



Research Paper

## Firm's Resource Characteristics and Organizational Learning Mechanisms: Extended Case Study of Flat Panel Display

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**ABSTRACT:** This article reports the findings from examining the effect of a firm's resource characteristics on organizational learning mechanisms and learning routes. Thus, firms first decide on the sequence of organizational behaviors between technology competence development and market competence development in firms. We used the extended case method and long-term depth interview to compare 2 cases regarding the effect of resource characteristics on learning routes and intra- and inter-organizational learning behaviors. We found that firms possessing improvement resources develop technological competence first and apply them to intra-organizational learning to promote market competence. Conversely, firms that have social resources develop market competence first and incorporate them into inter-organizational learning to promote technology competence.

**Keywords:** technology competence; market competence; resource-based theory; organizational learning theory

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### I. INTRODUCTION

The emerging topic about adding new competencies to a firm's repertoire to maintain prosperity in a dynamic environment has become an essential focus of research (Vestal and Danneels, 2018; Helfat and Winter, 2011; McGrath, 2010; McGrath, 2001; Floyd and Lane, 2000; Helfat, 2000; Cooper and Smith, 1992; Leonard-Barton, 1992; Dierickx and Cool, 1989; Penrose, 1959). It is more challenging for small firms with limited resources and scale (Temponi and Pandya, 1995) to compete with large resource-sufficient firms because small firms are incapable of developing several competencies simultaneously. Therefore, small firms are devoted to prioritizing their development of the most valuable competence, and then combining the first competence to promote new competencies.

Previous research that explored firm competence has mostly emphasized the process of competence development. For example, Wernerfelt (1984; 2011) argued that the essential factor affecting firm diversification is the sequence of resource development, rather than the sequence of product development. The sequential development of new resources determines how the next new market emerges (Wernerfelt, 1984). Danneels (2002) argued that firms must develop technological competence first and apply technological competence to new products that address new customers and serve new markets. Danneels opined that technological competence is crucial for supporting the customer competence that ensues. Collis and Montgomery (1997) reported that a firm's development of competence is constrained by its current stock of resources and competencies, as well as by the speed at which it can acquire or accumulate new ones. These studies have emphasized that firms must develop competence sequentially. However, most research on learning and grow features the experience of large organizations have not paid adequate attention to small firms with limited resources that do not develop several competencies simultaneously. Firms should develop prioritized competencies before promoting follow-up competencies. Determining the competencies that small firms should prioritize for developing follow-up competencies requires further study.

### II. LITERATURE REVIEW

The conceptual framework of this study is based on field research and integrating scholarly literature regarding resource-based theory and organizational learning theory.

Resource-based scholars have focused on the dynamic characteristics of competence by questioning how resources and competencies evolve over time (Helfat, 2000). The concept of "dynamic capabilities" (Teece,

Pisano, and Shuen, 1997) called attention to the need for renewal of firm competence, particular in changing environments. Eisenhardt and Martin (2000) argued that competence renewal is a dynamic capability of a firm because of its ability to alter resource configurations. In brief, these scholars have noted that competence renewal is crucial to a firm because it is one of the mechanisms by which firms use, recombine, leverage, and reconfigure resources.

Wernerfelt (1984) argued that a firm's resources lead to different immediate insights, in contrast to the traditional product perspective. Furthermore, firms develop resource position barriers as competitive advantages by exploiting existing resources and exploring new ones within the firm and among firms. Priem and Butler (2001) suggested investigating the accumulation of resources and competencies from the RBT perspective. Danneels (2002) argued for applying technological competence to developing new products that serve new customers. Danneels (2007) examined how resources can be used to promote new competencies and showed that the delinking and relinking of resources are crucial activities that can expand the resource base of a firm, thus enabling the development of new competencies. Applying resource-based theory to investigate the priority of competence development routes, this study distinguished the intra- and inter- organizational learning behaviors between inside-out and outside-in routes, and explored the behaviors between both learning routes from the perspective of dynamic competence.

Based on organizational learning concepts, March (1991) showed how resource characteristics influence a firm's renewal route by applying exploitative and explorative modes of learning. In addition to offering the application of March's distinction to organizational learning, scholars (Kogut and Zander, 1992; Henderson and Cockburn, 1994) also present an additional classification: the concept of basic competence (i.e., a firm's existing repertoire), composite competence (i.e., exploitative learning), and architectural competence (i.e., explorative learning). Composite competence and architectural competence are more important because they are helpful for firms to escape the trap laid by leveraging current competencies. Therefore, it is important to add new competencies to the firm's repertoire for a firm's continued prosperity in a changing environment (McGrath, 2001). Danneels (2007) further suggested that current competencies may be used as leverage to add new competencies, thus referred to as "resource leveraging," by engaging in inter-functional coordination (Narver and Slater, 1990). Klerk and Havenga (2004) argued that firm growth can be pursued by transferring external resources or extending internal resources. These scholars have referred to firms incorporating new competencies by using and combining firm resources.

According to Floyd and Lane (2000), "strategic renewal requires both exploiting existing competencies and exploring new ones." A firm's competence development involves expanding resource exploitation and exploration over time (Floyd and Lane, 2000). Kaplinsky and Readman (2001) found that the competence development of small firms relies on the important vehicle of continuous learning. However, their research focuses only on using a firm's existing endogenous resources. They do not develop firm resources by combining exogenous resources. To incorporate intra- and inter- organizational learning is crucial to the development of a firm's resources by combining with endogenous and exogenous resources and competencies.

Sinkula (1994) and Slater and Narver (1995) stated that market-driven organizational learning is a function of a three-step process: information acquisition (**IA**) is the process by which knowledge is obtained; information dissemination (**ID**) is the process by which information from different sources is shared, thereby leading to new information or understanding; information-shared interpretation (**ISI**) is the process by which distributed information is explained in the context of more commonly understood concepts.

Danneels (2002) introduced "technological competence" as a type of capability enabling a firm to design and manufacture a physical product with certain features. It is constituted by such technically related resources as design and engineering skillsets, product and process design equipment, manufacturing facilities and skillsets, and procedures for quality control. We adopted the technological competence by Danneels (2002) and extended it to consist of basic, composite, and architectural competencies.

We reviewed market competence literature to extend the Danneels (2002) concept of "customer competence." According to Danneels (2002), customer competence enables a firm to serve certain customers. It is constituted by such market-related resources as knowledge of customer preferences, distribution and sales access to customers, reputation of the firm reflected in the its brands, and communication channels for exchanging information between the firm and customers during development and commercialization of the product (Danneels, 2002). Moreover, Narver and Slater (1990) proposed the concept of "market orientation" and suggested that market orientation consist of three behavioral components: customer orientation, competitor orientation, and inter-functional coordination. We synthesized the concepts by both Danneels (2002) and Narver and Slater (1990) to develop a new definition of market competence.

### III. THE EXTENDED CASE METHOD

We conducted a field study using in-depth interviews, observations, and documents as data sources from two TFT-LCD equipment providers, which varied in age, size, and the historical progress of resources. The research sites (Table 1) were selected to achieve a dichotic sample that provides many possibilities for comparisons and theory development that is more comprehensive (Glaser and Strauss, 1967; Strauss and Corbin, 1990). We compared firms that were different in their variety of resource characteristics, and that exhibited different behaviors of competence development. Rouse and Daellenbach (1999) called for a rich and detailed investigation of the nature of firm resources through comparative case studies.

**TABLE 1 RESEARCH SITES**

<b>Firm pseudonym</b>	<b>Areas of activity</b>	<b>Age</b>	<b>employees/annual sales in \$ billion NT dollars</b>	<b>Research period</b>
<b>NEDA</b>	Robot design, robot application, automation skill, moving system, processing machinery, clean room equipment design, and control system application	Since 1978 32years	577/5.4	3th, Mar, 2006 to 28th, Feb, 2014
<b>ARET</b>	Automation equipment, micro-drill the entire factory equipment, micro-drill, robot design, and pack/unpack system	Since 1982 28years	489/4.25	

We used the extended case method (Burawoy, 1991; Danneels, 2002, 2007; Vestal and Danneels, 2018) as a guide to analyzing and gathering empirical data by conducting case studies to reconceptualize and extend theories. This study contributes to the integration of concepts and theories by using the extended case method, which integrates and synthesizes existing bodies of work (Burawoy, 1991). We reviewed the literature relevant to research problem areas, and applied the empirical data to fill the gaps of understanding related to research on firm resources.

All interviews were conducted by following a semistructured approach and included some or all of the questions listed in Table 2. The questions were selected to suit the level of the interviewee.

**TABLE 2 QUESTIONS POSED DURING SEMI-STRUCTURED INTERVIEWS**

<b>Questions</b>
1. When was your firm and industry established and/or restructured?
2. Please summarize the evolutionary history of your industry/ firm resource.
3. Does your company or do firms in your industry partake in any important intra-or inter- firm activities that affect firm's competence development?
4. What are the influencing factors of such intra-firm/ inter-firm interactions? What kind of roles do you think government agencies, research institutions, and private institutions play?
5. Are there any unique intra-firm/ inter-firm learning activities in this industry/ firm?
6. How is the market development within your firm/industry? Does the market competence promote follow-up competence?
7. How does resource characteristic influence the industry/firm competence development?
8. How is the technology development within your firm/industry? Does the technology competence promote follow-up competence?
9. How does resource characteristic influence the industry/firm competence development?

Triangulating various types of data collected through different methods can overcome the limitations of one method by counterbalancing the weaknesses of that method with the strengths of others (Jick, 1979). This study used various types and sources of data to provide a comprehensive and solid foundation for theory development. This study conducted 20 interviews based on the characteristics of resources, organizational behaviors of competence development, and the relationship between the characteristics of resources and the learning routes of competence development. Some of the reports by interviewees were retrospective (Miller, Cardinal, and Glick, 1997), whereas other reports were contemporary with the activities they described. This study conducted an additional 26 interviewees based on multiple functional areas (e.g., manufacturing, R&D, marketing, and management) at various organizational levels.

The research sites were NEDA and ARET. NEDA is a company that offers machine automation and maintenance for integrated circuits (ICs), semiconductors (SCs), flat-panel displays (FPDs), chemicals, parts materials, and solar cell industries. NEDA was founded in 1978, and had approximately 577 employees and \$5.4 billion in annual sales at the time this study was conducted. Its automation equipment, especially room-cleaning robots and control system applications, have been adopted extensively by leading

optoelectronics and SC firms in material moving and manufacturing.

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 \$4.24 billion 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.

#### **IV. TECHNOLOGY COMPETENCE AND MARKET COMPETENCE**

Technology competence is a combination of the resources in a firm's existing repertoire, the resource at exploitative learning, and the resource at explorative learning, help provide tangible and intangible goods and services. Technology competence refers to basic competencies, composite competencies, and architectural competencies (Kogut and Zander, 1992; Henderson and Cockburn, 1994). Based on the interview results, basic competencies involve using existing endogenous resources and competencies. It includes two types of competence that incrementally improve production processes (**T<sub>2</sub>**) and manufacturing know-how (**T<sub>1</sub>**) and skillsets. Composite competencies combine existing endogenous resources and competencies with new firm competence. It comprises quality control (**T<sub>4</sub>**) and research and design (**T<sub>3</sub>**) of existing and new products. Architectural competencies create new domain competence among firms that have obtained exogenous resources and competencies. It is composed of material radical innovation (**T<sub>5</sub>**) and manufacturing radical innovation (**T<sub>6</sub>**).

Market competence can help firms anticipate more accurately the response to actions designed to retain or attract customers, improve channel relationships or thwart competitors, and act on market information in a timely and coherent manner, which has significant implications for the attainment and sustainability of competitive advantage (Möller and Anttila, 1987; Slater and Narver, 1995). According to interview results, market competence is constituted by existing and new market-related resources and assets, such as customer knowledge of needs and preferences (**M<sub>1</sub>**), communication and links employees and customers with internal and external resources (**M<sub>2</sub>**), competing cooperative relationship with competitor knowledge (**M<sub>3</sub>**), satellite services system (**M<sub>4</sub>**), long-term post-purchases (**M<sub>5</sub>**), and the reputation of the firm and brand (**M<sub>6</sub>**). The distinction between technology competence and market competence is listed in Table 3.

**TABLE 3 TECHNOLOGY COMPETENCE AND MARKET COMPETENCE**

Patterns	Technology competence	Market competence
<b>Architectural competence (exploration resource)</b>	T <sub>6</sub> : Manufacturing radical innovation T <sub>5</sub> : Material radical innovation	M <sub>6</sub> : Reputation of the firm and brand M <sub>5</sub> : Long-term post-purchase
<b>Composite competence (exploitation resource)</b>	T <sub>4</sub> : Quality control T <sub>3</sub> : Research and Design	M <sub>4</sub> : Satellite services system M <sub>3</sub> : Competing cooperative relationship with competitor knowledge
<b>Basic competence (existing resource)</b>	T <sub>2</sub> : Incremental improvement in production process T <sub>1</sub> : Manufacturing know-how	M <sub>2</sub> : Communication with employees and customers M <sub>1</sub> : Customer knowledge of needs and preference

#### **RESOURCE CHARACTERISTICS AND COMPETENCE DEVELOPMENT**

This section demonstrates the interplay of resource characteristics and learning mechanisms in competence development, as well as the historical progress of the critical resource development of firms.

Based on the historical progress of NEDA's existing resource development, we found that NEDA has the resource characteristics of continuing improvement and exploitation (March, 1991). They obtain advanced knowledge from intra-firm interaction by continuing to improve their existing resources (Ittner and Larcker, 1997; Serel, Dada, and Moskowitz, 2001). In other words, small firms have historically progressed by developing, improving, and exploiting resources, and tend to prioritize developing technology competence.

Conversely, based on the historical progress of ARET in resource development, we found that ARET has the resource characteristics of social linkage and exploration (March, 1991). They obtain enhanced experience from external-firm connections by continuing to link their existing resources with social resources. In other words, small firms have historically progressed by exploring social resources, and tend to prioritize developing market competence.

#### **INTRA- AND INTER- ORGANIZATIONAL LEARNING MECHANISMS**

Based on the historical progress of NEDA's existing resource development, we found that NEDA has the resource characteristics of continuing improvement and exploitation (March, 1991). They tend to prioritize developing technology competence. The various departments, supervisors, and members are fully informed and

participate in the company's intra-organizational learning to promote technology-oriented resources to upgrade the three stages of "IA→ ID→ ISI" (Sinkula, 1994; Slater and Narver, 1995). More important, this mechanism of the firm's intra-organizational learning requires being built within a corporate institution (Lee and Saxenian, 2007).

Based on the historical progress of ARET's existing resource development, we found that ARET has the resource characteristics of social linkage and exploration (March, 1991). They tend to prioritize developing market competence. The various departments, supervisors, and members are fully informed and participate in the company's inter-organizational learning to promote market-oriented resources to upgrade the three stages of "IA→ ID→ ISI" (Sinkula, 1994; Slater and Narver, 1995). More important, these mechanisms of the firm's inter-organizational learning require collaborative coordination (Lee and Saxenian, 2007).

## **THE RESOURCE CHARACTERISTICS AND LEARNING ROUTES**

Applying intra-organizational learning interactions (Harvey, Palmer, and Speier, 1998) in intra- and inter-departments has upgraded NEDA's technical knowledge. The firm has shaped technological barriers (Hsu and Chiang, 2001) by developing more advanced equipment and exploring the external consumer market. Using the inside-out learning route (outward learning), firms prioritize developing technological competence, and further promote market competence by intra-organizational learning to upgrade their technical knowledge and experience (Harvey, Palmer, and Speier, 1998).

Using inter-organizational learning interconnections with external contractors and the embedded network (Hobday, 1995) has upgraded ARET's marketable knowledge. The firm has shaped marketability synergies and agglomerations (Grabher, 1993; Yeung, 1994; Amin and Cohendet, 1999) by improving the competitiveness of the company's product market and transferring external technology and knowledge (Mathews, 2002). By combining the outside-in learning route (inward learning), firms prioritize developing market competence and further promote technology competence by inter-organizational learning to upgrade their marketable knowledge and experience.

## **V. CONCLUSION AND SUGGESTIONS**

### **ACADEMIC APPLICATION**

The findings of this study are consistent with the views of scholars (Wernerfelt, 1984; Danneels, 2002, 2007) who have stated that a firm's development is necessary for considering sequential resource development. Furthermore, we emphasize that the crucial choice for small firms in the development process is the continual exploitation of existing resources, thus saving the firm financial costs and time. This view is consistent with that by March (1991).

We applied resource-based theory to explore organizational behaviors. Several contributions are described as follows. First, this study identified resource characteristics that are necessary for a firm's competence development, particularly regarding organizational behaviors. We found that firms possessing improvement resources develop technology competence first and apply them to intra-organizational learning to promote market competence. Conversely, firms that have social resources develop market competence first and incorporate them into inter-organizational learning to promote technology competence.

Second, this article shows that a firm must exploit existing resources and explore new ones (Floyd and Lane, 2000) to facilitate the renewal of small firm competencies. Furthermore, the processes of exploiting and exploring must occur simultaneously and are equally important. The findings of this study show that exploiting and exploring both existing and new resources are activities that can expand the resource base of a firm, thus enabling the development of new competencies.

Third, a small firm requires not only specific resources but also the mechanisms of intra- and inter-organizational learning with three stages of "IA→ ID→ ISI" (Sinkula, 1994; Slater and Narver, 1995), which actuate and complete a firm's competence development.

Fourth, this study articulates the dynamic and reciprocal relationship of inside-out and outside-in organizational learning routes based on the support of firm specific resources, leading to firm competence renewal. The insight into the reciprocity of the resource characteristics and organizational behaviors of competence renewal relationships extends resource theory by examining not only how resources are used in competence renewal but how they are built intra-firm or inter-firm as well, and by examining how resources/competencies can be used to promote new competencies. The findings contrast those of Danneels (2002) in that a firm should always apply the technology to new products that addresses new customers.

Finally, we found that small firms are devoted to prioritizing the development of the most valuable competence, and then use/combine the first competence to drive/ promote follow-up competence. NEDA should first develop technology competence and further use the technology competence through intra-organizational learning to drive market competence. Conversely, ARET should first develop market competence, and then combine the market competence through inter-organizational learning to promote technology competence.

## **PRACTICAL APPLICATION**

This study applied resource-based theory and organizational learning theory to explore the organizational behaviors of competence development. Several contributions to the efforts of industrial companies are described as follows.

First, the findings of this study can help small firms understand their resource characteristics and further formulate the direction of their competence development.

Second, small firms with limited resources and scales develop TFT-LCD industry require high costs and technologies. The findings of study can help small firms develop more urgently required competencies, and further use previous competencies to promote new competencies.

Third, small firms choose inside-out and outside-in learning routes by using the mechanisms of intra- and inter-organizational learning with three stages of "IA→ID→ISI" (Sinkula, 1994; Slater and Narver, 1995) to promote and complete new competence development.

Finally, for small firms, exploiting internal resources and exploring external resources are equally important and should be accomplished simultaneously. More important, as long as such resources are beneficial to a firm's future direction, expand the resource base of the firm, which enables firms further new competencies, why should care about inward- or outward-learning routes.

## **LIMITATIONS AND FUTURE RESEARCH**

The findings of this study are based on an in-depth study of two firms. We could not establish whether the findings are generalizable to firms that are not high-tech or are in newly industrialized economies, or whether the findings are generalizable to firms possessing abundant resources. Therefore, the findings of this study are limited.

The researched firms could have idiosyncrasies that may have influenced their competence development behaviors or renewal efforts. However, the findings of this study have an intuitive and conceptual appeal, and are amenable to quantitative verification. Future research may be directed toward quantitative approaches or extended to the alliance partners (Lane and Lubatkin, 1998) and mergers and acquisitions (Eisenhardt and Martin, 2000; Karim and Mitchell, 2000).

Based on Priem and Butler (2001), we suggest that a great research opportunity exists for investigating the process of accumulating resources and competencies.

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