Knowledge management systems and developing sustainable competitive advantage

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Abstract Recent literature in the strategic management field suggests that firms must learn to re-bundle internal competencies and resources in order to maintain competitive advantages over time. Utilizing the resource-based view of the firm and dynamic capabilities perspectives, this paper examines the roles that absorptive and transformative capacity play in organizational innovation, with specific emphasis placed on the role and effectiveness of knowledge management systems as a determinant of innovation practices.

Introduction

Recent literature in the information systems field extols the virtue of knowledge management systems (KMS) as the next state-of-the-art innovation pertinent to business practitioners. For example, recent books and articles by authors such as Davenport and Prusak (1998), Johnson (1998), Zack (1999), and Alavi and Leidner (2001) emphasize the criticality associated with corporations developing organizational-wide KMS to create and maintain competitive advantages in increasingly dynamic business environments. In addition, it appears that organizations have been listening to and are receptive to these messages. In a survey conducted by EIU-Braxton Associates, growth-oriented companies list the development of KMS as the foremost information technology issue they face, with KMS defined as "networked systems that share information and leverage knowledge throughout the enterprise" and "provide Internet-based access to customers and suppliers worldwide" (*Country Monitor*, 1998). However, KMS, in isolation, serve as only one link in the chain involved in leveraging organizational resources to develop sustainable competitive advantage over time. The paper integrates the knowledge management literature with the organizational learning and resource-based view of the firm perspectives to compose an integrative process model examining the crucial role the KMS play in the development and maintenance of sustainable competitive advantages over time.

Theoretical background

This section starts by examining theoretical explanations for the role that information systems (IS) play in the development of sustainable competitive advantages in

organizations. One prevailing perspective is derived from the value chain analysis of Michael Porter, which posits IS as a support function within the organization, supplementing value-adding firm activities such as production and marketing (Porter, 1985). By comparison, the resource-based view of the firm (RBV) discusses the nature of resources possessed by organizations and details the qualities that such resources must maintain in order to be converted into sustainable competitive advantages over time (Barney, 1991; Wernerfelt, 1984). Advocates of this theory propose that an organizational resource must be valuable, rare, imperfectly tradable, and inimitable, in order to provide the firm with a sustainable competitive advantage (Barney, 1991; Markides and Williamson, 1996). In addition, the organization must possess the ability to effectively and efficiently exploit the full potential of its resources, in order to develop and maintain any potential competitive advantages (Barney, 1997).

However, there are also theoretical positions that note the limitations associated with the employment of any one firm resource (including information systems) in the development of a sustainable competitive advantage. Clemons (1986) and Clemons and Knez (1988) note that while information systems can provide firms with short-term competitive advantages (such as the SABRE reservation system in the airline industry and ATM machines in the banking industry), such advantages tend to be unsustainable due to rapid technological changes and competitive adaptation to increased customer expectations.

Indeed, recent extensions of RBV theory note that sustainable competitive advantages are not achieved through the strategic utilization of any one resource, but through the bundling and revitalizing of multiple, distinctive firm resources and competencies in order to create valued outputs capable of becoming sustainable competitive advantages (Black and Boal, 1994; Galunic and Rodan, 1998; Teece *et al.*, 1997). For example, a pharmaceutical firm with a sustainable competitive advantage in new drug development due to its R&D activities might bundle activities and policies such as an information systems-based learning and knowledge seeking culture, higher pay and benefit systems relative to competitors, recruitment of personnel with strong research skills and histories, and a culture that encourages experimentation and risk-taking activities, in order to build and maintain such a R&D-based competitive advantage.

However, the development of a competitive advantage in a specific functional area does not ensure the stability of this competitive advantage over time. D'Aveni (1994) argues that many firms operate in hypercompetitive environments where competitive advantages are temporarily sustainable at best, primarily due to rapid shifts in technology advancements and competitor responses to strategic activities. This perspective is complementary to the dynamic capabilities framework of Teece *et al.* (1997), who maintain that as business environments increase in dynamism and complexity, firms lose the ability to incrementally adapt and maintain existing competitive advantages. According to this framework, the key to the establishment of sustainable competitive advantage relates to the firms' abilities to bundle competencies and resources in order to build competitive advantage, while

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"exploiting existing internal and external firm-specific competencies to address changing environments" (Teece *et al.*, 1997, p. 510). Organizations possessing such skill can scan environments for threats, opportunities, and pressures to change, build strategic competencies through learning to meet environmental requirements and customer needs, and bundle existing competencies with acquired or developed resources to extend or create competitive advantages.

This research merges the aforementioned perspectives of Porter (1985), Barney (1991), and Teece *et al.* (1997) by noting the distinctive contribution that information systems, specifically knowledge management systems, offer in the development of sustainable competitive advantages. The main thesis of this paper is that while information and knowledge management systems alone do not possess the qualities required to provide organizations with sustainable competitive advantages, the bundling of KMS with other firm resources and core competencies is the key to developing and maintaining sustainable competitive advantages through product and process innovation. In such a position, KMS play a major role in the conversion of learning capabilities and core competencies into competitive advantages and sustainable competitive advantages, by enabling and revitalizing the organizational learning and resource development processes.

At this point, it is important to distinguish between an organization's information system and knowledge management system. While the IS refers to the hardware, software, and processes that organizations utilize to facilitate communication and information processing, the KMS of a firm in an IS sub-system, specifically a firm-based network that enables the acquisition, storage, distribution, and retrieval of organizational knowledge and information (Alavi and Leidner, 2001; Huber, 1991; Zack, 1999).

Knowledge acquisition involves the intra-organizational processes facilitating tacit and explicit knowledge creation, codification, and transfer from individual members to the organization and the entry of this knowledge into the KMS, as well as the identification and absorption of information and knowledge from external sources (Garvin, 1993; Huber, 1991). Knowledge storage refers to organizational memory processes, where information and knowledge are formally stored in the KMS physical memory systems, and informally retained in the values, norms, and beliefs associated with organizational culture and structure (Walsh and Ungston, 1991). Knowledge distribution relates to "processes by which new information from different sources are shared", eventually leading to the creation of new information, knowledge, and understanding (Huber, 1991, p. 90). Finally, knowledge retrieval is associated with the ability of organizational members to locate, access, and utilize information and knowledge stored in the formal and informal memory systems of the organization (Huber, 1991; Walsh and Ungston, 1991; Zack, 1999). This paper regards KMS as a specialized learning resource, and specifically seeks to examine the role that KMS play in providing organizations with access to internal and external information and knowledge streams that fuel their innovation and competitive advantage establishment and maintenance processes (Alavi and Leidner, 2001).

There are several types of innovative and learning-based organizational activities through which KMS can make direct contributions to the development of sustainable competitive advantages. Examples of such activities include:

- Absorptive capacity – refers to an organization's ability to "recognize the value of new, external information, assimilate the information, and then apply the learned

> **“ The bundling of KMS with other firm resources and core competencies is the key to developing and maintaining sustainable competitive advantages. ”**

knowledge to it's own internal product and service outputs'' (Cohen and Levinthal, 1990, p. 128). The development of absorptive capacity is critical in the revitalization of existing competitive advantages and the creation of new core competencies and competitive advantages over time.

- Transformative capacity – refers to an organization's ability to gather, assimilate, synthesize, and re-deploy relevant knowledge and technology previously developed internally into new technologies and processes designed to meet the organization's specific, current needs (Garud and Nayyar, 1994). Transformative capacity is an internally-driven process that aids in the extension of existing competitive advantages and the creation of new, more effective and efficient products and processes.
- Provision, circulation, and storage of internal reports and information needed to utilize firm resources effectively and efficiently.
- Creation, processing, and distribution of data into information and knowledge to be assessed by organizational members for strategic decision-making.
- The examination of the external environment for identification of competitor activities and potential strategic learning opportunities such as joint ventures, mergers, and acquisitions (Hambrick, 1981).

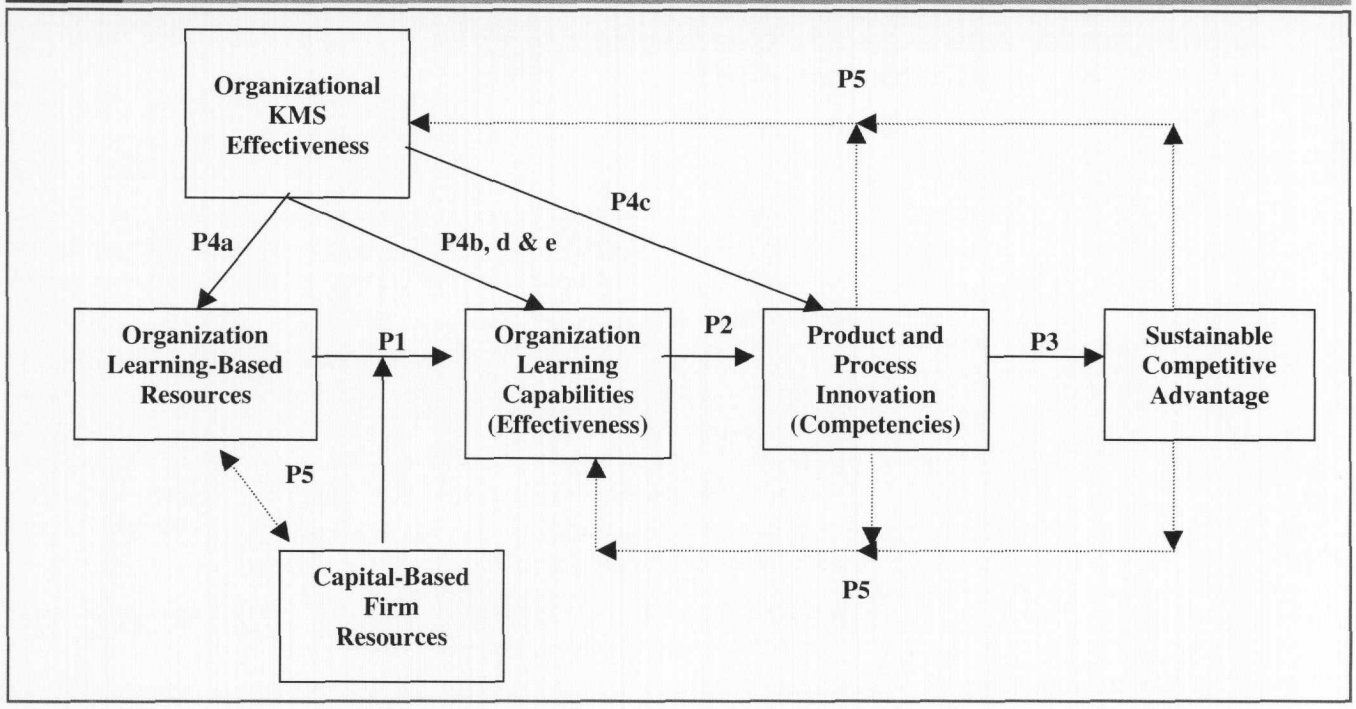
The remainder of this paper will develop a process model detailing the means by which organizations build and revitalize sustainable competitive advantages in learning environments, and specifically examine the role of KMS play in the innovation process. A major assumption of this paper is that organizations seeking to employ and develop KMS in the building and maintenance of competitive advantage will fit the categorization of a learning organization. For the purposes of this paper, the Garvin (1993) definition of a learning organization is utilized. Garvin (1993, p. 80) defines the learning organization as ''an organization skilled at creating, acquiring, and transferring knowledge, and modifying its behavior to reflect new knowledge and insights''. Based on the process model emphasized in this paper, this definition for the organizational type being studied.

Model construct definitions

This paper focuses on the processes by which organizations develop and maintain innovation systems to build sustainable competitive over time. Figure 1 illustrates the proposed conceptual model, and the model constructs are defined as:

Organizational learning-based resources. Organizational learning-based resources refer to the combined internal and external data and information streams, created knowledge, and variety of sources that an organization can assess and employ in the learning and decision-making processes. Basically, the learning resources represent the storehouse of information and knowledge that the organization has built and developed over its learning history, along with external inputs into the organization's knowledge management and development processes (Bedeian, 1986; Ghoshal and Kim, 1986). In the framework of this paper, learning-based resources are the

Figure 1 KMS-sustainable competitive advantage development process model



information and knowledge gathered and processed through the KMS and made available to organizational members to facilitate product, service, and process innovation.

Organizations typically build their learning resources through externally focuses activities such as benchmarking, technology brokering, and environmental scanning, along with internally focused systems such as Intranets, firm-wide databases, and cross-functional teams designed to facilitate information exchange and knowledge management across organizational levels and locations (Hambrick, 1981; Drew, 1997; Lei, 1997). A foundation element of this model is that organizations build absorptive capacity through externally focused information and knowledge gathering and implementation activities, while transformative capacity is developed through internally focused information and knowledge sharing and development processes (Cohen and Levinthal, 1990; Garud and Nayyar, 1994).

Capital-based firm resources. This construct refers to the financial, physical, human, and organizational capital that the organization employs and utilizes to implement strategies designed to improve firm efficiency and/or effectiveness (Barney, 1991; Daft, 1983; Hitt *et al.*, 1999). Financial capital includes all the monetary resources the firm can employ to develop and implement its strategies (Barney, 1997). Examples of such resources include seed money from banks and venture capitalists, retained earnings, and stock and bond-based income. Physical capital refers to resources such as the organization's plants and equipment, technology, and access to required raw materials (Hitt *et al.*, 1999; Williamson, 1975). Human capital includes the training, experience, judgment, intelligence, and insights of individual managers and employees of the organization (Barney, 1991; Becker, 1964). Organizational capital includes the firm's formal reporting structure for planning, controlling, and coordinating systems, along with the internal and external networks members can consult to access needed information and resources (Barney, 1991).

> **“Human capital includes the training, experience, judgment, intelligence, and insights of individual managers and employees of the organization.”**

The other concept essential to a discourse on capital-based resources deals with organizational slack. Organizational slack refers to the existence of a "pool of resources in an organization that is in excess to the minimum necessary to produce a given level of organizational output" (Nohria and Gulati, 1995, p. 32). Prior research suggests that the relationship between organizational slack and innovation has an inverted-U shape, where either too little or too much slack can inhibit the organizational processes firms employ to innovate (Bourgeois, 1981; Nohria and Gulati, 1995). This paper maintains that a firm's learning capacity is determined and limited by the nature and variety of resources that the organization can bundle and apply to the maintenance and development of competitive advantages, along with the availability of slack resources to be applied directly to learning and innovation efforts.

Organizational learning capabilities. A key link in the organizational learning structure relates to the internal processes organizations utilize to convert their learning and capital-based resources into desired outputs (Grant, 1996; Prahalad and Hamel, 1990). For the purposes of this paper, these processes are summarized in the construct of organizational learning capabilities. Specifically, this term refers to the strategic planning, information and knowledge management, internal processes, and cultural systems and styles learning organizations build and use to effectively and efficiently convert internal and external data, information, and knowledge inputs into knowledge-based outputs (Goh, 1998; Masoulas, 1998). A key linkage in this model concerns the development and maintenance of absorptive and transformative capacity skills, in order to build new organizational capabilities, as well as extend and revitalize existing organizational capabilities.

Organizational innovation as a distinctive competency. Organizational innovation is viewed as the functional systems and processes organizations utilize to upgrade their existing products, services, and processes, along with the creation and introduction of new products, services, and processes (Tushman and Anderson, 1986). Based on the work of Penrose (1959), Cohen and Levinthal (1990), Teece *et al.* (1997), and Galunic and Rodan (1998), we propose that organizations innovate through learning processes that enable the firm to re-bundle and revitalize existing and newly acquired resources into core competencies and competitive advantages, and by applying internally and externally created knowledge and technology to develop new products, services, and processes. The primary differences between core competencies and distinctive competencies deal with the general evaluative focus of the internal processes. While core competencies refer to the internal evaluation of the relative effectiveness and efficiencies of organizational processes, distinctive competencies and innovation deal with the organization's relative effectiveness and efficiency relative to competitors. For example, an organization may have a core competency regarding production efficiency with little or no defects, but this core competency can become a distinctive competency only if rival firms do not possess the same production capabilities. In such cases, core competencies protect against competitive disadvantages, while distinctive competencies contribute to competitive advantages.

Sustainable competitive advantage. Sustainable competitive advantage relates to the organization's ability to consistently maintain and earn returns on investments above the average for its industry (Porter, 1985; Clemens and Row, 1991). Such returns are typically realized either by realizing the benefits from product and process innovation (differentiation), and/or incurring lower production and distribution costs relative to competitors (cost leadership) (Porter, 1985; Clemons and Row, 1991). This distinction is important because while much of the absorptive and transformative capacity works focus on new product and service development as an innovation process, these capacities can also contribute to sustainable competitive advantage through the building and revitalization of production and service processing systems in order to achieve and maintain superior cost positions relative to competitors (Porter, 1985).

Organizational KMS effectiveness. The organizational KMS effectiveness construct refers to the organization's ability to access, maintain, and contribute data, information, and knowledge necessary for the development of absorptive and transformative capacities. This construct rates the effectiveness of the organization's knowledge acquisition and management systems by measuring the relative contribution that the IS function, and specifically the KMS, provides in the core competencies and competitive advantage development processes. Elements that are likely to impact KMS effectiveness include organizational member trust that knowledge imputed into the KMS will be used and rewarded fairly, perceived user friendliness, ability of the user to identify system contents and recall desired information, system facilitation of knowledge contribution to the system, and system ability to access and acquire information from internal and external sources (Alavi and Leidner, 2001; Davenport and Prusak, 1998).

Paper propositions

Based on the model displayed in Figure 1, five main propositions are offered for consideration and future study. One of the key assumptions of this paper is that organizations develop competitive advantages through the bundling and synergistic merging of various firm resources (Black and Boal, 1994; Galunic and Rodan, 1998; Teece *et al.*, 1997). However, a main goal of this paper involves extending these RBV-based by examining innovation activities through the bundling of learning and knowledge-based resources with capital-based firm resources. By bundling learning and capital-based resources in such a manner, organizations can expand their existing capabilities by applying new technologies and knowledge advances to current products, services, and processes (similar to the competency-enhancing effects discussed in Tushman & Anderson (1986), and exploration learning effects of March (1996)). As a result, the ability of an organization to build learning capabilities is dependent on the combination and availability of both learning and capital-based resources.

> **Proposition 1.** The relationship between organizational learning-based resources and organizational learning capabilities is moderated by the variety and availability of capital-based firm resources and organizational slack.

One of the primary determinants of the success of a learning-based culture relates to the extent to which an organization can achieve both learning capabilities and core competencies. Organizations implementing learning systems may strive not only to improve internal systems, but to also differentiate the outputs of those systems from those of competitors. One manner to achieve such as breakthrough is by combining newly acquired and/or developed knowledge and technology with organizational slack resources to develop, produce, and deliver new, frame-breaking products,

services, and resources (similar to the competency-destroying effects developed in Tushman and Anderson (1986), and the exploration learning effects in March (1996)). Such effects tend to alter the competitive nature of an industry through the introduction of new products, services, and processes that provide the innovator with favorable cost or product differentiation positions relative to competitors (or in the ideal situation, both cost and differentiated product advantages) (Porter, 1985). In this framework, organizations develop competency-enhancing and competency-destroying core and distinctive competencies by building transformative and absorptive capacities and enabling organizational learning and innovation via internally and externally generated knowledge (Cohen and Levinthal, 1990; Garud and Nayyar, 1994; Tushman and Anderson, 1986). As a result:

> **Proposition 2.** Organizations convert learning capabilities into core and distinctive competencies such as product and process innovation, through the active application and utilization of the principles of transformative and absorptive capacities.

Once an organization has realized distinctive competencies and competitive advantages through product and process innovation, how do these firms maintain such advantages? Due in large part to the rapid nature of environmental and technological change and increased competitive effects generated by to global business environment, Analog Devices CEO, Ray Stata, has argued that organizational learning is the only true sustainable competitive advantage available to firms (Stata, 1989). With this statement Stata supports the main thesis of this paper, that organizations gain and maintain competitive advantages through the systematic application of learning, knowledge acquisition, and knowledge application via product, service, and process innovation activities. This learning perspective is consistent with the positions of D'Aveni (1994), Teece *et al.* (1997), and Galunic and Rodan (1998), with each emphasizing that the only sustainable advantage pertinent in today's business environment relates to the organization's ability to innovate and create or reinvent advantages through the creation of new products and processes emphasizing greater effectiveness and/or efficiency (Stata, 1992; Tushman and Anderson, 1986). Therefore:

> **Proposition 3.** Organizations create and maintain competitive advantages through the constant development of learning and innovation processes, in an effort to revitalize existing products, services, and processes and create new products, services, and processes.

The next series of propositions examine the role that KMS play in the acquisition and building of learning-based resources, along with the development of learning competencies. The role of the KMS in this process model involves:

- The accessing of external technology, information, and knowledge streams that the organization can utilize in the development of absorptive capacity to recombine existing resources into new core and distinctive competencies (Cohen and Levinthal, 1990; Galunic and Rodan, 1998).
- The coordination of internal technology, information, and knowledge to aid in the development of transformative capacity, again in the effort to recombine existing resources into new core and distinctive competencies (Galunic and Rodan, 1998; Garud and Nayyar, 1994).
- The maintenance of core and distinctive competencies through environmental scanning activities, aiding in the facilitation of competitor benchmarking and the strategic assessments of industry rivals (Alavi and Leidner, 2001; Hambrick, 1981).

The KMS also influences the organization's ability to develop absorptive and transformative capacities over time. As absorptive capacity refers to an organization's ability to identify, assimilate, and apply external information and knowledge streams to product, service, and process innovation, the key KMS functions that facilitate absorptive capacities are the acquisition and distribution processes (Alavi and Leidner, 2001; Cohen and Levinthal, 1990, 1994; Huber, 1991). The organization's ability to develop absorptive capacity grows as the firm is able to identify and access external information and knowledge sources pertinent to its innovation efforts, and then distribute this knowledge to organizational areas were that information and knowledge may be best utilized in its innovation development activities (Cohen and Levinthal, 1990).

The key KMS functions shift somewhat, as organizations seek to develop transformative capacity. Since transformative capacity refers to an organization's ability to re-deploy previously developed internal information and knowledge and technology to build new innovations that meet current and future organizational needs, the KMS functions of storage, retrieval, and distribution are essential to transformative capacity development (Alavi and Leidner, 2001; Garud and Nayyar, 1994; Huber, 1991). The firm's ability to develop its transformative capacity should grow as the KMS enables organizational members to store potentially vital knowledge into the KMS, and allows members to identify the existence of and retrieve stored knowledge as future uses of that knowledge arise (Garud and Nayyar, 1994). Finally, the KMS should work to facilitate communication and knowledge exchange across different organizational entities that share knowledge, learning interests, and experiences. The greater the effectiveness of the KMS in fulfilling these various roles, the more likely that the organization will be able to innovate its products, services, and processes via absorptive and transformative capacity means. Therefore:

Paper propositions

Proposition 4a. The effectiveness of the KMS function will be directly and positively associated with the variety and quality of internal and external information and knowledge streams available for innovation application.

Proposition 4b. The effectiveness of the KMS function will be directly and positively associated with the development of learning-based capabilities, through product, service, and process development and innovation.

Proposition 4c. The effectiveness of the KMS function will be directly and positively associated with product and process innovation, through the internal development and revitalization of firm products, services, and processes, along with external benchmarking of competitor and referent activities.

Proposition 4d. The firm's ability to develop absorptive capacity over time will be primarily influenced by the KMS effectiveness in its acquisition and distribution processes.

Proposition 4e. The firm's ability to develop transformative capacity over time will be primarily influenced by the KMS effectiveness in its storage, retrieval, and distribution processes.

The final proposition relates to the learning and experience effects associated with innovation through absorptive and transformative capacity development. Cohen and

Levinthal (1990) note that the assimilation and use of prior knowledge and learning facilitates later knowledge and learning experiences. In addition, significant experience effects impact learning environments and situations as individuals and groups start to differentiate between flawed information and knowledge sources, develop efficient problem-solving routines, and communicate accurate and flawed inquiry experiences through the KMS (Alavi and Leidner, 2001; March, 1996; Ruggles, 1999). In addition, prior experience in bundling learning and capital-based resources should enable firms to identify and acquire resources needed in the effective and efficient development of new competitive advantages. These knowledge assessment and KMS input processes are illustrated by the dotted lines in Figure 1, representing knowledge transfers back into the system and its users concerning previous learning experiences and outcomes. Therefore:

> **Proposition 5.** Organizational learning systems will tend to gain effectiveness over time, as learning and experience effects are transferred into the KMS system, work, and decision-making processes.

However, in Levinthal and March (1993), the authors warn of competency traps in learning environments, referring to a tendency for individuals, groups, and organizations to become comfortable and secure in past success, thus failing to prepare for environmental and competitor changes and adaptations. In addition, Sitkin (1995) urges organizations to develop a learning culture that emphasizes the need to learn from failure as well as success. Such organizations do not punish their members for small failures, instead encouraging the sharing of negative experiences so that other organizational members and groups avoid traveling down the same path. In summary, organizations instilling learning culture must seek temporal balance, learning from past experiences while remaining uncomfortable with what works today, and also seeking out and pushing towards new strategic goals and anticipated costumer needs.

Paper conclusions and contributions

As much of the current research in organizational learning and innovation development would indicate, the primary challenge of this stream involves empirically testing many of its conceptual foundations. While many scholars acknowledge the face validity associated with the learning concepts, empirically validating the direct and indirect contributions that organizational learning provides its practitioners remains a complex task. However, there are also strong incentives and benefits available relative to meeting these challenges. This paper offers some direction in seeking to test learning propositions and concepts, by emphasizing the importance of separating out the organizational resources and competencies in its innovation activities, in an effort to identify and understand each interacts to influence innovation. In addition, the literature and this paper suggests that firms re-bundle resources and competencies in different combinations in order to extend existing competitive advantages and develop new advantages. It could be especially interesting to employ a case study methodology to examine the processes firms employ to revitalize products, services, and processes, and to investigate the formal and informal nature of these change mechanisms. Finally, this work seeks to emphasize the specialized role that KMS play in acquiring and distributing information and knowledge to facilitate innovation.

This paper focuses on the use of technology – specifically knowledge management systems – to facilitate organizational learning and innovation processes. However, it is

vital to note that the primary determinant of the effectiveness of such systems relates to the nature of the organization's culture. Those organizations that have successfully implemented organizational learning principles emphasize the importance of building a culture where knowledge development and sharing is both valued and rewarded (Alavi and Leidner, 2001; Brown and Daguid, 1996; DiBella *et al.*, 1996). The building of trust in both the technology and people using the technology for learning and innovation practices underlies the success of knowledge management and knowledge management systems.

As the work of D'Aveni (1994) and Teece *et al.* (1997) indicates, the long-term viability of any firm operating in dynamic and complex environments will ultimately be determined by its ability to learn and innovate successfully. While the innovation research has tended to discuss and consider transformative and absorptive capacities as separate and distinct constructs, an argument can be made that all firm innovation involves the meshing of transformative and absorptive capacities to facilitate the merging of externally and internally generated knowledge to generate new products and services. While the consideration of both of these capacities as separate entities has advanced our understanding of innovative organizational activities, we have reached a point where the merging of these complementary perspectives will provide a more comprehensive picture of innovation behaviors.

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