involve sensitive materials (e.g. diaries, letters, confidential papers)? | |
| My research does not have this issue. | |
| If your research involves minors or vulnerable individuals have you had the necessary criminal background check required? | |
| My research does not have this issue. | |
| Risk to the researcher | |
| Where will your investigation take place? | |
| Participants' companies | |
| Is the research environment potentially unsafe? | NO |
| If you answered YES please provide copies of your Fieldwork Risk Assessment Form | |
| If you are involving live participants, will you be alone with them? | YES |
| Will the investigation involve illegal activity or the discussion of illegal activity? | NO |
| If you answered YES to any of these questions please detail the steps you will take to additionally safeguard the researcher. | |
| Please refer to Fieldwork Risk Assessment Form | |
| Risk to the College | |
| Might the research raise media/social/legal concern in the public domain? NO | |

| |
|---|
| Could this research potentially compromise the reputation of the College? NO |
| Do you envisage needing help or advice in managing legal or media attention? NO |
| If you answered YES to any of these questions please provide details. |

Conflicts of interest

| |
|---|
| Is there a potential for a conflict of interest? NO |
| Are you involving participants to which you have access in a different capacity (e.g. through your place of work)? NO |
| If you answered YES to any of these two questions please provide details. |

Storage and dissemination of data

| |
|--|
| <p>How will your data be stored, transferred, transcribed?</p> <p>The data collected (MP3 files of the qualitative interviews, notes, content analysis, questionnaires, statistical analysis and consent forms) will be password protected and will be kept on the researcher's laptop and google drive. Also, there will be a copy in a USB flash drive for transferring or transcribing data.</p> |
| <p>How will your data be saved, shared and disseminated after the project is completed?</p> <p>All data for further use will be accessed only by me as promised to participants after the project is completed. Also, the data will be on my laptop, google drive and a USB flash drive with passwords.</p> |
| <p>Do you have a data management plan? If yes, please provide a copy.</p> <p>As mentioned in the information sheet and consent form, all data will be accessed only by the research team (me, 1st and 2nd supervisors, translator (as the first language of the participants is Mandarin), PhD examiners and a possible assistant in data coding). That means I won't make data openly accessible. Also, original data will be only saved on my laptop, google drive and a USB flash drive with passwords.</p> |

If you feel the proposed investigation raises other ethical issues please outline them here.

N/A

FOR COMPLETION BY THE RESEARCHER:

I have answered the above questions as fully and honestly as possible. **YES**

I agree to inform my supervisor/departmental ethics officer if there is any change to the research project detailed here and if my supervisor deems necessary will seek additional ethical approval. **YES**

I agree to carry out the study in an ethically informed way and to ensure that participants, researcher(s) and the college are safeguarded. **YES**

I agree to carry out the study in line with current Freedom of Information and Data Protection regulations, including storing and transferring data securely. **YES**

I confirm that the research conforms to expectations of ethical research in my discipline. **YES**

SIGNATURE of researcher:

Date: Nov 23th

Yiteng chiang

FOR COMPLETION BY THE DEPARTMENTAL ETHICS OFFICER (DREO):

I consider the application: routine / sensitive / extremely sensitive

2. If 'non-routine':

Please provide details of the ethical concerns briefly here:

SIGNATURE of DREO:

Date: 27 May 2020



Staff and PhD students' proposals for ethics review should be considered by the DREO. If the DREO considers the proposal to be routine then they can sign the form to indicate this and the research can begin. The exception is ESRC funded research which must be reviewed by the College Ethics Committee and cannot be signed off by the DREO. All non-routine proposals must be referred to BEI Ethics Committee by the D

Appendix 2 Fieldwork Risk Assessment Form

This form is designed to safeguard researchers carrying out fieldwork. It asks you to evaluate and rate the level of risk to you or your research participants that arise from your fieldwork. By carrying out a risk assessment you can direct attention and resources where they are most needed to prevent injury, ill-health and harm.

The five steps to carry out a risk assessment are:

1. Identify the risks - find out about the location, the work, where you will be staying, how you will be travelling etc.
2. Identify who might be harmed and how - think about risks to yourself and others in your team, and your research participants. People with health problems, disabilities or lacking experience in fieldwork may be at greater risk and need extra protection.
3. Think about harmful effects of your work on the environment and how these can be minimised.
4. Evaluate the risks (likelihood) and risk level (likelihood x severity) taking into account the present precautions and consider if and how the risk levels of harm can be reduced (if they need to be) - i.e what extra arrangements, equipment and training etc. will help to avoid harm?
5. Record your findings - on the risk assessment form below. This assessment should form the basis of safe working practices and local rules. Don't just fill in the form and forget it - make sure everyone in your team knows about the risks and how to avoid them.
6. Review and revise your assessment where necessary - you should do this when there are significant changes in work methods, location or people involved. Assessments should also be reviewed if there are accidents, near-misses or complaints associated with the work.

Your details

| | |
|---|--|
| Name of researcher(s) | Yiteng Chiang |
| Contact email(s): | jitedison@gmail.com |
| Academic status (i.e. staff or PhD student) | PhD student |
| Name and contact email of supervisor (if you are a PhD student) | Dr Qian Guo q.guo@bbk.ac.uk Professor Xiaming Liu xiaming.liu@bbk.ac.uk |
| Proposed start date | 2017 Feb |
| Funding source (if any) | |

Your project

Title of your project:

Understanding Technology transfer: An Extended Resource-Based View

Dates fieldwork is to be carried out:

2017 Feb 13th

Type of fieldwork (e.g. independent student project, research, supervised field trip):
Research

How will you collect your data (e.g. face-to-face interviews, observations)?

Face to face interview

Location(s) of fieldwork (e.g. country, region, organisation):

Participants' companies

Transport information including road arrangements:

Take public transportation

Your local contact details:

No. 1, Section 4, Roosevelt Rd, Da'an District, Taipei City, Taiwan 10617

+886 917558275

If the fieldwork is carried out abroad, is there a local mentor or other support?

Here are things I will do.

First, make sure I am at the right address and talking to the right person. Surely, know where the door is should I need to leave. Moreover, let my supervisor know when I arrive at the address. Also let my supervisor know when I leave the address. Last but not least, keep my mobile phone charged and keep it topped up with credit.

Risk assessments

| Description of risk and steps undertaken to mitigate risks (please provide as much details as possible) | Risk level (high, medium, low) |
|---|---------------------------------------|
| Physical risks (e.g. extreme weather or terrain) All companies are located in the city. Physical risks may seem like a low risk. I however will make sure that I am aware of the organisations fire procedures/ know where the building exits are/ ensure building exits are clear before starting to interview. | Low risk (1*2) |

| | |
|--|----------------|
| <p>Personal safety (e.g. lone working, attack on person or property.) If abroad check the Foreign Office's advice on the country.</p> <p>Since it's a firm level investigation, all selected companies are well-known companies. However, it's likely I may be subject to verbal abuse. As such, if I feel pressure/ presented with violence/ the threat of violence, I will then leave immediately.</p> | Low risk (1*2) |
|--|----------------|

SIMPLE RISK LEVEL ESTIMATION

RISK LEVEL = (A) POSSIBLE SEVERITY OF HARM FROM THE HAZARD X (B) LIKELIHOOD OF HARMFUL EVENT OCCURRING

(A) POSSIBLE SEVERITY OF HARM

1 = Minor harm (trivial injury; < 3 days off work)

2 = Moderate harm (> 3 days off work)

3 = Serious harm (death or major injury)

(B) LIKELIHOOD OF HARMFUL EVENT (taking control measures into consideration)

1 = An event that is unlikely to occur

2 = An event that has a reasonable chance of occurring

3 = An event that is likely to occur

*The likelihood of harm reduces with the precautions taken, e.g. training, planning, support.

A RISK LEVEL (A x B) OF:

6/9 = High Risk – The activity should not be carried out

4 = Medium Risk – Further precautions or controls are required to reduce the risk

2/3 = Low risk - Possibly no more precautions are required, unless (B) i.e. LIKELIHOOD is marked 2/3. If so, take action within a few days to reduce risk level by elimination or more controls.

Appendix 3 Consent Form



Consent Form Department of Management

Please read the following before participating in this research:

- I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.
- I understand I have the right to withdraw from the study at any time and to decline to answer any particular questions.
- I agree to provide information to the researcher(s) on the understanding that my name will not be used without my permission. (The information will be used only for this research and publications arising from this research project.)
- I agree/do not agree to the interview being taped.
- I agree/do not agree to the interview being video-taped.
- I understand that I have the right to ask for the audio/video tape to be turned off at any time during the interview.
- I agree to participate in this study under the conditions set out in the Information Sheet

Signed by:

The researcher:

Date:

The interviewee:

Date:

Appendix 4 Interview Information Sheet

Understanding Technology transfer: Extended Resourced-Based Theory

I would like to invite you to participate in this study which is part of my PhD research. I am inviting CEOs, and R&D directors who have the experience of transferring technologies more than 5 times in the past 3 years. Participation in this research is voluntary; choosing not to take part will not disadvantage you in anyway.

Please carefully read this information sheet, before you decide whether or not you would like to take part. Please feel free to contact me, if you would like to request more information.

The requirements of taking part:

If you decide to take part in this study, I will first discuss the interview procedure with you. After ensuring you are still willing to participate in this interview, you will be asked to sign a consent form and be arranged an interview in a private place (for confidentiality reasons) on the premises where you work.

The interview will last approximately 60 minutes depending on how much you would like to add to the topic. The interviews will ideally take place face-to-face at a mutually convenient time, although Skype is also an option. The interview should take place before 31th December 2017. The interview will be digitally-recorded, subject to your permission.

Participation is voluntary and you are entitled to refusing to answer any of my questions, and may withdraw from this interview at any time. You may also ask me to stop audio-recording the interview at any time.

Additionally, you may withdraw from participating in the study up to 1st January 2018. This means that your interview will be completely discarded from my analysis, and PhD chapter. After this date, it will however not be possible for you to withdraw from this research.

Confidentiality and Anonymity:

Please note that the interview will be audio-recorded for transcribing and analysis purposes and I will refer to you with your first name only during the interview. Your name and your company's name will be replaced with aliases in the transcripts and thesis. The interview transcripts and MP3 files will be password protected and will be kept on the researcher's laptop and a USB flash drive for a period of 5 years. This time-frame is deemed necessary to ensure the PhD thesis is completed in its entirety and defended.

In addition, the interview transcripts and MP3s will be accessed only by the research team (me, 1st and 2nd supervisors, translator (as the first language of the participants is Mandarin) and a possible assistant in data coding). The examiners of the PhD thesis may also have access to the interview transcripts.

The interview transcripts will be analysed using thematic analysis or content analysis. When quotations from the interviews are published, the researchers will check that in their best judgement quotes cannot indirectly lead to the identification of you or your organization. Besides, your contact details will not be passed onto anyone, nor used in the research.

The brief introduction of the research

The whole thesis consists of three technology transfer researches which are 1) How can Technology Transfer be explained by an Extended Resource-Based View? 2) How do resources drive technology transfer in Taiwan? And, 3) What are the relationships between technology transfer capabilities and performance of Information Technology and electronics industry in Taiwan.

After completing mentioned above research, the thesis will investigate and integrate them into a conceptual framework of technology transfer for companies attempting to implement strategies of technological transfer.

The intention of this study

Qualitative data will be acquired through in-depth interviews with industry experts and scholars. The interviews will be aimed at clarifying the nature of transfer–transferee partnerships in the information technology and electronics industry and how such relationships are influenced.

The design of this study

The data collected in this stage, from interviews, will be valuable in providing contextual knowledge regarding technology transfer’s strategic management. With regards to case-selection, this paper applies purposive sampling of information technology and electronics industry for interviews.

Based on the findings, this study develops strategies of technology transfer and a structured questionnaire approach. Also, these interviews will adhere to Birkbeck’s research guidelines of integrity to ensure that all standards related to informed consent, confidentiality and anonymity are met.

Contact details

If you have any questions or require more information about this study, please contact me using the following contact details:

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Thank you for taking time to read this information sheet and for considering taking part in this study.

Appendix 5 Semi-structured Interview

- Interviewee's background
-
- What is the activity related to Technology transfer recently?
 - Why is your company willing to share technologies with others?
 - How does your company choose the potential partner for doing technology transfer?
-
- How does your company perform Technology transfer?
 - Why does your company perform Technology transfer in this way?
 - How does your company control while doing Technology transfer?
 - Is there any way to improve?
-
- How does your company build and sustain the relationship with transferee?
 - Will Technology transfer be different in different channels or product development?
 - What are your partnership tendencies when choosing channels for transferring technology?
 - Will the Partnership tendency affect implementation process?
-
- What are the benefits of doing Technology transfer?
 - How do you evaluate the effect of the technology transfer?

Appendix 6 Questionnaire Information Sheet

Understanding Technology transfer: An Extended Resource-Based View

I would like to invite you to complete a short questionnaire which is part of my PhD research. I am inviting CEOs, Top managers, or R&D directors who have the experience of transferring technologies more than 5 times in the past 3 years and answer questions in relation to “What are the relationships between technology transfer capabilities and performance of Information Technology and electronics industry in Taiwan. You can choose to skip any particular question and exit the questionnaire without any information being recorded until you press the submit button at the end.

The questionnaire is anonymous and does not ask for your name or that of your organisation. I, my supervisor, and the markers of my project have access to your responses. All responses will be saved password protected on laptop and a USB drive for 5 years.

In the research report I will present responses in aggregated form using graphs and statistics.

If you have any questions or require more information about this study, please contact me using the following contact details:

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Appendix 7 The conceptualisation and measurement of Technology Transfer Capability and Competitive advantages

| Construct | Variable | Description (5 points Likert scale) |
|--------------------------------|-------------------------|---|
| Technology Transfer Capability | Transfer Capability | 1.1 My company creates compatible production philosophies and systems with transferees 1.2 My company insists on accurate data collection with transferees 1.3 My company hones core transferee's technological capabilities. 1.4 My company builds transferee's problem-solving skills. 1.5 My company develops a common lexicon with transferee. 1.6 My company uses rigid formats for sharing information with transferees. |
| | Network Capability | 1.7 My company has unofficial discussions and feedbacks with transferees pretty often. 1.8 My company goes to see how transferee's work pretty often. 1.9 My company respects transferee's capabilities 1.10 My company commits to co-prosperity and exchanges best practices with transferees 1.11 My company provides immediate and constant feedback for transferees |
| | Management Capability | 1.12 My company has regular meetings with transferees. 1.13 My company sends monthly report cards to transferees. 1.14 My company has dedicated senior managers involved in solving problems with transferees |
| Competitive advantages | Operational performance | 2.1 Compared with other companies in this industry, transfer technology can help to know better of our target customers and markets 2.2 Compared with other companies in this industry, transfer technology can lower the risks 2.3 Compared with other companies in this industry, transfer technology can have an advantage in innovation and improvement 2.4 Compared with other companies in this industry, transfer technology can help to open up new business opportunities |
| | Strategic performance | 2.5 Compared with other companies in this industry, transfer technology can help my company have an advantage in client responses 2.6 Compared with other companies in this industry, transfer technology can help my company have an advantage in Cost of Goods Manufactured 2.7 Compared with other companies in this industry, transfer technology can help my company have an advantage in reputation |