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MANAGING TECHNOLOGICAL INNOVATION THROUGH EFFECTIVE ORGANIZATIONAL LEARNING

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Abstract:

With the rapid change and intensive competition in the emerging global economy, the capability to capture, absorb, and develop new knowledge is a key success factor for organizations.

Through effective organizational learning, companies will have the speed, innovation, and quality essential to respond competently to the growing expectations of customers and to the threats of competitors. We first examine the strategic role of technological innovation and then examine the importance of organizational learning in creating and managing technology-based innovation. We then propose several factors which influence the rate and effectiveness of organizational learning. Finally, we advance several managerial implications.

Özet:

Teknolojik Yeniliğin Örgütsel Öğrenme Yolu İle Yönetimi

Küresel ekonomide ortaya çıkan hızlı değişim ve yoğun rekabet ortamında yeni bilgiye ulaşmak, bu bilgileri içselleştirmek ve geliştirmek firmalar için temel başarı faktörleridir. Firmalar, etkili örgütsel

Keywords: Technological innovation, learning organization, learning outcomes.
Anahtar Sözcükler: Teknolojik yenilik, örgütsel öğrenme, öğrenmenin sonuçları.

öğrenmeyle, rekabet tehditlerine ve müşteri beklentilerine daha hızlı, kaliteli ve yenilikçi yollarla cevap verebileceklerdir. Bu çalışmada ilk önce, teknolojik yeniliklerin stratejik rolü üzerinde durularak, örgütsel öğrenmenin teknoloji temelli yenilikleri yaratma ve yönetmedeki önemi incelenmiştir. Daha sonra, örgütsel öğrenme verimliliğini etkileyen başlıca temel faktörler açıklanarak, bunların yönetimsel uygulamaları üzerinde durulmuştur.

INTRODUCTION

The dimensions and the standards of organizational success change rapidly and sometimes, radically. Change is an organizational reality. Management experts and corporate executives are increasingly speaking of a "paradigm shift" in management thought. Business has entered the knowledge era, where information is power and learning rapidly and competently is seen as the prominent strategy for global success (Marquardt and Reynolds, 1994: 3-4). Thus, only those organizations that can adapt quickly and continuously will survive and prosper in the new millennium. The ability to adapt and innovate with increasing speed requires new ways of organizational thinking, acting, and most importantly, learning.

Accelerating the rate of organizational learning is key to discovering new and better solutions and linking them to customer satisfaction and competitive advantages. As management strategist, M. J. Kiernan writes: "Propelled by the competitive exigencies of speed, global responsiveness, and the need to innovate constantly or perish, and enabled by new information technologies, learning will become the only viable alternative to corporate extinction." (Schwandt and Marquardt, 2000: 2).

In our paper, we examine organizational learning as applied to technological innovation and then examine the importance of organizational learning in creating and managing technological innovation. We then propose several factors which enable organizational learning. Finally, we advance several managerial implications.

ORGANIZATIONAL LEARNING OF TECHNOLOGICAL INNOVATION

A. The Strategic Role of Technological Innovation

One of the most important roles progressive organizations perform is that of change agents which bring innovation to customers and markets. Innovation

provides the means whereby customer demand can be effectively satisfied. Quinn, Baruch and Zien (1997: 7) note that *innovation* consists of the social and managerial processes through which solutions are first translated into social use in a given culture. These authors also note that technological innovation involves a novel combination of art, science, or craft employed to create the goods and services used by society. Christensen (1997: 11) explains *technology* as the processes by which an organization transforms labor, capital, materials, and information into products and services of greater value. His concept of technology includes engineering and manufacturing processes as well as marketing, investment, and managerial processes. Technological innovation requires to use of new technological or market knowledge to offer new products or services to customers.

It is undeniable that the processes of technological innovation are critical to societal evolution (Tornatzky and Fleischer, 1990: 4). One can easily observe the impacts new computer-based information systems and new databases have had on nearly every industry and in our daily lives (e.g., Aaker, 1998: 102).

Technological innovation also is a significant part of the renewal function of organizations. Firms must create new products and/or services and adopt new technologies if they are to compete successfully (Robbins and Coulter, 1996: 444-448). In the 1990s, for example, Intel Corporation has been one of the world's most profitable companies. Intel's stock price rose at a 48% compound annual growth rate in the last 10 years. In 1999 alone, it earned $29.4 billion net revenues. Sony, founded in 1946, had $63 billion sales in 1999. Still, the standard of innovation to which many organizations strive is that achieved by the Minnesota Mining and Manufacturing (3M). 3M is known for its successful innovations, from Scotch Tape to Post-it Notes and has achieved legendary status in product innovation. The common and distinguishing element in these cases is innovation. Thus, for many firms, competitive advantage is gained and maintained through continuous innovation (Afuah, 1998: 2). Some argue that no other organizational task is more vital and demanding than the sustained management of innovation (Tushman and Nadler, 1996: 4-93).

What is needed to make business organizations more innovative? One answer is highly progressive business and innovation strategies which include organizational learning. A firm's innovation strategy – its goals, timing, actions, and resource allocation efforts in using new knowledge to offer new products or services – plays a crucial role in creating and using the right competencies and assets in the environment in which it operates. There are several strategies that can be useful including offensive, defensive, imitative, dependent, traditional, and opportunist (e.g., Afuah, 1998: 28-29; Parker, 1978: 41).

Knowledge plays an important role and all companies need organizational learning ability. However, there are differences in learning efforts depending on the type of innovation strategy. In order to be successful in applying these strategies, the organization and its structure needs to be aligned with its strategy. Meyer and Utterback (1995: 298) note, "development of novel technologies for unfamiliar markets and latent markets requires a great degree of experimentation and learning to reduce uncertainty." The decision on which types of technologies to learn and when to begin learning is closely related to the innovation strategy a firm pursues. When firms have limited experience and resources to learn about innovative technologies, they have difficulty in pursuing an offensive strategy. Only a few firms are able to pursue an offensive strategy by employing new, unproven technologies, which can produce market distinction and technological competencies and can also lead to undesirable project outcomes such as high product unit-cost, late development process, or failures. On the other hand, the firm with a defensive innovation strategy needs to learn rapidly and to innovate differently, since the "gap in market entry" and differentiation are vital to defensive strategy firms. Compared to the offensive strategy or the defensive strategy firms, those firms pursuing imitative, traditional, or opportunist strategies have less difficulty in learning the technologies since they enter markets later and learn from the technologies already developed. The technology to be learned is not new and they would not seek alternative technologies.

B. Organizational Learning

Argyris and Schön (1978: 3-4) note that "Organizational learning is the process by which organizational members detect errors or anomalies and correct them by restructuring organizational theory in use." Comparing organizational learning to individual learning, Stata (1989:73-74) observes that organizational learning occurs through shared insights, knowledge, and mental models. Further, learning builds on past knowledge and experience, which depends on institutional mechanisms used to retain knowledge.

For a better understanding of organizational learning, the types of learning that result from detecting and correcting errors in organizational theories being used need examining. According to Argyris (1999: 7-11), learning occurs under two conditions. First, learning can occur when an organization achieves what it intended -- a match between its design for action and its outcomes. Second, learning can occur when a mismatch between intentions and outcomes is identified and is corrected -- a mismatch turned into a match. Whenever an error is detected and corrected without questioning or altering the underlying values of the system, the learning is considered *single-*

loop learning. However, *double-loop learning* occurs when mismatches are corrected by first examining and altering the governing variables and then the actions. Single-loop and double-loop learning are diagrammed in Figure 1.

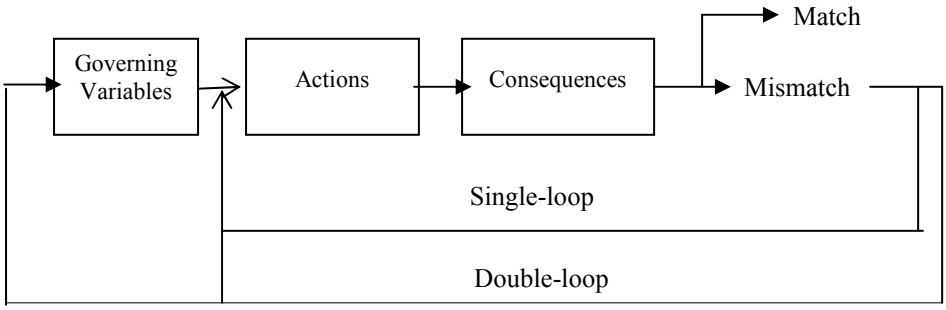

Figure 1. Single-loop and Double-loop Learning

Source: C. Argyris (1999), *On Organizational Learning*, 2nd ed., Malden, MA: Blackwell Publishers Inc., p. 68.

The efficacy of learning and the nature of change are inextricably bound. Continuous change suggests the appropriateness and efficacy of single-loop learning, but the necessary mode of learning under conditions of discontinuity is double-loop learning (Douglas and Wykowski, 1999: 13). While single-loop learning rarely leads to significant change in a firm's basic assumptions, double-loop learning involves changing an organization's culture (Yeung, Ulich, Nason and von Glinow, 1999: 24-28).

Argyris and Schön (1978: 4) report that when an organization engages into *deutero learning*, its members learn about organizational learning and encode their results in images and maps. They call this phenomenon "learning about learning." Deutero-learning refers to an organization's or individual's learning from critical reflection on taken-for-granted assumptions (Marquardt and Reynolds, 1994: 28). Double-loop and deutero learning are generative or creative types of organizational learning.

C. Importance of Organizational Learning to Technological Innovation

The outcome of organizational learning provides competitive advantages for firms in the market place. It is possible to identify the outcomes that are

frequently associated with individual, team, and organizational learning efforts (Preskill and Torres, 1999: 108-110):

a) Learning Outcomes Which Can Benefit Individuals:

- understand how their actions affect other areas of the organization
- develop greater sense of personal accountability and responsibility for the organization's outcomes
- take greater risks
- engage in more coaching and consultation
- develop creative solutions
- share the work and responsibilities

b) Learning Outcomes Which Can Benefit Teams and Organizations:

- develop new products, services, and technologies
- increase productivity and profits
- increase morale, improved work climate
- experience less turnover
- experience less waste and error
- provide more satisfying services to customers
- create change more quickly and with less effort

To maximize these outcomes, organizations need to develop and maintain a supportive infrastructure for learning to take place throughout the organization. As a desired end, a learning organization is one that has a climate that encourages and accelerates individual, team, and overall organizational learning. Learning organizations continuously transform themselves (Bierema, 1999: 46-56). Learning organizations also help employees understand the critical thinking underlying what the organization does and why it does it. This capability helps organizations learn from mistakes as well as successes. A summary of the most important features of a learning organization are recorded in Table 1.

Table 1. Qualities of Learning Organizations

- Capitalizes on uncertainty as an occasion for growth
- Creates new knowledge with objective information, subjective insights, symbols, and hunches
- Embraces change
- Encourages accountability at the lowest levels
- Encourages managers to be coaches, mentors, and facilitators of learning
- Has a culture of feedback and disclosure
- Has shared organization wide vision, purpose, and values
- Has decentralized decision making and employee empowerment
- Has leaders who model calculated risk taking and experimentation
- Has systems for sharing learning and using it in the business
- Is customer driven
- Is involved in its community
- Links employees' self development to the development of the organization as a whole
- Provides frequent opportunities to learn from experiences
- Uses cross-functional work teams
- Views the organization as a living, growing organism
- Views the unexpected as an opportunity to learn

Source: M. Marquardt and A. Reynolds (1994), *Global Learning Organization: Gaining Competitive Advantage through Continuous Learning*, New York: Irwin Professional Publishing, p. 23.

Continuous learning becomes crucial in innovating and achieving a competitive advantage, particularly in technology-based organizations. The essence of innovation management lies in its ability to continually enhance an organization's knowledge base. This implies that individuals involved in innovation projects be engaged in a constant process of learning. These individuals would then transmit their learning to others and the cumulative knowledge acquired from projects should be embodied in the organization (Ayas, 1999: 176-180). Iansiti (1993: 108-117) notes that when it comes to transcending the product generation gap, efficiently transferring knowledge is essential. But without fundamental changes to the entire R&D process, such as the use of integration teams to facilitate organizational learning, R&D is likely to be inefficient. Involving engineers in the integration of *several* product generations is necessary to allow them to transfer valuable knowledge. Kim (1997: 86) defines technological capability as "the ability to make effective use of technological knowledge to assimilate, use, adapt, and change existing technologies" and notes that it also enables one to create new technologies and

to develop new products and processes in response to the changing economic environment. The dynamic process of acquiring a technological capability is referred to as technological learning.

ENHANCING ORGANIZATIONAL LEARNING OF TECHNOLOGICAL INNOVATIONS

Organizational learning is the capacity or processes within an organization to maintain or improve performance based on experience (Nevis, DiBella and Gould, 1995: 73-85). An organization's learning capacity can be defined as its ability to learn individually and collectively. We conceive of this evolving ability as an aggregate indicator measuring an organization's progress towards becoming a learning organization and is composed of a variety of dimensions. This capacity is constituted by individual or collective capacities to learn, but also needs to include organizational capacities. Finger and Brand (1999: 130-141) note that individual capacity to learn corresponds with an individual's ability and competence. There is, for example, the ability to think systematically, critically, and openly. They also note that collective learning capacities characterize groups of individuals solving problems and dealing with important organizational issues. Indeed, as organizational learning theory argues, an organization's learning capacity results, in part, from the successful interaction among individuals and groups as they deal with important organizational issues.

A. Factors Influencing Organizational Learning

In order to discover new management tools and methods to accelerate and improve organizational learning, it is necessary to identify the factors influencing (or the characteristics relating to) organizational learning. Garvin (1993: 78-91), for example, mentions that learning organizations are skilled in the following activities: systematic problem solving, experimentation with new approaches, learning from their own experience and past history, learning from the best practices and experiences of others, and transferring knowledge quickly and efficiently throughout the organization. Nonaka and Takeuchi (1995: 25-28) suggest several characteristics of knowledge-creating companies: expressing the inexpressible by using metaphor and analogy, disseminating knowledge by sharing an individual's personal knowledge with others, and acquiring new knowledge in the midst of ambiguity and redundancy. Relating to "redundancy," they illustrate that a product development team is divided into competing subgroups that develop different approaches to the same project and then argue over the advantages and

disadvantages of their proposals. From this procedure, the team eventually develops a desirable approach and shares a common understanding of it. Kim (1997: 92-94) illustrates the dual approach used in the development of 256K DRAM and 1M DRAM at Samsung. Antonacopoulou (1999: 120) notes several factors facilitating learning in organizations (see Table 2).

Table 2. Factors Facilitating Learning

- Encouraging managers to identify their own learning needs
- Regularly reviewing performance and learning
- Providing feedback both on performance and learning
- Reviewing managers' performance in developing others
- Assisting managers to recognize learning opportunities on the job
- Providing or facilitating the use of training on the job
- Tolerating some mistakes
- Encouraging the planning and review of learning activities
- Challenging traditional ways of doing things

Source: E. Antonacopoulou (1999), "Developing Learning Managers within Learning Organizations: The Case of Three Major Retail Banks," in Easterby-Smith, M., Burgoyne, J. and Araujo, L. (eds), *Organizational Learning and the Learning Organization*, London: Sage Publications, p. 220.

Based on the previous research, we advance behavioral and structural factors which influence organizational learning. The factors are consisting of management actions, such as, culture, qualifications, organizational design, and leadership play a crucial role in a learning system to reach desired outcomes. Understanding these factors described below can be helpful in creating a learning organization.

Developing a learning culture: Developing a culture that encourages learning is fundamental to organizational learning. The significance of the context in which learning takes place has been receiving increasing attention. A basic requirement is a climate that encourages, facilitates, and rewards learning. Organization culture is defined as the shared norms and values within a firm. Organization members' beliefs regarding a product and/or technological innovation in promoting corporate objectives is a shared value (e.g., Dwyer and Mellor, 1991: 39-48). Stata (1989: 63-74) notes that the values and culture of an organization have a significant impact on individuals and the collective learning processes and on how effectively a company can adapt and change. For

example, a slogan GE has used to help foster a learning culture is, "finding a better way everyday." This translates into a set of core values that directly encourages learning and innovation (Yeung, Ulrich, Nason and von Glinow, 1999: 34-39).

Achieving qualifications through staffing, training, and development: Here, we emphasize the extent to which individuals, teams, and an organization have competencies for learning. Qualifications represent the knowledge, skills, and abilities of individuals or teams within an organization. In that frame, specific actions managers might take to build learning qualifications include:

- Hiring and/or promoting people who are known as learners and who have demonstrated a capacity to learn (Quinn, Anderson and Finkelstein, 1996: 71-80)
- Instituting job rotations and assignments across divisions
- Creating training programs to share best practices
- Sponsoring continuing educational experiences

Botkin's (1985: 25-39) innovation model starts by assuming a level of creativity and then focuses on four issues: education, management style, research and development, and capital costs. He stresses the importance of education because technology is fast-paced and organizations so complex.

Setting performance systems: For example, 3M conferred 67 different awards to different work teams in 1991; the value of those ideas in terms of sales was $522 million (Marquardt and Reynolds, 1994). To encourage performance, especially high performance, it is important that managers provide rewards people value in a timely, fair manner (Cascio, 1998: 608). Reward systems need developing which recognizes learning and encourages others to learn. Since managers know that people generally act out of self-interest, building learning capability and setting reward systems for specific learning behaviors is essential. Rewards need not be limited to physical or financial terms. Quinn, Anderson and Finkelstein (1996, p. 72) note, "Highly motivated and creative groups often outperform groups with greater physical or financial resources." The following practices can prove useful (e.g., Yeung, Ulrich, Nason and von Glinow, 1999: 48-54):

- Changing performance appraisals to include learning objectives, actions, and outcomes
- Rewarding useful postmortems of mistakes and successes
- Encouraging and rewarding experimentation
- Integrating the bonus/incentive systems with learning

Building organizational structures and communication processes: The structural capacity to learn corresponds to the characteristics of an organization which favors individual and collective learning .The nature of learning and its contribution to product innovation is influenced by the organization's structure and its communication practices (Ayas, 1999: 163). To build a governance system that encourages learning, the organization's structure, decision-making process, and information systems need to encourage the generation of high-impact ideas which support the company's mission. Particularly if new innovative ideas involve a high degree of technology and are therefore likely to be slow-movers, they need conscious, effective promotion in order to overcome resistance (Vandermerwe, 1987: 256-264).

The *intranet* clearly allows organizations to share knowledge more effectively. It is useful in identifying the previous experiences of the organization that are relevant to current projects, as well as in integrating new information and experiences into the organization's knowledge base (Iansiti and MacCormack, 1997: 138-147).

Additionally, empowerment is a key factor in creating a successful learning environment. Empowerment enables individuals (and teams) to set their own work goals, make decisions, and solve problems within their sphere of responsibility and authority (Moorhead and Griffin, 1995: 128-139). If employees are offered the ability to achieve responsibility, recognition, and opportunity, they are more likely to work and learn at optimal levels. Stata (1989: 63-74) found that the best way to introduce knowledge and modify behavior is by working with small teams that have the power and resources to enact change. Managers, therefore, need decision-making and accountability at the lowest possible level.

Organizing work processes and systems: The ways in which work is allocated and accomplished may encourage learning. Capacities resulting from the organization of work implies that the production processes are organized so that individual and collective learning is favored and not impeded.

Even more important, designing and structuring work systems can continuously reinforce an organization's overall capacity for change. The following specific actions can be useful:

- Building flexible, current information systems
- Establishing physical settings that encourage idea sharing
- Participating in team projects or cross-functional assignments
- Developing activities which foster learning

Appointing leaders who value and promote learning: Leader behavior is another important element of an organization's learning capacity. Through their behavior, their management style, their reward systems, as well as coaching and mentoring, leaders have a significant influence on individual and collective learning. It is argued that no other role in organizations has received more interest than that of the leader (Schwandt and Marquardt, 2000: 28). Leaders are central to building learning capability. An organization's culture often reflects the personality of its leaders; consider GE, Samsung, Motorola, HP, and 3M. Leaders engage in numerous activities which can serve as models of learning.

B. Major Barriers to Learning in Technology-Based Firms

Schein (1996: 11-12) proposes several reasons for learning failures. He notes that there are three different major occupational cultures in most organizations – "operator," "engineering," and "executive" cultures and that a lack of alignment among these three groups hinders learning in organizations. There are also several personal and organizational factors that can inhibit organizational learning. Some of the barriers to learning are imposed by individuals, such as a lack of self-esteem, low expectations in the pursuing learning goals, the inability to communicate, one's physical condition, and level of stress experienced. Additionally, the organizational structure, culture, and communication and feedback are found to have a major impact on the learning process and act as barriers to learning. These factors seriously limit an organization's ability to respond to its environment and slow the innovation process, giving significant "catch-up" time to competitors. In addition, they can result in a loss of competitiveness in high-growth, lucrative markets, a loss of image, self-imposed censorship of ideas, and the attrition of good people (e.g., Vandermerwe, 1987: 256-264).

Based on the previous research, we can classify major barriers into the following categories: individual, organizational, situational, leadership blocks, and overemphasis on the status quo. Some examples are shown in Table 3.

Table 3. Majors Barriers to Learning in Technology-Based Firms

Barriers to Learning	Examples
Individual Blocks	• Intellectual mental capability • Lack of self-confidence • Lack of sense of control over one's own work Resistance to changes • Lack of communication ability • Lack of related knowledge/experiences
Organizational Blocks	• Inappropriate reward systems • Autocratic decision making • Lack of vision • Lack of current strategy • Inappropriate organizational structures • Insufficient empowerment • Lack of communication • Lack of understanding of other functional groups • Lack of diversity • Lack of creative cultures
Situational Blocks	• Insufficient time and resources • Satisfactions with existing performance • Lack of stimuli to change
Leadership Blocks	• Lack of commitment • Inappropriate leadership styles • Insufficient understanding of the importance of learning
Overemphasis on the Status Quo	• Listening to current customers

C. Learning Opportunities or Venues for Technology-Based Organizations

The outcomes and the usefulness of learning depends heavily on the content of what is learned (Huysman, 1999: 62). Selecting what to learn and knowing where to learn are critical in maximizing the efforts invested in learning. Von Hippel (1999: 47-57) note that what separates companies is the kind of information they collect and from whom they collect it. Therefore, where high learning opportunities exist in technology-based organizations and how efficiently and effectively workers have access to those sources are important for the high performance of organizational learning.

Venues of learning include manufacturing processes, management information systems, marketing, R&D, supply chain management, team processes, productivity improvements, customer relationships/satisfaction, outsourcing processes, management information systems, managerial processes, etc. We can categorize the sources of organizational learning into internal, external, and global sources (see Table 4). Organizations having strengths in learning and improving performance in such areas are more likely to achieve high performances.

Table: 4 Examples of Learning Sources

Sources of Learning	Learning Areas	Examples
Internal Sources	R&D NPD process	Technological innovations
	Marketing	Customer Competitors Intermediaries
	Manufacturing	Suppliers Substitutors
	Human resource management	New employees
External Sources	Strategic Alliances	Joint ventures, direct investments
	Developments of Industry or other industries	Improvements in telecommunications Internet
	University	University – Industry Collaboration
	Inventors	Technological Innovations
Global Sources	Global competitors	Global products Global raw materials
	Global networks	Global telecommunications
	Global teams	Cultural diversity

Furthermore, the ability to identify and select promising technological innovations is an important capability. Forecasting new technologies and assessing the impact of those technologies, including the cross-impact of one technology on another, is important in selecting which one to learn (Aaker, 1998: 78). A firm's innovation strategy, information network, existing knowledge base, and market/technology trends are factors which influence what to learn and the means to learn.

IMPLICATIONS

Several implications can be derived from our work as follows:

- In order to survive and prosper in a continuously changing, intensively competitive world, the ability to innovate is imperative, especially for those companies that are technology-based, as well as for those operating in emerging and transitional economies.
- Organizational learning is related to discovering new and better solutions and linking them to customer satisfaction and competitive advantages. Dependently, continuous learning becomes crucial in innovating and improving processes to achieve competitive advantages. Managing innovation requires the ability to continually build the underlying organizational knowledge base, which promotes effective organizational learning.
- Improving the ability to learn begins with a clear understanding of what the organization's present capability is in performing and learning. Improvements need to be based on strengths, weaknesses, and future objectives.
- The outcomes and usefulness of learning depend heavily on the content of what has been as well as is being learned. The sources of organizational learning come from internal, external, and global environment. Thus, the capability to recognize, select, and develop the right sources to learn is important.
- Understanding organizational learning and identifying its influencing factors and their consequences are important. It is also important to understand the differences between personal and organizational barriers to learning. Individual learning and development is clearly linked with organizational learning and development and vice-versa.
- A combination of several learning capacities creates an organization's capacity to learn continuously and effectively. Focusing on only one or two aspects of learning limits the potential of an organization.
- The outcomes, which result from dealing with complex and innovative tasks, technologies, markets, and other organizations, are likely to provide competitive advantage for the firms in the market place.

Based on our study, we suggest an organizational learning of technological innovation framework as shown in Figure 2.

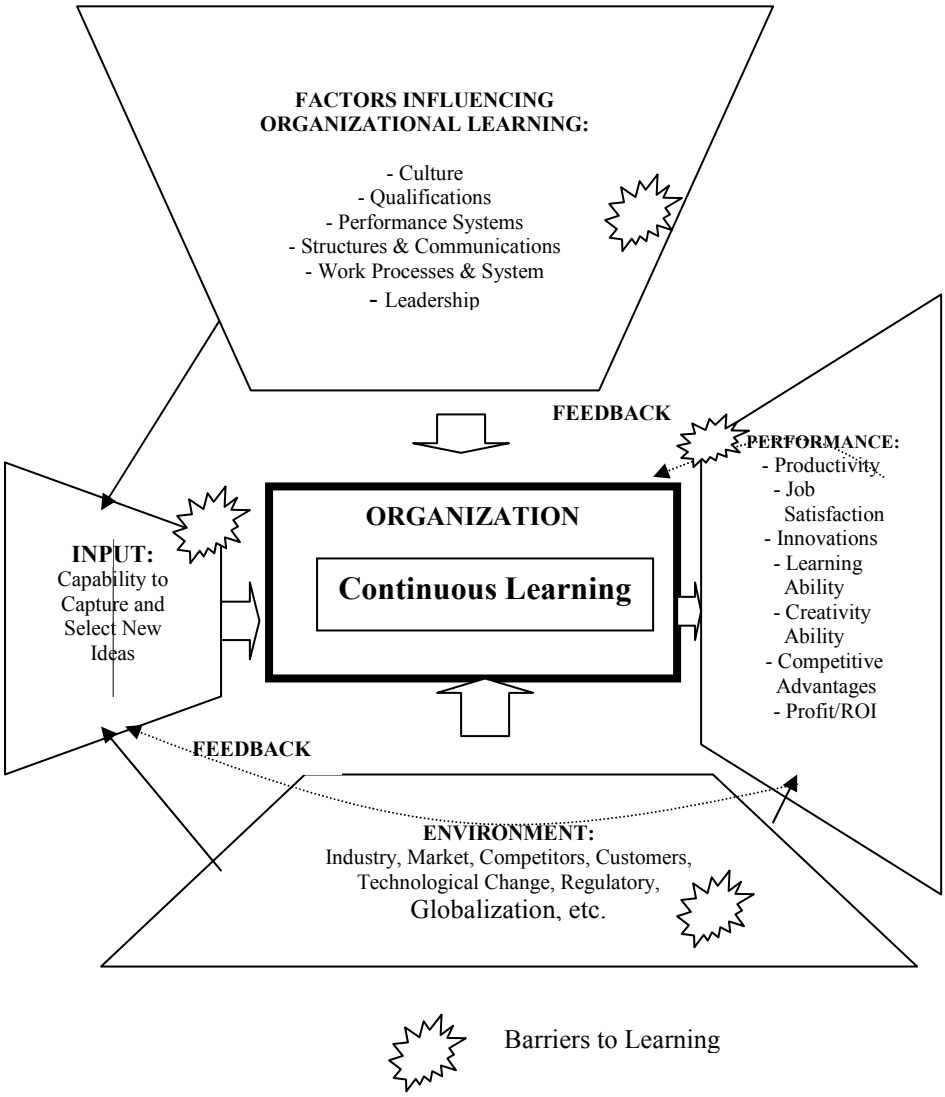

Figure 2: A Framework of Organizational Learning Process

Figure 2 reveals that there are many factors and forces influencing an organization's learning. As noted previously, various factors such as culture, performance system and leadership influence organizational learning. Moreover, what to learn (: Input) and under what circumstances (: Environment) can affect organizational learning. The results of learning lead to several

performances such as productivity, innovations, and competitive advantages. The feedback of performance also affects the learning activities. And each component include barriers to learning.

Based on the Figure 2, we illustrate how a technological learning can be performed. At first, the capability to capture and select new ideas triggers learning processes as well as the performance of organizational learning. While learning a new idea, there are various factors influencing organizational learning. Through these interactions and processes, organizational learning ability produce various performance. And the performance influence organizational learning ability by feedback (e.g., single-loop, double-loop, and deutero-loop learning) as well as the future selection of the "input." All the factors relating to organizational learning and performances are affected by the environment of the firm.

SUMMARY

With rapid changes in markets and competition, it is essential for technology-based firms to continually acquire new technological capability. In this paper, we examine the importance of organizational learning in creating and managing technological capability. We also identify several factors influencing organizational learning and examine managerial actions to enhance it. While there have been valuable findings regarding organizational learning, more studies are required to understand the relationship between organizational learning and technological innovation. As Argyris notes, organizational learning is a competence that all organizations need to develop. The effective management of learning regarding technological innovation can result in important competitive advantages for companies which rely on a continuous flow of development projects.

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