

## **The mode of competence development for Flat Panel Display: technology competence to market competence**

Peng-Jung Lin<sup>\*1</sup>, Ching-Kuei Kao<sup>1</sup>, Yan Tian<sup>1</sup>, Cathy Lee<sup>1</sup>

<sup>1</sup>*Department of Marketing, Bei-Jing Institute of Technology, Zhuhai, China)*

*\*Corresponding Author: Peng-Jung Lin*

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**Abstract:** Previous studies have illustrated that international business competence types should be developed sequentially (e.g. technologies promote markets, TPM); however, few studies have clearly indicated which type of competence a firm with limited resources should first develop to facilitate attaining other follow-up competence types. In practice, we observe contradiction that the international businesses adopt the market competence to transfer external firm's technologies (MPT). It is an interesting phenomenon that motives to resolve the gap between the theoretical argument and practice. This study explored whether a firm with limited resources should first develop technology. By longitudinally tracking two Taiwan Flat Panel Display (FPD) equipment manufacturers for 8 years and using the extended case method (ECM), the ideal competence development route for manufacturers was determined: to first exploit technology competence. This study indicated that the mode of international business competence development was determined by resource characteristics, learning mechanisms, and development routes. We found if firms possess improvement resources (IR) or social resources (SR), then they should apply an inside-out or outside-in routes; in other words, these firms should first exploit technology competence or explore market competence, and then apply the intra- or inter- OL mechanisms to facilitate attaining other competence.

**Keywords:** technology competence, market competence, resource-based theory, organizational learning theory, Small-Sized Firm

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### **I. INTRODUCTION**

In a dynamic environment, developing new types of international business competence to maintain corporate survival is a critical topic (Helfat and Winter, 2011; McGrath, 2001). For example, Wernerfelt (1984, 2011, 2014) proposed that the key factor influencing corporate diversification and growth is the resource development sequence rather than product development sequence. Danneels (2002) recommended that firms first attain technological competence and subsequently apply it to develop new products, thereby attracting new customers, creating novel markets, and harnessing customer competence. Levinthal and March (1993) reported that firms should first exploit their existing resources because doing so is more time- and cost- efficient than developing new resources. Thus, developing resources sequentially is critical for international business. Danneels (2002) briefly mentioned the sequence of developing technological and customer competence; however, most scholars have failed to illustrate competence development sequences.

Past research explored the development of firm competence mostly stressed on large organizations (Nonaka, Chia, Holt, and Peltokorpi, 2014; Wernerfelt, 2014). However, they do not give enough attention to international business constrained on the situation of limited resources, not to develop several competences simultaneously, and think how international businesses use previously competence to facilitate follow-up competence. Which competence shall prioritize to develop so as to build another competence for international business, accordingly, needs further study. Particularly, few empirical studies have focused on international businesses prioritize to develop necessary competence, promote another competence, and consider the strategic thinking over the characteristics, mechanism, and routes of interaction of international business.

The purpose of this study was to explore how international businesses utilize firm's limited resources, learning mechanism, routes, and prioritize to develop necessary competence for firm's survival. The research problem of this study is that international business constrained on the situation of limited resources, not to develop several competences simultaneously, and think how international businesses using previously competence to facilitate follow-up competence. And what thinking should be used for international businesses to choice of the fitness learning mechanism and routes.

This research by longitudinally tracking two Taiwan FPD equipment manufacturers for 8 years and

using the extended case method (ECM) compared dichotic successful route of competence development. We found that Neda (disguised name) possessing the characteristics of improvement resources (IR), develop technology competence first, and apply intra-organizational learning (intra-OL) mechanism and inside-out routes (IOR) to promote market competence (Technology Promote Market, TPM). Conversely, ARET (disguised name) has the characteristics of social resources (SR) (Alcacer and Oxley, 2014; Chittoor, Kale, and Puranam, 2014), develop market competence first, and execute inter-organizational learning (inter-OL) mechanism and outside-in routes (OIR) to promote technology competence (Market Promote Technology, MPT). The article concludes with noting the academic and practical application. Research limit and future research direction is offered as well.

## **II. LITERATURE REVIEW**

### **1. Definition of the resource-based view**

Penrose (1959) stated that only resources with unique characteristics can assist international businesses in generating profits. Additionally, Mahoney and Pandian (1992) reported that both tangible and intangible resources are corporate assets. Furthermore, Wernerfelt (1984, 2014) indicated that resources are the key to developing resource position barriers because they can assist international businesses in gaining relatively advantageous positions. Moreover, Barney (1991) asserted that corporate resources should possess the following characteristics to enable firms to generate sustained competitive advantages: value, rareness, inimitability, and nonsubstitutability. These scholars have emphasized that resource heterogeneity facilitates building a corporate competitive advantage. Regarding resource types, Noda and Bower (1996) proposed the concept of universal resources and indicated that their high adaptability and alternatively assist firms in continuously modularizing resources for competence development. Tsai and Ghoshal (1998) as well as Nahapiet and Ghoshal (1998) proposed the concept of social resources, which can produce social connectivity with external and internal organizational relationships to enable collaborations and generate opportunities.

### **2. Relationship between resources and competence**

Scholars following the RBV have varying opinions regarding methods of using resources to develop competence. Wernerfelt (2014) stated that international businesses should leverage their existing resources to establish resource position barriers, thereby developing new types of competence, placing firms in advantageous positions, and generating corporate competitive advantages. Danneels (2002) reported that applying existing corporate resources to develop new types of competence involves resource exploitation and greatly influences corporate competence development; Danneels (2007) also emphasized leveraging internal corporate resources to develop new types of competence; and March (1991) asserted that two types of resource exploitation and resource exploration, namely, internal and external resource configuration, are involved in exploiting corporate resources to develop competence. Internal resource exploitation is more beneficial to corporate competence development because less time and fewer resources are used for internal resource exploitation than for external resource exploration. Helfat and Peteraf (2003) emphasized a dynamic resource-based view and indicated that corporate competence development should focus on the evolving dynamic essence of resources over time and that the evolution of internal resources determines the direction of corporate competence development. Teece, Pisano, and Shuen (1997) reported that, to respond to external and internal environmental changes, firms should achieve business prosperity by creating, integrating, combining, and allocating resources. These scholars have stressed that developing internal and existing corporate resources is the key to developing corporate competence, thereby suggesting that the RBV is critical to the development of corporate competence.

### **3. Competence development**

According to the concept of developing competence through resources, previous studies have mostly focused on applying existing competence types to develop new competence types. For example, McGrath (2001) reported that a firm should increase its existing competence to enrich its corporate resource database and develop new competence types, thereby enhancing the international business's survival in a dynamic environment. Danneels (2002) emphasized that a firm should apply its existing internal resources to develop first-order competence, which can facilitate attaining second-order competence. Henderson and Cockburn (1994) divided competence into two levels: (1) component competence, which is generated by applying and combining existing competence types and (2) architectural competence, which further modularizes component competence to a higher level, thereby gradually developing corporate competence.

### **4. Learning mechanism and competence development**

Sinkula (1994) as well as Slater and Narver (1995) emphasized the three steps of organizational

learning: information acquisition, information dissemination, and information-shared interpretation. Specifically, information acquisition refers to the process by which knowledge is obtained; information dissemination refers to the process by which information from different sources is shared, thereby leading to new information or understanding for organizations; and information-shared interpretation refers to the process by which one or more types of knowledge or applications are generated after more commonly understood concepts.

Regarding the question of how to apply existing corporate resources to develop new types of corporate competence, scholars following OLT have proposed numerous benefits of organizational learning for corporate competence development. March (1991) emphasized exploitative learning, a concept that focuses on the reuse of existing and internal corporate resources and competence. Additionally, Danneels (2007) concluded that underused and existing corporate resources should be applied for executing exploitative learning to develop corporate competence. Furthermore, Barney (1991) indicated that efficient and effective corporate competence can be produced when firms apply controllable resources and competence to develop new types of competence. These scholars have emphasized that firms should execute organizational learning and develop corporate competence by using their existing corporate resources.

However, numerous other scholars adhering to OLT have indicated that learning is not restricted to internal corporate learning; instead, external resources can be integrated to achieve inter-OL. For example, Yannopoulos, Auh, and Menguc (2012) emphasized applying various learning types to improve and expand existing resources for corporate competence development. Exploration learning is an innovative and entrepreneurial perspective and approach that challenges corporate conventions (March, 1991). Inkpen and Dinur (1998) proposed that firms should effectively employ inter-OL from external corporate channels to explore innovation options. Additionally, Holmqvist (2003) reported that firms should no longer apply their internal corporate experience and knowledge as sources for learning; instead, firms should learn according to new approaches and concepts that are external to corporations. The aforementioned scholars have stressed using innovative approaches to explore learning opportunities as well as applying external corporate resources to engage in inter-OL and develop corporate competence.

### **III. METHODOLOGY**

This study employed the extended case method (ECM) for qualitative research to conduct in-depth interviews, observations, and a practical literature review of Taiwan panel equipment manufacturers. The two cases that served as dichotic samples facilitated conducting comparative analyses and extensive theoretical development (Glaser and Strauss, 1967, 2014; Strauss and Corbin, 1990). Additionally, the processes of corporate competence development were longitudinally tracked for 8 years to explore how this type of development was influenced by corporate resource characteristics, learning mechanisms, and development routes. This case study involving long-term comparative analyses offered abundant and detailed survey results and findings (Rouse and Daellenbach, 1999).

#### ***1. Brief introduction of the case company***

Neda Company (assumed name) is a panel equipment manufacturer located in the Central Taiwan Science Park. Established in 1978, Neda, which has 587 employees and earned a revenue of approximately NT\$561 million in 2014, provides automation devices for integrated circuit, semiconductor, flat panel display, and solar energy industries. Neda's automation technology is widely applied in equipment shipping and manufacturing in the photovoltaic and semiconductor industries. The key technology developed by Neda in recent years has been applicable to the research, development, and manufacturing of automation equipment in the high-tech industry; the details are provided in Table 1.

ARET is a company that offers machine automation and maintenance for cathode ray tubes (CRTs), SCs, ARET is a company that offers machine automation and maintenance for cathode ray tubes (CRTs), SCs, thin-film transistor liquid crystal displays (TFT-LCDs), and solar cell industries. ARET was founded in 1982, and had approximately 489 employees and \$424 million (in 2014) in annual sales at the time this study was conducted. In many ways, ARET has been a successful company. Its automation equipment, especially micro-drills, the entire factory equipment and pack/unpacking system, have been adopted extensively by leading optoelectronics firms in material moving and manufacturing.

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## **2. Interview data**

The present study employed the extended case method (Burawoy, 1991, 2014). Danneels (2002) asserted that adopting this method for collecting empirical data facilitates integrating, reconceptualizing, and extending theories, rather than creating theories. Burawoy (2014) also indicated that, because the extended case study method is used to compare theories and interview data and subsequently to compare concepts and theories, the two-cycle exchanges and intensive analyses thereby enhance data interpretation. The interview period of the present study was 8 years (from March 3, 2007 to April 30, 2015), during which 47 interviews were conducted. The presented interview information was retrieved from the interviews with those in charge of the company; the interviewed executives were from different departments (such as, departments of quality control, design, materials, and management), and various entities and people were also interviewed (authorities, research institutes, and clients). The interview lasted from approximately 45 minutes to 2 hours; numerous interviewees consented to the interviews being recorded, and those who provided key information were subsequently invited to confirm the correctness of the relevant interview information (Miller, Cardinal, and Glick, 1997). Jick (1979) reported that the restrictions of employing only one research method can be overcome by adopting various approaches to collecting different types of data. Thus, in addition to the interview data, corporate documents and files also served as abundant and diverse bases for theoretical development.

## **IV. FINDINGS**

In accordance with the research purpose, the research findings were classified into three parts: (a) technology competence and market competence, (b) technology competence to promote market competence, and (c) resource characteristics and selection of a competence development route. Each is discussed below.

### **1. Technology competence and market competence**

To theoretically interpret the technology and market competence of the research case companies, we extended the concepts of component and architectural competence proposed by Henderson and Cockburn (1994) and defined competence as a competence group formed by resources that can be continuously exploited or developed, in which a layer called composite competence is incorporated. The first layer, called component competence, refers to existing corporate competence. Additionally, the second layer, composite competence, is a group's unique composite competence developed by applying and combining existing types of corporate competence. Moreover, the third layer, architectural competence, refers to high-end architectural competence formed by further modularizing different types of composite competence. Thus, technology competence can be divided into three layers. The first layer, component competence, refers to existing corporate manufacturing skills and know-how ( $T_1$ ) (Wu, Wan, and Levinthal, 2014; Danneels, 2002). Furthermore, the second layer, composite competence, represents the research and designs ( $T_2$ ) (Walsh and Ungson, 1991) executed by applying and combining the various types of existing corporate manufacturing skills. Finally, the third layer, architectural competence, refers to the radical innovations in the processes and materials ( $T_3$ ) (Obloj and Zemsky, 2014) formed by further modularizing the research and designs derived from composite competence.

Market competence can also be divided into three layers of competence. The first layer, i.e., component competence, refers to personal (employees) relationship connections ( $M_1$ ) (Eggers, 2012, 2014), which indicate the existing and external social connections possessed by corporate executives. Additionally, the second layer, composite competence, refers to competitor relationships ( $M_2$ ) (Park, Srivastava, and Gnyawali, 2014; Kleinbaum and Stuart, 2014) formed by combining the existing and external social connections possessed by corporate executives in order to establish collaborative relationships with competitors. Finally, the third layer, architectural competence, refers to customer relationships ( $M_3$ ) (Engerman, and Rosenberg, 2014), which modularize the various competitor relationships into connections that extend beyond competitors to crucial clients. The distinction between technology competence and market competence is listed in Table 2.

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### **2. Technology competence to promote market competence**

This section demonstrates the interplay of resource characteristic impacts on firm's competence development, as well as the historical progress of the critical resource development. Based on the interview and the historical progress of Neda's existing resource, we found that Neda has the characteristics of improvement resources (IR)

and exploitation resource (March, 1991). They obtain advanced knowledge from intra-firm interaction by continuing to improve their existing resources. In other words, international businesses have historically progressed by exploiting improvement resources, and tend to prioritize developing technology competence, and then to promote market competence (TPM) (Nyberg, Moliterno, Hale, and Lepak, 2014).

### 2.1 $T_1$ to $M_1$

The key for  $T_1$  to enhance  $M_1$  is the intra-OL atmosphere and mechanism within the company, in which intradepartmental, interdepartmental, and personal knowledge should be employed to distribute technological knowledge to other departments, including the department of sales (Harvey, Palmer, and Speier, 1998). The aim was to employ the concept of exploitative learning to transfer the existing and internal corporate technological skills to the professionals and executives of all departments (information acquisition), thereby enabling these personnel to learn to provide in-depth services to clients (information interpretation). The learning network at Neda involved weekly formal departmental meetings, monthly cross-departmental meetings, intradepartmental apprenticeships, informal chats during meal times, and activities held during voluntary overtime working periods. Employees were encouraged to participate in these diverse meetings and activities to transfer interdepartmental professional technological knowledge (information dissemination). Subsequently, the knowledge could be transferred to clients outside the company, and the professional executive–client relationship could also be established. The executives' personal technological competence was sufficient to enable them to professionally interact with the technology licensors from the major foreign companies; specifically, professional technological competence was crucial for clients in engaging in long-term collaboration with the company. Director Tsai of the liquid crystal display group division (September 14, 2009) indicated the following:

*“We are all trained as electromechanical technicians. Our boss guided us in learning the series connection and structural alignment of electromechanical devices; even the staff of the Department of Sales had to have these skills. We removed and reinstalled the devices when they failed to meet our expectations and standards. For example, magnetic traction is used to manufacture the patent rollers used in cleanrooms, thereby preventing dust from forming on the roller caused by the mutual contact between the roller and the surface required for cleaning. We think ahead, and thus our clients naturally become more dependent on us.”*

### 2.2 $T_2$ to $M_2$

When the manufacturing skills supported the corporate competence in research and design, competitors naturally pursued a horizontal alliance and collaboration, thereby engaging in cooperation with the market competitors (Badaracco, 1991). In Taiwan, the common method applied for research and design ( $T_2$ ) to enhance competitor relationships ( $M_2$ ) is using strategic alliances derived from joint research and development (R&D) or capacity sharing. The premise of strategic alliances in joint R&D is that firms are required to possess design, research, and development competence to integrate various systems (Wernerfelt, 2011), thereby enabling further social interaction with competitors and facilitating competitor relationships. Manager Chi of the Department of Management (June 1, 2010) indicated the following:

*“When we integrated the methods we were familiar with, the product manufacturing processes sometimes became very smooth. For example, PIM [plastic injection molding] is developed through an integration of PMM [precision mold manufacturing] and IM [injection molding]. This integration achieved favorable effects and also drew the attention of our Japanese competitor, Shibaura Mechatronics Corporation, and we subsequently collaborated to develop sealing machines.”*

The following is a classic example of an intra-OL mechanism in which  $T_2$  enhance  $M_2$ : The department of precision machinery at Neda Company transferred relevant knowledge on injection molding and laser marking technology to the departments of integrated circuit and precision machinery (information acquisition), and the technical staff members at different levels from these departments jointly developed various types of systems (e.g., plastic injection mold components, automated semiconductor punching machines, and automated semiconductor laser marking machines) through the following interaction and joint learning channels (information dissemination): weekly meetings, monthly meetings, gatherings after work, and during free time when socializing with clients. These types of technology involved in new R&D (information-shared interpretation) attracted the attention of Neda's Japanese competitor Shibaura Mechatronics Corporation, which invited Neda to jointly develop new products. Director Zheng of the semiconductor department (February 20, 2014) reported the following:

*“Among our 600 employees, 300 are involved in R&D, amounting to the largest number of employees involved in R&D in the LCD industry in Taiwan. Discussions and interactions take place during regular meetings and in private. For example, once during our free time when we were socializing with our clients, we discussed how to assemble structures and develop precise systems and machines; subsequently, we returned to our office at midnight to draw the layouts. Because of our efforts and devotion, our competitors who previously*

*did not hold us in high regard are now more likely to pay attention to us.”*

### 2.3 T<sub>3</sub> to M<sub>3</sub>

Taiwanese equipment suppliers must be cost-effective and innovative in manufacturing processes and materials to be recognized in the global equipment supply chain, a process that may require a long-term commitment (Lin, Chen, Sher, and Mei, 2010). Using the strategy of applying breakthrough process and material innovations (T<sub>3</sub>) to facilitate forming customer relationships (M<sub>3</sub>), Neda satisfied its customers and reduced costs through modular innovations in manufacturing processes and materials (Danneels, 2002), thereby developing connections with its crucial customers. Deputy Director Huang of the department of sales development (June 24, 2008) addressed the following regarding strategies for using T<sub>3</sub> to enhance M<sub>3</sub>:

*“Our innovation in the plastic materials used for cleanrooms substantially elevated the dust-proof capability and cleanness of the coating machines, and that is why we are able to enter into and collaborate with the major clients of the panel and IC (integrated circuit) industries with favorable prices for our products.”*

General Manager Tsai (June 1, 2008) indicated the following:

*“When I was at a lecture given by Shin-I Lin in 2005, Kun-Yao Lee phoned me, hoping that our company could merge with Gallant Precision Machining Co., Ltd. to manufacture equipment supplied to local companies. Subsequently, we became the only company capable of offering services to the touch panel company TurnKey Linux, and the process equipment services we provided involved glass cutting, chamfer milling, adhesive residue scraping, washing, patching, lighting inspection, and packaging and shipping....”*

To create an intra-OL mechanism in which T<sub>3</sub> enhances M<sub>3</sub>, Neda management led innovative learning sessions. This innovative learning was developed on the basis of the existing LCD manufacturing technology as well as the hardware and software control technology (information acquisition). Specifically, General Manager Tsai, who is an innovator, led the departments of LCD, electromechanical engineering, and materials in person to encourage brainstorming among the staff in these departments (information dissemination), and the corporate war room gradually developed diverse process innovations such as the automatic optical and automatic test equipment (information-shared interpretation). For example, Neda Company collaborated with major companies such as Statinc Company.

*“With regard to our internal QDTCS spirit, our equipment quality and technology are weaker than those of the major international companies; however, we have advantages in product delivery and cost. We aim to use the existing materials (technology) in an attempt to try out different cooking methods (modules) and then offer new dishes (equipment) to our customers. Working overtime with the boss is stressful, and executing process improvements at midnight is tiring, but only by doing so can we accept red orders (accept orders at a loss), deliver black orders (profit from delivered orders), and collaborate with the major clients.” (Deputy Director Huang of the department of equipment, March 23, 2011)*

### 3. Resource characteristics and selection of a competence development route

When addressing the influence of resource characteristics on the selection of a competence development route, scholars following the RBV have all emphasized applying static resources to develop dynamic competence (Wernerfelt, 1984; Danneels, 2002; Helfat, 2000). The key to competence development is to first examine the existing resource characteristics and subsequently select the routes for corporate competence development. The corporate culture of Neda Company is focused on technological research, development, and innovation; in addition, its improvement resources can serve as a basis for developing an inside-out route (IOR) for corporate competence development. Through intra-OL and exchange, various levels of technological competence can be attained and subsequently applied to facilitate developing different levels of market competence. Director Shi of the automation business division (January 31, 2012) stated the following:

*“The founder of our company developed the first robot in Taiwan, and thus we can say that engineering is in our company’s DNA. The reason why our company is able to continuously develop to this day is greatly related to our initial mission: to compete with Japanese companies in automation technology!”*

Through the cases, we identified the sequence and mechanism for competence development. The priority for corporate competence development was determined by corporate resource characteristics. If a firm possesses improvement resources (IR), then it should follow inside-out route (IOR) of internal to external development. Specifically, technological competence should first be attained and then elevated through the intra-OL mechanism to create innovative products and new product markets, thereby driving the development of corporate market competence. If a firm possesses social resources (SR), then it should follow outside-in route (OIR) of external to internal development. Particularly, market competence should first be attained and then enhanced through an inter-OL mechanism to develop innovative resources and new types of product technology, thereby facilitating attaining corporate technological competence.

## **ACADEMIC APPLICATION**

Scholars following the RBV have emphasized examining the course of corporate growth from a resource-based rather than a competence-based perspective. On this basis, the present study offered a new perspective for research in the field of strategic selection that can especially benefit companies with limited resources. The concept of sequentially developing resources forwarded in this study was similar to the concept of resource allocation proposed in previous studies. Similarly, this study can serve as a reference for firms during corporate strategic development. When existing types of competence are applied to sequentially develop other competence types, including advanced competence (Danneels, 2002), decision-makers can select various routes and mechanisms for corporate competence development on the basis of the different routes derived from organizational learning mechanisms.

Scholars adhering to the RBV have indicated that, in general, corporate resources are not fully utilized (Penrose, 1959). The present study investigated an approach to maximizing the use of corporate resources: viewing corporate competence as a surplus for developing other types of competence. However, this approach has not been seriously considered in previous studies, and, by using the routes of competence development, the present study was the first to evaluate this approach. Statements from a few other studies (Wernerfelt, 1984; Danneel, 2002, 2007; Noda and Collis, 2001) related to the present study found a correlation among different types of competence development; nevertheless, the development mechanisms indicated in these previous studies have never been explored in detail. We integrated the RBV and OLT to investigate the corporate experience value derived from the various mechanisms on which different routes of competence development ultimately depend. Moreover, the RBV and OLT are correlated regarding resource allocation and competence transfer; specifically, a lack of basic resources may restrict competence development. Critical mechanisms and influences are also involved in the processes of resource allocation and competence transfer.

We also indicated the lack of literature on the mechanisms of competence development. The concept of resource allocation, which includes a transition from general resources to specific types of competence, was addressed to explore cases involving competence development. We supported the OLT-proposed concept of internal and external learning because only an appropriate information learning route can facilitate competence development, and the research results corresponded with those of March (1991). In addition to this concept, we also emphasized the importance of the mechanism for competence development, for which the connection between resources and competence was not necessary but sufficient and for which the relevant mechanism was necessary and sufficient. In addition, competence was not completely developed on the basis of endogenous variables; numerous routes required external environmental stimuli. With regard to information management, this study also revealed the segmentation between information exploration and application. To address the importance of knowledge management in strategy studies, future researchers should consider viewing a firm as a bundle of capabilities or knowledge as a critical perspective for developing the following, all of which are crucial for corporate growth: cross-departmental or cross-organizational strategic knowledge management, competence development groups, and interdisciplinary platforms for competence and knowledge enhancement.

Firms possessing improvement resources should employ the route from internal to external development; specifically, these firms should first develop intra-firm technological competence to promote the continuous exploitation of internal corporate resources and development of new types of competence, thereby facilitating the attainment of external market competence (TPM). Leonard-Barton (1995) and Conner (1991) reached similar conclusions, emphasizing that a firm should first develop its existing corporate technological resources and then develop its new product markets; in other words, a firm should develop sequentially: It should first invest technological resources to attain market resources and then follow an inside-out corporate development route. Danneels (2002) indicated that a firm should employ its existing technology competence to service its new customers and markets, a process that symbolizes the following: internal to external development, sequential competence development from technological to customer competence, and application of technological competence to facilitate attaining customer competence. Rothaermel and Deeds (2004) reported that a firm with superior technology competence should commit to exploiting its manufacturing and marketing resources to benefit its promotion of commercialized products and new market development. This finding is similar to that proposed in the present study: technology competence should be applied to facilitate and promote market competence development.

Danneels (2002, 2007) regarded using corporate resources as critical for attaining corporate competence. The present study concluded that leveraging and utilizing internal corporate resources are the key to corporate competence development and indicated that connecting external corporate resources is another option for developing corporate competence.

## V. LIMITATIONS AND FUTURE RESEARCH

Researchers and firms intending to apply the results of this study should note that the resources were only divided into two categories according to the characteristics of the cases and that the research on competence route development merely explored technology and market competence. The relationships among other types of resource competence as well as other development routes and mechanisms can be discussed in follow-up research. Future studies can also consider extending the research on firm competence development to corporate alliances (Lane and Lubatkin, 1998) as well as to corporate mergers and acquisitions (Eisenhardt and Martin, 2000; Karim and Mitchell, 2000). To date, the confirmable research on corporate growth suggests that the key to this growth is balanced development and connections between existing and new competence types (Floyd and Lane, 2000; Holmqvist, 2003). This study constitutes preliminary research in the strategic research domain, and follow-up studies can conduct in-depth investigations on the applicability of different competence development routes and correlations among resources. Identifying existing competence types (resources) is an unpredictable process. In addition, various types of situational constraints are involved in the routes and mechanisms of competence development, and implementing relevant systems and coordinating organizational structures and cultures are challenging; all of these problems merit investigation in future research. The results of this study were limited by the strong intuitive and conceptual ideas involved in the cases; thus, future researchers may consider employing quantitative methods to verify the research results.

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**Table 1.** Case company

Company	Service Items	Time of Establishment	Number of Employees/annual sales in \$ million NT dollars	Research period
Neda	Robot design, robot application, automation skill, moving system, processing machinery, clean room equipment design, and control system application	Since 1978 32years	577/5.4	3 <sup>rd</sup> , Mar, 2007 to 30 <sup>th</sup> , Apr, 2015
ARET Company	Automation equipment, micro-drill the entire factory equipment, micro-drill, robot design, and pack/unpack system	Since 1982 28years	489/4.25	

**Table 2** Technology competence and market competence

patterns	Technology competence	Market competence
Architectural competence	Manufacturing and material radical innovation(T <sub>3</sub> )	Relationship with customers(M <sub>3</sub> )
Composite competence	Research and Design(T <sub>2</sub> )	Relationship with competitor(M <sub>2</sub> )
Basic competence	Manufacturing know-how(T <sub>1</sub> )	Relationship with employees(M <sub>1</sub> )

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