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基於環境依賴和組織學習模式的知識管理策略

Knowledge Management Strategies Based on Environment-Dependent and Organizational Learning Patterns

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摘要

先前的學術研究較少探討基於環境和組織學習模式的知識管理策略。本研究針對組織定位(顧客導向與科技導向)與任務因素(流程型任務與內容型任務)等兩大知識驅動環境面向中的四種組合(顧客導向*流程型任務、顧客導向*內容型任務、科技導向*流程型任務、科技導向*內容型任務)，進行四個大型組織的個案研究。本研究結果顯示，在知識驅動環境面向中，組織定位和任務因素會影響組織學習和知識轉換過程。此外，本研究也解釋了知識管理策略與知識轉換過程，以及知識管理策略與相關知識管理實踐之間的關聯性。

關鍵詞：知識管理、知識驅動環境、組織學習、個案研究

Abstract

Previous studies have seldom addressed the design of knowledge management (KM) strategy based upon environmental and organizational learning factors. The case study was conducted on four large organizations representing four combinations (customer-driven * process-oriented tasks, customer-driven * content-oriented tasks, technology-driven * process-oriented tasks, technology-driven * content-oriented tasks) of two knowledge driving environments namely, organizational positioning and task characteristics. The results show that organizational positioning and task factors influence the organizational learning and knowledge conversion processes. In addition, this study proposes an association between KM strategies and knowledge conversion processes, as well as between KM strategies and related KM practices.

Keywords: Knowledge Management, Knowledge Driving Environment, Organizational Learning, Case Study

1. Introduction

Determining effective knowledge management (KM) strategies (Zack, 1999) is not an easy task. Several theoretical perspectives can be used to justify the development of certain action plans for knowledge management (Prahalad & Hamel, 1990; Collis & Montgomery, 1995; Nowacki & Bachnik, 2016). However, the environment faced by enterprises is constantly changing. Therefore, knowledge management often requires dynamic changes to respond the changes in the environment. Few previous approaches sufficiently incorporate the dynamic aspect of KM strategies (Choi & Lee, 2003). One notable approach by Scheepers et al. (2004) demonstrates the dynamic nature of KM and potential combinations of management practices to optimize organizational knowledge management. Yet this approach only focused on limited factors. Reviewing an organization's external and internal factors helps uncover its knowledge characteristics. This dynamic view emphasizes environmental adaptation through organizational learning and innovation. Spender (1994) also proposed that an organization is an evolving dynamic body of knowledge that must respond to environmental changes by continuously harnessing its knowledge stock via a learning mechanism.

Strategies can be observed through planned activities like an organization's KM practices. Prior research indicates that KM can be acknowledged as a required business process (Gartner Group, 2002). An important feature of recent KM practices is the employment of information systems in which knowledge and information are explicitly encoded, such as knowledge-based systems and KM systems (Evermann, 2005; Kettinger et al., 2015; Park et al., 2015). Adopting a KM-related practice entails the acceptance of a combination of technologies, strategies, and competencies.

In a dynamic environment, firms must continually improve their performance by transforming the know-how and experience they've accumulated in their field of expertise into a problem solving capability to strengthen their competitiveness. Continual performance improvement is only possible if the firm successfully engages in organizational learning – that is, bringing in or creating new knowledge. Hence, the understanding and management of organizational learning is vital to the design of KM strategy.

This study attempts to explore the formulation of KM strategies by developing a theoretical basis for understanding the relationship between the knowledge driving environment, organizational learning, and KM strategies. Specifically, the research question addressed in this study is:

What effective model should a firm adopt to develop its KM strategy especially when organizational learning plays a key role in response to environmental challenges?

The rest of the paper is organized as follows. The next section provides a review of the relevant literature, followed by a delineation of the environment-dependent model of KM in Section 3. Section 4 explains the case analysis conducted in the empirical study, and Section 5 discusses the propositions derived from the case analysis. Finally, in Section 6 we draw our conclusions and address the implications for both academics and practitioners.

2. Literature Review

The success of organizational learning and KM practices depends on what levels the knowledge management is implemented, such as organizational or individual level (Chen & Liang, 2016). This paper focuses on organizational knowledge management, which inevitably involves industry and firm characteristics. Thus, the approach adopted here towards organizational learning is based on a combination of external and internal perspectives, and the problems posed by environmental challenges (Souder et al., 1998). The following sections discuss the current literature relating to knowledge driving environment, organizational learning and KM strategies.

2.1 Knowledge Driving Environment

Knowledge creation or transfer can benefit companies not because the knowledge itself (the facts), but the context-specific characteristics of the knowledge (Teece, 2000). Prior research has identified several driving factors which are essential for effective knowledge management, such as environmental uncertainty, bureaucracy, and culture, (Gabriel, 1999; Lee & Choi, 2003; Loon,

2019). Few previous studies have investigated how companies could establish valuable organizational knowledge through leveraging the driving environment. This lack of an integrated view calls for an understanding of the concept of the knowledge driving environment which is defined here as that what encourages the need for knowledge management. We include factors that are both external and internal to the organization based on the environmental, organizational, and individual-group levels of the organizational hierarchy. After reviewing the literature, the key constructs of these levels included rate of environmental change, organization positioning, and task characteristics. These constructs are discussed as follows.

2.1.1 Key Construct in Environmental Level - Rate of Environmental Change

Huber (1991) stated that learning occurs in an organization "if through its processing of information, the range of [the organization's] potential behaviors is changed." The organization will change its behaviors and strategies in response to environmental stimuli and will attempt to solve problems based on past experiences and knowledge (Cyert & March, 1992; Hsiao & Tsai, 2003). Organizations facing a changing and complex environment would attempt to define, combine, and reorganize their internal information in line with their operational structure in the hope of reducing the impact of market uncertainty (Bourgeois & Eisenhardt, 1988; Souder et al., 1998; Agarwal & Helfat, 2009; Shin & Pérez-Nordtvedt, 2020).

2.1.2 Key Construct in Organizational Level - Organization Positioning

Previous studies suggest that organizational management strategy may be customer-driven or technology-driven (Ames & Hlavacek, 1989). "Customer-driven" embraces the customer-first concept, with the focus being on customer needs as an organization carries out knowledge management activities. Customers in customer-driven organizations often play an essential role in providing information. In a customer-driven organization, the operation is completely centered on customers, customer ideas, and customer needs with the aim of securing key reference points (Ames & Hlavacek, 1989; Kohli & Jaworski, 1990; Lin et al., 2015). Technology-driven organizations, on the other hand, are typically far ahead of the present market in terms of various kinds of technology; that is to say, a technology-driven

organization should lead customers' needs and create a demand (O'Conner, 1998).

This study infers that organizations with different strategic orientations need different sources of information. Customer-driven organizations focus on markets and relevant customer knowledge, while technology-driven organizations draw on their own core competencies as a source of knowledge. The difference between these two types of organizations entails different learning behaviors and methods.

2.1.3 Key Construct in Individual Level - Task Characteristics

Perrow (1967) posits that different task characteristics incur different information needs. Tasks can be divided into several types based on analyzability and variety, routine, engineering, craft, and non-routine, which entail different information and knowledge requirements. Given this variance, Donoghue et al. (1999) proposed that, based on dependence and complexity, organizational tasks can be divided into integration, collaboration, transaction, and specialization. The required knowledge and KM mode varies between the different types (Song & Sun, 2018). Becerra-Fernandez & Sabherwal (2001) further explain the relationship between task characteristics and knowledge creation by classifying tasks into four types based on task orientation and task domain, namely process orientation, content orientation, depth task domain, and broad task domain.

2.2 Organizational Learning

The creation and utilization of knowledge via organizational learning behavior is one of the keys to improving organizational performance (Nonaka, 1994; Spender, 1994; Grant, 1996). The driving force for improving organizational performance comes from proprietary knowledge residing within the organization as well as the management of this type of knowledge (Davenport & Prusak, 1998; Holsapple & Joshi, 1999). This view not only transforms the conceptualization of organizational learning into a KM process, but also emphasizes that the need to respond to the environment is what motivates an organization to learn. After reviewing the literature, the key constructs of these levels included rate of environmental change, organization positioning, and task characteristics. These constructs are discussed as follows.

2.2.1 Organizational Learning Process

Huysman et al. (1998) summarized approaches to organizational learning into process and outcome perspectives. The process perspective holds that organizational learning is an improvement procedure conducive to routine work efficiency and job skills (Thomas & Vohra, 2015; Bloodgood, 2019). The outcome perspective considers that organizational learning is the result of improvement, and that it is through the accumulation of organizational knowledge that that the organization can adjust to changes in its environment (Odor, 2020). Four processes that contribute to organizational learning, namely, knowledge acquisition, information distribution, information interpretation, and organizational memory (Huber, 1991). This paper employs the process perspective to investigate the impact of organizational learning.

2.2.2 Knowledge Conversion Process

The knowledge conversion process can be conceived of as part of organizational learning. Knowledge conversion is the creation of new knowledge within an organization and the subsequent dissemination of that knowledge throughout the whole organization, which ultimately manifests itself in new products, services and systems (Nonaka, 1994; Ray, 2014; Chatterjee et al., 2018). This conversion is accomplished through the interaction of implicit and tacit knowledge, namely internalization, externalization, combination and socialization (Nonaka & Takeuchi, 1995; Holste & Fields, 2010). Socialization converting new tacit knowledge into explicit one via apprenticeship (Brandi & Elkjaer, 2011).

2.3 KM Strategies

Strategy is an important enabler and is crucial for allowing the firm to achieve competitive advantage(s). Such a concept is important in today's knowledge economy since knowledge is seen as a means to create value and is considered a valuable strategic asset that can be used to create a sustained increase in enterprise profitability (Beckman, 1997; Hansen et al., 1999; Zack, 1999; Earl, 2001; Choi & Lee, 2003; Kettinger et al., 2015; Kim et al., 2021).

As a result, previous studies have approached KM strategies from different viewpoints, such as learning, strategic, and content perspectives. Bierly & Chakrabarti

(1996) adopted the organizational learning perspective to investigate R&D intensity, science linkage, knowledge dispersion, technology cycle time and learning radicalism in the US pharmaceutical industry, dividing KM into four strategy groups: Explorers, Exploiters, Loners, and Innovators. Earl (2001) integrated several major disciplines, including philosophy, economics, computer science, psychology and sociology in a proposed framework of KM strategies. This framework included seven schools in three fields: systems, cartography and engineering in the technocratic field, commerce under the economic field, and organization, space, and strategy in the behavioral field. Other researchers have proposed that knowledge content could be deemed a composition which involves explicit and tacit knowledge, leading to the proposal of different KM strategies for the deployment of organizational KM, such as system codification and human personalization strategies (Swan et al., 2000; Zheng et al., 2010; Kumar & Ganesh, 2011; Imran et al., 2016; Buenechea-Elberdin et al., 2018). Scheepers et al. (2004) argued that firms must evolve their KM strategies by mixing codification and personalization strategies to use organizational knowledge effectively in light of several influential factors, such as business economics, political, and cultural contexts. Comparing above mentioned classification of KM strategies, each one has its advantage of understanding knowledge itself and how it could be managed. Among them, the content perspective, which adopts codification and personalization dimensions, is the most popular one for studying KM strategies.

2.4 KM Practices

Previous studies have discussed the possibility of supporting KM with IT to raise the efficiency of knowledge storage, dispersion, application, and innovation (e.g. Hansen et al., 1999; Gold et al., 2001; Park et al., 2015), but few studies have focused on the actual application of KM (Gartner Group, 2002). Volkoff et al. (2004) identified several barriers to effective knowledge transfer from the implementation team to users in an enterprise system (ES) implementation. They believed the lack of common KM practices was evident in the team's training material not being grounded in users' tasks. The Gartner Group (2002) classifies KM practices into five categories - information management and access, process knowledge, knowledge workplace, e-business, and intellectual capital management. The employment of KM

strategy can be induced from the actual use of KM practices. For example, the KM deployment of firms pursuing codification strategies depends predominantly upon information management and access, or on e-business. Likewise, companies deploying KM in a knowledge workplace are likely to employ personalization strategies (Muhammad et al., 2017).

3. Research Methodology

This study adopts the case study method, specifically the embedded multiple cases approach (Yin, 1994), to investigate research questions regarding learning activities and KM strategies. Case-based research is useful when the phenomenon of interest is of a broad and complex nature and therefore best studied within the context in which it occurs (Yin, 1994). Multiple case designs allow a "replication" logic (Yin, 1994) that permits the induction of more reliable models.

Organizational KM is a multi-faceted phenomenon (Becerra-Fernandez & Sabherwal, 2001; Lee & Choi, 2003), which is subject to the influence of multiple enablers at different levels. Thus, the design of embedded unit analysis provides a more holistic view of how firms should select their KM practices and strategies based on environmental and learning factors in different organizational dimensions. This study considers the hierarchy of three levels designated by industry, organization, and individual-group as the environment-dependent dimension for its analyses. While an embedded design is complex, it provides greater richness and multiple perspectives that can be used to explain behavior.

Case study results can be optimized through using a rigorous and empirically proven procedure (e.g., Benbasat et al., 1987; Lee, 1989). Our research design process includes providing *a priori* constructs (or dimensions) as an analytical basis, selecting cases and data collection methods, analyzing data, shaping propositions, proposing a new research model based on the enfolding literature, and research closure. Details of the research design process are presented below.

Literature relating to the research themes was collected and summarized into a prior specification of constructs in the Literature Review Section. Based on the literature review, this study proposes a KM framework to guide case analysis including the dimensions of knowledge driving environment, organizational learning,

and KM deployment (see Table 1).

Four companies that have successfully implemented KM were then chosen for case studies and to fill the theoretical categories shown in Table 2. In the case study, Case A, Case B and Case C were in high tech industry which found to be high velocity environments. In comparison, Case D was in conventional industry were found to be low velocity environments. Because KM depends on particular processes and their associated tasks, different organization in different industry environment provides a more appropriate unit of analysis. To highlight the differences in industry and task, this study compared KM endeavors in high and low velocity environments.

In terms of organizational positioning (Ames & Hlavacek, 1989; O'Conner, 1998), the four cases cover two types of organization: customer-driven and technology-driven. Given the massive output of the wafer foundry industry, the key success factors are customer satisfaction, product quality, and competitive costs. Thus, Case A focuses on enhancing technologies on the production line to provide high quality products at lower cost, making Case A is a customer-driven company. Given the short product lifecycles, rapidly evolving technology, globally linked distribution networking, increasing product variability and high levels of demand and supply uncertainty of mobile phone industry, the key success factors of supply chain is proper and Highly coordinated key company's strategy. Thus, Case C focuses on Highly meet the needs of various models (i.e. Tailor-made research and development, design to cost, globally service), making Case C a highly customer-driven company.

Table 1: Analytical Framework of the Study

Dimensions	Key constructs	Attributes
(A) Knowledge driving environment	(A1) Rate of environmental change	• High velocity environment (Bourgeois & Eisenhardt, 1988; Jones & Mahon, 2012) • Hypercompetitive industries (Bogner & Barr, 2000) • Environment and knowledge (Hsiao & Tsai, 2003) • Environmental uncertainty and technology (Yap & Souder, 1994; Fábio et al., 2019)
	(A2) Organization positioning	• Customer-driven organization (Ames & Hlavacek, 1989; Kohli & Jaworski, 1990; Martinelli & Tunisini, 2019) • Technology-driven organization (Ames & Hlavacek, 1989; O'Conner, 1998; Srisamran & Ractham, 2014)
	(A3) Task characteristics	• Task orientation- Process or Content (Perrow, 1967; Donoghue, et al., 1999; Becerra-Fernandez & Sabherwal, 2001) • Task domain- Depth or Breadth (Perrow, 1967; Donoghue, et al., 1999; Becerra-Fernandez & Sabherwal, 2001)
(B) Organizational learning pattern	(B1) Learning process	• Knowledge acquisition (Thomas & Vohra, 2015; Bloodgood, 2019) • Information distribution (Thomas & Vohra, 2015) • Information interpretation (Thomas & Vohra, 2015) • Organizational memory (Huber,1991; Thomas & Vohra, 2015)
	(B2) Knowledge conversion process	• Internalization (Chatterjee et al., 2018) • Externalization (Holste & Fields, 2010) • Combination (Holste & Fields, 2010) • Socialization (Nonaka, 1994; Nonaka & Takeuchi, 1995; Brandi & Elkjaer, 2011)
(C) KM strategy	(C1) Role of information technology	• Codification (Kumar & Ganesh, 2011; Imran et al., 2016) • Personalization (Hansen, et al., 1999; Gold, et al., 2001; Zheng et al., 2010; Imran et al., 2016)
	(C2) KM practices	• Information management and access (Gartner Group, 2002; Yeh et al., 2006) • Process knowledge (Gartner Group, 2002; Yeh et al., 2006) • Knowledge workplace (Gartner Group, 2002; Yeh et al., 2006) • E-business (Gartner Group, 2002; Yeh et al., 2006) • Intellectual capital management (Gartner Group, 2002)

Data source: this research

In comparison, Case B was established with the mission of building a better coordinated world class national organization with more efficient and flexible administration covering cutting edge areas. Thus, Case B focuses on science and technology international competitiveness and technology competence, making Case B a technology-driven company. On occasion, orders exceed production capacity at Case D. To maintain its strategic position, the company focuses on enhancing product quality and functionality, in part through the application of new technologies, making Case D a technology-driven company. Based on the attributes of orientation and domain task characteristics (Becerra-Fernandez & Sabherwal, 2001).

Table 2: Case Design for organization positioning and task characteristics

		Organization Positioning	
		Customer-driven	Technology-driven
Task Characteristics	Process	Case A	Case B
	Content	Case C	Case D

Data source: this research

Finally, the study triangulated data collected from multiple sources such as interviews, observations, and archival sources. With regard to KM activities, collected from documents, extensive interviews with front line staff, and occasional observation of the use of KM systems in the selected case companies.

4. Cases Analysis

Interviews were conducted with representatives from four case companies. Given the fact that organizational knowledge activities may not be designated by routines but implied by daily operations, front line staffs were the primary interview targets since they are most familiar with the details of KM activities. Interviews with top management executives were also conducted to obtain the overall picture of the company.

A total of eight interviews were conducted, each conducted by two investigators and lasting at least two hours. The interview data and secondary data were then analyzed and triangulated by the two investigators based on an analytical

framework (see Table 1) to seek insights into the research question.

With regard to the validity of this quantitative study, content validity is concerned in this study. Under the review of several cases, we collated the case data to the interviewee to confirm whether it is consistent with the actual situation. Therefore, this study has content validity.

4.1 Knowledge Management Activities in the Companies

Case A offers a full range of IC foundry services, including wafer fabrication, wafer detection, packaging and testing, mask production, and design support. Case A does not design or produce proprietary products. Case A has a long history of KM. Initially KM was used to increase semiconductor related knowledge for reference by its R&D personnel. Case A embarked on a virtual factory program, requiring optimization of KM processes to integrate information from manufacturing, R&D and customer service. The HR department also implemented its own KM program at a later date.

Case B is an independent non-profit institute. The primary mission of Case B is to provide the large-scale experimental platform and facility to support the academic researches in Taiwan. The research areas of Case B are the critical technologies foreseen by the nation. It has encountered two relatively serious problems of KM. First, the focused research areas involve emergent technologies with high uncertainty and deep domain knowledge. The difficulty of KM lies in the in-transferability of tacit knowledge residing in specific human beings, as the knowledge updates fast and makes the transfer invalid. Second, how to catch the new leading edge knowledge becomes a problem due to its low employee turnover rate.

Case C is the supplier of cell phone keypads in the world and supplies mobile phone components for all major mobile phone makers. While facing highly competition and variety technology environment, it has encountered following problems. For instance, as competition in mobile phone industry increases and profit margins decrease, the transfer and exchange of organizational tacit knowledge effectively become more important. Because the speed of introducing new cell phone models is the key of company competing. Therefore, horizontal exchange of

knowledge between departments is very essential. Seeking outside professional expertise to teach the production crew in managing manufacturing process control. The purpose is to utilize the past experience to institutionalize the production process.

Case D is the supplier of steel products, and has accumulated a wealth of intellectual assets. While the company has used these assets to enhance its competitive advantage, it has encountered two relatively serious problems. First, the retirement of senior staff and a work rotation mechanism prevent the conversion of precious personal knowledge into organizational knowledge, thus depriving the company of valuable knowledge assets. Second, Though Case D's IT systems are considered advanced in the steel industry, a lack of a horizontal exchange or use of organizational knowledge restrict the realization of the synergistic effects of knowledge innovation. Furthermore, tacit knowledge is still being preserved exclusively in the minds of employees, which creates difficulties for the use and synthetic sharing of organizational knowledge. Like many other firms, Case D implements KM mainly to preserve and pass on organizational knowledge.

4.2 Case A

To keep up with increasingly complex supply chains and customer demands, Case A offers customers the option of placing orders via the Internet or inter-company networks. Case A's virtual factory, which allows customers to view Case A as their own factory, consists of two parts: a back-end manufacturing system which optimizes production planning for the operating processes between Case A and its supply chain partners; and a front-end system that communicates with and deals with the customers. The objective of the EC department is to understand its customer's needs, establish an effective front-end service system and provide transparent information services to meet the customer's information needs and to control the fabrication process. The established IT infrastructure allows customers to exchange data with Case A, and it also provides a yield analysis so that customers can obtain quality information regarding their products. Table 3 presents analysis results based on the Case A EC department's analytic framework.

Table 3: Case analysis of Case A

Attribute analysis
A1: A high degree of market familiarity among system developers leads to low customer uncertainty since customer requirements can be clearly defined and translated into software specs (Yap & Souder, 1994). Given the intensity of market competition and the turmoil of market conditions, it is rather difficult for the EC department to obtain exact customer requirements and expectations, and to predict changes in customer behavior.
A2: ● Consumer-driven. ● Focused on developing a close rapport with customers. ● Customers dictate system design directions and functions. ● Seeking enhanced customer service and customer satisfaction.
A3: ● Task description: In a virtual factory, the mission of the EC department is to build and establish a comprehensive customer service environment requiring the construction of various IT systems. Demand analysis is the key to success or failure in the system development process. Thus it is imperative for the EC department to first analyze and integrate customer needs to ensure that the IT system satisfies those needs. ● Task domain: Content-oriented and deep.
B1: ● Knowledge is mainly acquired from customers (IC design houses). ● Sources of knowledge include market information, customers, customer service departments, sales departments and consultants. ● The system project consists of project initiation and an investigation of user requirement. In the former, team members acquire explicit knowledge from documents, training courses and consulting services. The latter stage emphasizes the acquisition of implicit knowledge, which is based on interviewing salespersons/users, observation of field operations, and interactions with team members. Differences of opinion between users and developers often lead to inconsistencies in system requirements. As the domain knowledge in IC design is implicit by nature, intensive communication and interaction with the user party is necessary to uncover the type of knowledge relevant to system development. In this process it is important to interpret the users' statements based on the developers' understanding of domain knowledge. ● Organizational memory: Software development procedures, work reports.

B2: ● Knowledge is shared through the processes of externalization and combination. ● Externalization: Acquiring customer knowledge and producing system analysis documents for confirmation by customers, and incorporating the final customer response in the system design. ● Combination: Combining the knowledge of different departments (customer service, sales, MIS, etc.) and consultant firms, and exchanging and combining information via documentation, meetings and networking.
C1: ● Gathering and learning customer data: Customer service phone centers, business intelligence analytical tools, transaction databases (storing past transaction data and statements), and data mining tools. ● Sharing of industry knowledge: Lotus Notes (work reports and troubleshooting), business databases, communication tools (online conferencing systems, emails, and customer relations management systems). ● Major management activities include a codification strategy to implement the "e-business" of EC departments to develop a consistent service interface and to communicate with customers through uniform data formats.
C2: ● In implementing e-business, the collection, storage and classification of relevant information are essential to better understand customer profiles. A people-oriented approach was adopted by inviting outside consultants to provide customer knowledge. ● To sum up, in this case KM is built mainly on e-business, and the document management mechanism must be enhanced in the e-business process.

Data source: this research

4.3 Case B

In order to keep professional knowledge and expert opinion within the organization, it is a must to apply network technology in assisting the realization of KM. Providing large-scale experimental platform must engage in R&D and invest in platform improvement to maintain a high quality service for cutting edge research needs. Case B is a large complex research institution and therefore not only relies on advance large-scale experimental platform technologies but also relies on domain research knowledge. Case B is the source of its advanced core technology.

Technology in large-scale experimental platform for cutting edge research is characterized by rapid change, high uncertainty and increasing development costs, all of which pose great challenges for the R&D. Organizations must reduce the high risks associated with R&D work and draw on past experiences to help reduce such costs. Recently, Case B has undertaken various KM measures to address these issues. The results of the analysis of the Case B according to the analytic framework are shown in Table 4.

Table 4: Case Analysis of the Case B

Attribute analysis
A1: The cutting edge areas Case B invest are including nanotechnology, space science, life sciences, computational sciences, IC design and etc...The large-scale experimental platform service for theses cutting edge research is a highly technically intensive sector characterized by a short product life cycle and a great need for research and development. The R&D department has to grasp sophisticated and rapidly evolving technical knowledge, and hence faces high technological uncertainty (Mohr, 2001).
A2: ● R&D personnel concentrated in R&D and improvement of process technology. ● Based on Case B's unique role for large-scale experiment, the Case B's know-how and service surpasses existing market demands, making it technology-driven and a demand creator.
A3: ● Task description: Enhancing the core technology competence and know-how of the organization to maintain its status as promote national technological competitiveness; thus the task of Case B is new technologies on large scale platform and domain research ability. ● Task domain: Process-oriented and deep.

Attribute analysis
B1: ● Knowledge is mainly acquired through an apprenticeship mechanism, supplemented by outside learning courses, conference and seminar. Novice engineers learn from experts in the field and their senior co-workers. ● Sources of knowledge include internal personnel, learning courses, and databases (published technical reports, internal technical reports, external technical databases and patent databases). Comprised of two to three people, a task force led by a senior expert is formed to search for solutions. In addition, an integration team consisting of various task force teams can be formed to increase interaction among team members. New perspectives are created from such intensive communication. ● Knowledge evolves rapidly, is highly sophisticated, and is highly tacit. The apprentice acquires know-how through interpreting information acquired through learning by doing. ● Organizational memory: Technical reports, patents and published papers.
B2: ● Knowledge conversion stresses the processes of socialization and internalization. ● Socialization: The process of creating tacit knowledge through the sharing of experience; the crucial points are experience, a common working environment and common perceptions. ● Internalization: Gaining knowledge from experts or venders through training and strategy, with an emphasis on "on-the-job learning."
C1: ● Information technology plays only an supporting role in the KM of the R&D activities, providing IPR databases, learning platforms, and communication tools (e.g. discussion boards and video conferencing) ● The main IT system is to conduct Intellectual capital management, including patent, copyright, project and so on. ● Main management activities involve a personalization strategy for the "knowledge workplace" in which organizational learning needs are met through well-established communication channels.
C2: ● Over-emphasis on a people-oriented learning method may result in a situation in which knowledge is stored mainly in the minds of a few people. Thus "intellectual capital management" is important to ensure knowledge is retained within the organization.

Data source: this research

4.4 Case C

Case C is a Taiwan based company principally engaged in the business of designing, manufacturing, and supplying of mobile phone keypads. The case company focuses on developing mechanism parts of mobile phones. The primary task of the Case C is to quickly develop a Keypad that customers can use and achieve cost to design. It would rather define Case C as a member in manufacturing industry, but professional technical services industry instead (Table 5).

Table 5: Case analysis of Case C

Attribute analysis
A1: Case C is a supplier of cell phone keypads in the world and supplies mobile phone components for all major mobile phone makers. Case C faced highly competition and variety technology environment.
A2: ● Consumer-driven . ● Serving international large-scale mobile phone manufacturing company. ● Content-oriented tasks stress “know-what”, i.e. what kind of activity or task must be performed.
A3: ● Task description: To collaborate with supply chain operations of worldwide cell phone companies, such as design, manufacturing, and delivery. ● Task domain: Content-oriented and broad. Cell phone key pad technology is essentially a combination of mechanism and chemical material. The challenge is not from the technology itself, but lies in the manufacturing experience and the knowledge integration among supply chain operations. Concentrated on cost to design (Yield rate).

Attribute analysis
B1: ● Knowledge is mainly acquired from external customers and co-workers (colleagues). ● Sources of knowledge: Procurement department of international mobile phone manufacturers, R&D department, Keypad upstream component supplier, co-workers, market information, government ordinances, work manuals, with knowledge obtained primarily from personal conversation (not databases). ● The organizational culture is sharing information with others (including inter-department). Many active knowledge sharing activities abound in the organization such as interactions among knowledge groups, organizational learning meetings, and KM strategy contests. ● The structure of knowledge is non procedural knowledge, which can not be standardized and summarized in sequences. The need for information interpretation is so much. ● Organizational memory: Documentation of R&D professional knowledge, courses on e-learning platforms.
B2: ● Knowledge conversion stresses the processes of socialization and internalization. ● Socialization: The process of creating tacit knowledge through the sharing of experience; the crucial points are cross-department knowledge exchange and fast speed problem solving. ● Internalization: Gaining knowledge from outsides or venders through business activity. Emphasis on “lesson and learn”.
C1: ● Gathering and learning customer data: Customer service, business activities, Customers’ manufacturing documents. ● Sharing of industry knowledge: Interdepartmental meeting, R&D database. ● Communication aids: e-mail, telephone. ● Main management activities involve a personalization strategy for the “knowledge workplace” in which organizational learning needs are met through well-established communication channels.
C2: ● Over-emphasis on a people-oriented learning method may result in a situation in which knowledge is stored mainly in the minds of a few people. Thus “intellectual capital management” is important to ensure knowledge is retained within the organization.

Data source: this research

4.5 Case D

Case D's KM program was scheduled to be deployed in three stages, including initiation, implementation, and diffusion. Six departments within Case D have taken the lead in adopting the KM program Results of the analysis of Case D are presented in Table 6.

Table 6: Case Analysis of Case D

Attribute analysis
A1: The steel industry is characterized by a long product life cycle and is associated with less technology uncertainty. As its workforce ages (the average age of current Case D employees is 48), the Case D faces the challenges of personnel and knowledge gaps and young talent is reluctant to enter the field.
A2: ● Technology-driven tasks: Concentrated on developing core production and maintenance know-how.
A3: ● Task description: Maintaining the normal operation of production process, immediate handling of worksite problems, and optimization of product costs. ● Task domain: Process-oriented and broad.
B1: ● Knowledge is mainly acquired from co-workers and experts. ● Sources of knowledge: co-workers, experts, organizational learning meetings, and e-learning systems. ● Initially the organizational culture did not include sharing information with others. Progress was achieved through culture-change activities such as interactions among knowledge groups, organizational learning meetings, and KM strategy contests. ● The structure of knowledge is procedural knowledge, which can be standardized and summarized in sequences. There is only a small amount of tacit knowledge (mainly the experience of experts). The need for information interpretation is minimal. ● Organizational memory: Documentation of professional knowledge, courses on e-learning platforms.

B2: ● Knowledge conversion during the early stage stresses the processes of socialization and internalization. ● Socialization: Creating tacit knowledge via observation, imitation and experience sharing. ● Internalization: Absorbing expert or co-worker knowledge through training and the implementation of knowledge absorbing strategy. ● Case D is faced with the imminent retirement of many internal experts. Thus recent KM efforts emphasize retaining the experience and knowledge of these experts within the organization, and stress the process of externalization. ● Externalization: Extracting and documenting expert knowledge and in text, sound or image form.
C1: ● Case D's KM strategy emphasizes the use of IT tools (under the premise that knowledge changes slowly). ● Organizational learning activities rely on the aid of IT. ■ Personnel communication: Webcam, discussion zone, online meeting system. ■ Data storage: knowledge map, expert yellow pages, database, e-learning platform, and discussion zone. ■ Personnel training and learning: E-learning and e-training. ■ Case D's KM website: Bulletin boards, knowledge maps, project management, and knowledge community activities. ■ Major management activities tend towards a codification strategy.
C2: ● Major management activities tend towards a codification strategy of "process knowledge and information management and access" because the KM program focuses on defining and acquiring knowledge and on encouraging knowledge transfer. The objective of the codification strategy is to preserve expert knowledge in the organizational memory in document form (text, sound and image) rather than storing it invisibly in the heads of experts.

Data source: this research

Table 7 summarize the analysis for four case companies illustrated by analytical framework of this study.

Table 7: The summary of the case analysis for four case companies

Dimensions	Key constructs	Attributes	Case A	Case B	Case C	Case D
(A) Knowledge driving environment	(A1) Rate of environmental change	• High velocity environment • Hypercompetitive industries • Environment and knowledge • Environmental uncertainty and technology	High velocity environments	High velocity environments	High velocity environments	Low velocity environments
	(A2) Organization positioning	• Customer-driven organization • Technology-driven organization	Consumer-driven	Technology-driven	Consumer-driven	Technology-driven
	(A3) Task characteristics	• Task orientation- Process or Content • Task domain- Depth or Breadth	Content-oriented and deep	Process-oriented and deep	Content-oriented and broad	Process-oriented and broad
(B) Organizational learning pattern	(B1) Learning process	• Knowledge acquisition • Information distribution • Information interpretation • Organizational memory	Knowledge is mainly acquired from customers	Knowledge is mainly acquired through an apprenticeship mechanism, supplemented by outside learning courses, conference and seminar	Knowledge is mainly acquired from external customers and co-workers	Knowledge is mainly acquired from co-workers and experts
	(B2) Knowledge conversion process	• Internalization • Externalization • Combination • Socialization	Externalization and Combination	Socialization and Internalization	Socialization and Internalization	Socialization and Internalization
(C) KM strategy	(C1) Role of information technology	• Codification • Personalization	Codification	Personalization	Personalization	Codification
	(C2) KM practices	• Information management and access • Process knowledge • Knowledge workplace • E-business • Intellectual capital management	E-business	Intellectual Capital Management	Intellectual Capital Management	process knowledge & information management and access

Data source: this research

5. Propositions

Proposition 1: *Organizations with different knowledge driving environments will show significant differences in their organizational learning pattern.*

Proposition 1a

Organizations facing a 'Customer-driven plus content type' environment tend to learn by outside sources, and emphasize socialization and internalization during organizational learning.

The speed and cost of tooling modification for each type of phone is the key success factors in keypad industry. Hence the source of competitive advantage lies in design to cost and quick response to customer need. (notes: Due to the short life cycle of cell phone product, only six months available for the product development time, in which mechanism is the most time-consuming process and key pad plays an important role in this process. After the installation of all other parts, key pad needs to have a perfect match with the cell phone. Should a design mistake occurs, the supply chain lead time will increase and time to market will be delayed. Hence Case C has a close relationship with cell phone companies in design collaboration in order to reduce design modification cost.) The primary task of Case C is to meet customer demand, and matches with supply chain management strategies of major cell phone companies, from its strategic goal to follow-up project execution details. (notes: Case C adopts join-design as its supply chain collaboration practice, reviews together with its up-stream suppliers with respect to customer's original product blueprint. The purpose is to gain consent and trust from supply chain partners, insuring the consequent economic scale of production.) For example, when Case C formulates its annual goal and implementation strategy, it is necessary to illustrate which customer the potential growth comes from, and which factory of that customer. If it is Factory A of Nokia, what about its local capacity, who is the major decision maker, what are the odds of overwhelming local competitors; These are the questions to be addressed in Case C's customer-driven culture.

The customer-driven strategy of Case C relies upon big data and multiple information channels to insure the correctness of its organizational strategy. For example, except marketing staff, global sales staff not only are responsible for getting

orders, but also need to collect regional market information. (note: Major cell phone companies lead the industry, each has its own way of managing supplier knowledge. A complete set of document in codified knowledge form is established, covering the whole range of supply chain process like R&D, manufacturing, and logistics. Once Case A become the qualified supplier, it can access the knowledge document. Case C is the cell phone key pad supplier; hence it has all sorts of knowledge document from all major cell phone companies,) As the division of labor in the cell phone industry elaborates, in some situation, small and medium size suppliers have control of R&D and manufacturing knowledge. Case C also maintain relationship with other supply chain up-stream suppliers in order to obtain such knowledge.

In the aspect of socialization and internalization, Case C relies heavily on a large amount of cross-department project meeting including functional areas like R&D, marketing, and engineering, which help speed up the internalization of information. This leads to a quick response to customer demand, fulfilling the need for speed in the cell phone industry. For example, in 2009, the worst time of financial storm, Case C moved to the organization strategy, low profit margin and high market share, and developed a series of highly customer-driven strategy. Based on a salesman's report that India Telecom will have a joint venture with Nokia, Case C immediately sets up a service facility with assembly line (which is laser sculpture service, conducted locally to meet the government regulation). Hence the consignment service is available for providing Nokia cell phone to India Telcom. This strategic move helps escalate Case C's market share in India. Another example is Samsung's move to Viet Nam. Case C also sets up a service facility near Samsung's cell phone factory in Viet Nam to provide local service.

Case C has been successful in managing knowledge with respect to socialization and internalization, and gets rid of prejudice of R&D personnel and senior worker. The key approach is to let all units in the organization face customer directly. An important practice is the establishment of "triple 3"rule, 1/3 time for customer contact, 1/3 time for creative thinking, 1/3 time for product development. For example, when companies like Panasonic or Sharp visit Case C's factory, or conduct supply chain qualification consultation, it will arrange R&D staff, production and quality engineers to interact directly with the visitors. This will help Case C absorb

knowledge and experience from international big companies.

Proposition 1b

Organizations facing a 'Technology-driven plus process type' environment tend to learn by outside sources, and emphasize socialization and internalization during organizational learning.

Case B's Management philosophy that pushes for development of new technology based on technical abilities and trend rather than operation completely centered on customers. As a national-level large complex organization, Case B need to be far ahead of the present R&D in terms of various kinds of technology. Case B focus on identifying "Where does the technology toward?" rather than " What is customer's needs. It leads customers' needs and creates a demand.

As technology-driven plus process type organization, because Case B required knowledge is highly specialized, changes quickly (highly replaceable), and needs to integrate various knowledge. Interdependency and knowledge complexity, caused by specialization and fast change, had an important factors to impact knowledge management in Case B. Therefore, Case B needs to absorb new external knowledge and confirm whether the R&D direction has kept up with the international trend. Due to professionalism and rapid changes, the KM method cannot be managed by the central unified system. Instead, each lab and each project plan by themselves and adopt diversified methods.

Case B prefers to adopt internalization and Personalization. The absorption of external knowledge is mainly through individual participation in external technical activities, such as seminars, technical exhibitions, education training, etc. In practice, Case B obtains knowledge from many equipment venders, and integrates those into new systematical knowledge. Furthermore, formal channels will be used to acquire knowledge at the organizational level (such as holding expert technical forums, expert consultation meetings, etc.). In the personalization process, This research found that Case B managed knowledge in the workplace by concentrating on interactions between people and sharing via a personalization strategy. For example, through group meetings to share experience, establish book clubs, and learn by doing to internalize the knowledge.

Proposition 2

Effective organizations with an emphasis on the learning pattern of socialization and internalization tend to adopt the KM strategy of personalization.

Personalization strategy is the main thrust for organizational learning in the apprenticeship environment, i.e. the knowledge workplace. Technical knowledge can only be transferred to others through observation and strategy implementation in the field. In addition, similar work experience is a prerequisite for sharing knowledge among colleagues. Hence, the individual, rather than the implementation of any systematic approach, is the predominant factor in knowledge creation and the learning process in the knowledge workplace.

The management on the knowledge created in the workplace focuses on managing knowledge held by the worker, such as tacit knowledge. The socialization process concentrates on the conversion of one's tacit knowledge into new tacit knowledge for others through social sharing and interactions among organizational members (e.g., apprenticeships).

This research found that Case B managed knowledge in the workplace by concentrating on interactions between people and sharing via a personalization strategy. Department activities encouraged socialization through inward learning on tacit knowledge. Furthermore, knowledge in science and technology research is highly unstructured and various, thus organizations need to enhance internalization process so that internal knowledge can keep up with international development. Case B emphasis promote information circulation using various interactive channels (e.g., on-the-job training, international conferences and routine communication sessions) rather than only using a systematic IT system or database for knowledge acquisition and storage. Case B's KM adopts Flexible and individual-oriented to improve the ability of the employee to perform the same task in different context (Information interpretation and organizational memory).

The development of emerging technology is associated with all sorts of deep knowledge, high uncertainty, and fast change speed. Therefore Case B is unable to pursue codification strategy for knowledge management. The reason that Case C adopts personalization strategy is twofold. First, a cell phone project has to satisfy specs document of the client company. However, the company often requires that

these specs document are only for the project use, and does not allow for other usage. Hence the knowledge provided by big cell phone companies can only be shaped into experience through internalization, and cannot be transformed into codification knowledge. Second, since the personnel turnover rate in Case C is lower than 5%, it will be easy to obtain experience within the organization. In addition, Case C's organization culture has a high regard for inter-unit knowledge sharing. Hence personalization is a very effective KM strategy to deal with versatile situations, as finding a suitable source of knowledge within the organization is not difficult.

The key successful factor of Case C's personalization strategy is inter-unit knowledge sharing. The technology barrier to key pad is not high, and the challenge lies in the combination of tooling, decoration, and material. Design to cost depends on the yield rate in the production line, affected by various factors like product design, quality control, etc. Hence inter-unit knowledge sharing can help solve problems associated with yield rate. Case C has a tutoring system for recruits. Every recruit will receive training in different departments, under the guidance of a senior staff in each department. The purpose is to accumulate cross-domain knowledge. As a result, when a staff negotiates an order with the client, he can address potential problems in production right from the beginning design stage. This will reduce time to market. The foundation of inter-unit knowledge sharing is long term personal relationship, which leads to a network of ties for sharing knowledge. Conducting a project in the organization is seldom involved with a single functional department, rather in a form of cross-department. Rather than the best practice solution, the focus of project meeting is about lesson learned in the project. In the project meeting, the problems of participating units are shared to explore the root cause of performance failure. The format of analysis based on experience learned from major cell phone companies is applied to identify the problem and find the solution. In addition, there is a design data base of key pad parts available for the analysis.

The Case D also adopted a personalization strategy, with KM practice involving workplace and process knowledge. During the early stages of KM project implementation, the Case D performed knowledge conversion via the processes of socialization and internalization. In the socialization process, the key is to share experiences in a common working environment and between common perceptions. In the internalization process, the focus is the "on-the-job learning" through

observation, on-the-job training and face-to-face communication.

6. Conclusion

The development of new technologies often creates a high degree of uncertainty, meaning the technology thus created is highly sophisticated, rapidly evolving and difficult to predict (Mohr, 2001; Panda & Rath, 2021). To deal with this uncertainty, knowledge management is critical in the development process. The creation, storage/retrieval, transfer, and application in knowledge management processes are essential for effective organizational knowledge management, and IT plays an essential role (Alavi & Leidner, 2001; Chatterjee et al., 2020). Despite these revelations, so far few systematic studies have examined how the antecedent variables of different levels inside and outside an organization can lead to versatile KM strategies.

Results from four cases studies show that a knowledge driving environment (comprising rates of environment change, organizational positioning, and task characteristics) influences organizational learning strategies, learning processes, and knowledge conversion processes in companies. Moreover, organizational learning strategies influence the selection of KM practices and strategies. The case studies also show that sources of environmental change include different kinds of uncertainty. These findings can offer insights into the management of knowledge strategies, and explains how these case companies interact with dynamic contexts both inside and outside the organization.

This study is contributed to both theoretical and practical perspectives. Theoretically, a framework is proposed for empirical studies to investigate the relationships between a knowledge driving environment, organizational learning, and KM strategies. The results also suggest that environmental uncertainty increases the need for organizational learning, while IT facilitates the handling of such uncertainty. In addition, organizational positioning and task factors influence organizational learning and the knowledge conversion processes. Finally, Different from the results of Imran et al. (2016), this study proposes an association between KM strategies and knowledge conversion processes in knowledge creation, and an association between KM strategies and related practices in knowledge dissemination. This paper's results

confirm the view of Scheepers et al.'s (2004) regarding the dynamic nature of KM, and extends their work by explaining how a knowledge driving environment and organizational learning factors can influence dynamic KM practices.

From a practical point of view, understanding the relationships among a knowledge driving environment, organizational learning, and KM strategies may provide a clue as to how firms can adjust knowledge management strategies to meet the needs of organizational learning, and can adjust such schemes to meet environmental challenges. Furthermore, managers will find it easier to determine which factors in a knowledge driving environment category are critical for the organizational learning process and knowledge creation.

This study focused only on exploring the antecedent factors from a knowledge driving environment. Future research might address more factors influencing organizational learning and KM from different aspects, such as cultural and dynamic capabilities. An interesting example is the knowledge enabler model of Lee & Choi (2003), which suggests four types of enablers: culture, organizational structure, people, and IT. Specific questions could include: what kind of culture is conducive to organizational learning, and what kind of dynamic capabilities can be established to deal with environmental issues and create a new KM structure to improve competitiveness through the use of IT? These questions require more research on the connections between organizational climate and KM, or the connections between organizational culture and KM.

Moreover, rather than test a certain theory, this study attempts to lay a theoretical foundation to expand our understanding about our world. Additional work is needed to determine the generalizability of the proposed theoretical model in a variety of circumstances, perhaps through large-scale quantitative research. Finally, this study is limited by its "cause" view for depicting knowledge management strategy in organizations. The results of this study show that KM strategies are tied to organizational learning and a knowledge driving environment. Appropriate knowledge management strategies may be derived from organizational learning activities to address challenges from internal and external knowledge driving environments. However, the current study does not address the "effect" view, and determining the impact of these KM strategies may be of interest for future research.

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