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PREVIEW

**DISCOVERY-DRIVEN ORGANIZATIONAL LEARNING:  
APPLYING INFORMATION TECHNOLOGY TO SUPPORT  
ORGANIZATIONAL LEARNING**

BY

Ruidong Zhang

A DISSERTATION

Presented to the Faculty of

The Graduate College at the University of Nebraska

In Partial Fulfillment of Requirements

For the Degree of Doctor of Philosophy

Major: Interdepartmental Area of Business  
(Management)

Under the Supervision of Professor Sang M. Lee

Lincoln, Nebraska

December, 1995

**UMI Number: 9611078**

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DISSERTATION TITLE

Discovery-driven Organizational Learning: Applying Information  
Technology to Support Organizational Learning

BY

Ruidong Zhang

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GRADUATE COLLEGE  
UNIVERSITY OF NEBRASKA

**DISCOVERY-DRIVEN ORGANIZATIONAL LEARNING:  
APPLYING INFORMATION TECHNOLOGY TO SUPPORT  
ORGANIZATIONAL LEARNING**

Ruidong Zhang, Ph.D.  
University of Nebraska, 1995

Advisor: Sang M. Lee

This dissertation is an exploration of the application of information technology to enhance an organization's capability in organizational learning. The discovery-driven organizational learning (DDOL) model is developed to operationalize the concept of organizational learning and to facilitate the application of information technology to support the process of organizational learning. The DDOL model is constructed with the building blocks of organizational knowledge base, business event, discovery-driven mechanism, cognitive map, and system dynamics model base. The DDOL model consists of two layers. The first layer is the outer layer, which is the actual learning process consisting of four phases: discovery, invention, production, evaluation and generalization. This layer will interact with various business events and identify the features of business events. The second layer is the inner layer, which supports the learning process and consists of the discovery-driven mechanism, the organizational knowledge base, and the system dynamics model base. A prototype system, which is called Discovery-driven Organizational Learning Support System (DDOLSS), is developed using Microsoft Visual Basic 3.0, professional version to implement the DDOL model. Evaluation of DDOLSS indicates that through the DDOL model, information technology can be applied to support organizational learning, and DDOLSS is desirable, useful, and practical to be implemented.

## **ACKNOWLEDGMENT**

This dissertation could not have been accomplished without the help and support of many individuals. I am grateful and indebted to these individuals for their advice, suggestions and support.

A special appreciation is expressed to my graduate committee chairman, Dr. Sang M. Lee, for his continuous support and encouragement during my study at UNL, and for his being the writing coach and critic of my dissertation. Many thanks go to the other members of my committee, Dr. Lester A. Digman, Dr. Marc J. Schniederjans, and Dr. Steve Wise for their guidance and support.

Dr. Mike Godfrey and Mr. Gerald Biby warrant special thanks. Without their careful proofreading of this dissertation and their valuable comments and suggestions, this dissertation would simply not be the same dissertation. A special thank also goes to Linda Rohn and others in the Department of Management for their assistance in the completion of this dissertation.

Lastly, many thanks to my wife, Jun Yin, and my parents. Without their support, understanding, and love, the completion of this dissertation and my study at UNL would not have been possible.

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PREVIEW

# CHAPTER 1

## INTRODUCTION TO DISCOVERY-DRIVEN ORGANIZATIONAL LEARNING

*Learning and the individual human being - not material resources - are the key to the world's future.*

Botkin, Elmandjra, and Malitza

*Learning is the process that underlies and gives birth to change. Change is the child of learning.*

Frank Friedlander

The world is changing rapidly. Intense business competition has been globalized. To succeed in the competitive global marketplace and to keep pace with the advance of technology, an organization must be able to make necessary organizational changes. Change or perish has been widely recognized as a reality.

Theories of organizational learning (OL) provide a foundation which makes it possible for an organization to anticipate, rather than react to changes. "Changing one's self is not magic - it is simply that significant learning has preceded the change" (Friedlander, 1983). The learning capability of an organization has become critically important for its survival and growth. As a matter of fact, both researchers and practitioners have recognized that the learning capability of an organization is instrumental to the survival and success of the organization and may be the sole source of the organization's sustainable competitive

advantage (Luthans et al., 1995; Senge and Sterman, 1992; Senge, 1990; Stata, 1989). Friedlander (1983) also pointed out that the lifeblood of an organization is its ability to learn.

This dissertation is an exploration of the application of information technology (IT) to enhance an organization's learning capability. The term "information technology" is used in this dissertation in a very broad sense "to cover all technologies used in the collection, storing, processing and transmission of information, including voice, data and images" (OECD, 1989). This chapter is devoted to laying a conceptual foundation for the remaining chapters of this dissertation. More specifically, the following questions are addressed in this chapter: *What is organizational learning? What is the purpose of this dissertation? What is the major research problem to be addressed in the dissertation? What is discovery-driven organizational learning?* In addition, an outline of this dissertation is provided at the end of this chapter.

### **1. The Operationalizability of Organizational Learning**

The study of organizational learning can be traced back to as early as Frederick W. Taylor's work in 1916 (Ulrich et al., 1993; Luthans et al., 1995). However, it is Argyris (1978, 1990) and Senge (1990) as well as their colleagues and many others who systematically studied the subject of organizational learning and popularized the concept of organizational learning or learning organization.

In reviewing previous studies on organizational learning, an obvious problem is: there is no one commonly agreed on definition of organizational learning (Luthans et al., 1995). Garvin (1993) argues that an important reason for the confusing and even utopian results in the study of organizational learning is due to the lack of an accurate definition of organizational learning. He postulates we need a well-grounded definition of organizational learning which is actionable and easy to apply.

The difficulty in defining organizational learning lies in the fact that organizational learning is a concept with multi-dimensions. These multi-dimensions result largely because organizational learning activities can occur in an organization anywhere, any time, to anybody, in any form (explicit or implicit, individual or group, cognitive or behavior). For example, in terms of the measurement of organizational learning, an organizational learning process involves cognitive changes, behavior changes, and performance changes (Garvin, 1993). In terms of factors or variables involved in an organizational learning process, there are theories of action, learning system, individual and collective inquiry, as well as organizational routines (Argyris, 1990). In terms of motivation for organizational learning, a learning process can be driven by human inner drive to improve or creativity as a way of life (Senge, 1990), creative tension (Senge, 1990), the presence of tension (Luthans et al., 1995), the introduction of new technologies, and the introduction of new management programs or procedures. In terms of the levels of learning, organizational learning can happen at the individual, team or organizational level, and the organizations

that will truly excel in the future will be the organizations that discover how to tap people's commitment and capacity to learn *at all levels* in an organization (Senge, 1990).

Because of the multidimensional characteristic of organizational learning, the definition of organizational learning varies from researcher to researcher, depending on which dimension is addressed. Therefore, it is very natural to have different versions of the definition on organizational learning under different contexts or perspectives. The problem does not lie in the different versions of the definition of organizational learning or learning organization. Rather, the problem lies in the lack of operationalizability when defining the concept of organizational learning and in the lack of integration of these different views on organizational learning. The lack of the operationalizability of the concept of organizational learning has lead to the difficulty in applying information technology to support the process of organizational learning, while the lack of the integration of perspectives on organizational learning has lead to the piecemeal understanding and implementation of the concept of organizational learning.

For example, Argyris and Schon (1978) think that human behavior is guided by their theory of action. From the perspective of action science, they define organizational learning as a process in which members of an organization detect an error or anomaly and correct it by restructuring organizational theory of action, embedding the results of their inquiry in organizational maps and images (Argyris and Schon, 1978). There are two types of organizational learning: single-loop learning and double-loop learning. Organizations

are less likely to correct errors in theories of action. They argue that external intervention (like consulting) is necessary to restructure an organization's theory of action and to facilitate the double-loop learning. Therefore, it is implied that it is less likely for an organization itself to implement the concept of organizational learning. Also, to a large extent, how to embed the results of organizational learning in organizational maps and images is not well addressed by Argyris and/or Schon.

Senge (1990) goes beyond Argyris and Schon's perspective on organizational learning and tries to disciplinize organizational learning. He argues that organizational learning is a process of practicing five disciplines: personal mastery, mental models, shared vision, team learning, and system thinking. Each discipline has a set of principles and skills. System thinking, which is about seeing wholes or patterns of structure, is the discipline that integrate other disciplines. Senge imagines that a type of organization, which he calls learning organization, can be resulted through the continuous practice of the five disciplines. He defines a learning organization as an organization that is continually expanding its capacity to create its future. Senge further pointed out that learning means changes in perspectives and behavior, and learning means not only solving a problem, but also changing the thinking that produced the problem. Senge, together with his colleagues, has also explored establishing computerized learning laboratories (or microworlds) to support organizational learning. However, learning laboratories are hard to be woven into the fabric of daily business activities and are not developed to be accessed by anybody and at any time. Still, there are difficulties in integrating and implementing the five disciplines.

For example, how and where can we embed the results of organizational learning? How do we know when to implement which discipline? How can each discipline be supported by information technology?

Therefore, it is necessary to operationalize the concept of organizational learning so that organizational learning can be implemented with the support of information technology. This can also partially be evidenced by a small-scale survey which was conducted to justify the topic of this dissertation. The respondents of this survey were employees of local organizations at Rochester, Minnesota area. These respondents were also part-time students. The result of this survey, as listed in Table 1.1, indicates that the concept of organizational learning is poorly recognized (19 out of 25, or 76%, of the respondents have little or no knowledge about the concept of organizational learning). But what is surprising is that almost everybody agreed that an organization can learn, and that the learning capability is important for an organization's survival and growth.

Table 1.1 The Result of a Small-scale Survey

Survey Question	Yes	A little or Not Sure	No	Total
Have you ever heard about organizational learning or learning organization?	6	15	4	25
Can an organization learn?	23	2	0	25
Is an organization's learning capability important for the organization's survival and growth?	25	0	0	25

It is believed in this dissertation that the less popularity of the concept of organizational learning in practice can be greatly attributed to its lack of operationalizability and its



difficulty of implementation. We really need an operational definition of organizational learning, which combines theoretical perspectives of organizational learning and allows us to explore the possibility of applying information technology to support organizational learning.

What do we mean by *an operational definition*? "An operational definition will contain a specification of all operations necessary to achieve the same result (Simon, 1969)." In Deming's view, "An operational definition puts communicable meaning into a concept. Adjectives like good, reliable, uniform, round, tired, safe, unsafe, unemployed have no communicable meaning until they are expressed in operational terms of sampling, test, and criterion. The concept of a definition is ineffable: It cannot be communicated to someone else. An operational definition is one that reasonable men can agree on. (Deming, 1986)."

It is impractical and perhaps impossible to operationally define organizational learning as it would be to define the quality of a product (like size, color, or weight). Although it is difficult to develop an operational definition, as defined by Simon and Deming, of organizational learning, every effort should be made to try to operationally define organizational learning at least to a level where information technology can be applied. In another words, a *quasi-operational* definition of organizational learning is possible. In this spirit, when defining organizational learning, we should specify the operations that an organization needs to perform to achieve a certain goal. We should try to define organizational learning in communicable terms. Specifically, in the dissertation, we think

that a *quasi-operational definition of organizational learning* should address the following issues:

- ♦ What is the goal we want to achieve?
- ♦ Where should we start to achieve the goal?
- ♦ What are the path and steps to achieve the goal?
- ♦ What are the variables involved, and what are the relationships among the variables?
- ♦ How will we know the goal is achieved?

An operational definition provides a framework which can define our actions. An operational definition of organizational learning should shed light on the implementation of the concept of organizational learning and the application of information technology to organizational learning. Following is an elaboration of the above criteria aiming at reaching a quasi-operational definition of the concept of organizational learning.

(1) The *eventual* goal of an organizational learning process is to improve an organization's performance. As secondary goals, the process of organizational learning also implies cognitive and behavioral changes as well as the expansion of an organization's knowledge base. In this dissertation, to avoid too broad a scope of study, we limit our consideration to the expansion of organizational knowledge base as the goal of organizational learning. In this dissertation, an organizational knowledge base is defined as a collection of pairs of business events and organizational theories of action. These

business events and theories of action are connected in a meaningful way. Theories of action can be expressed in cognitive maps, which use generally agreed symbols to express the interrelationships among concepts or cognitive units. An organization's knowledge base should be updated and challenged dynamically.

(2) The starting point for an organizational learning process are business events. Here we define a business event as a type of business activity in which people's mental models are challenged, the reality is reevaluated, different organizational functions are involved, different opinions are exchanged and debated, and action may be taken. A business event could be a routine business meeting, an introduction of a new product, a change in organizational structure or policy, or a change in a government regulation. A business event could also be a problem such as the loss of profit or a decline in worker's productivity. A business event can occur at any functional areas, such as R & D, accounting, finance, human resource, and manufacturing. A business can also occur at any organizational level, such as operational level, management level or strategic planning level.

(3) The path to achieve the goal of organizational learning is discovery-driven organizational learning (DDOL), which involves the discovery of solutions for business events and the identification of various opportunities for organizational learning during and after a business event. A model for discovery-driven organizational learning will be discussed and described in Chapter 4. A discovery-driven organizational learning model to

organizational learning is similar to a value chain model to an organization's competitive advantage.

(4) Many complex factors are involved in an organizational learning process, such as people and their theories of action, business events, cognitive maps, policies, organizational norms and routines, information availability, information technology support, external environment, organizational knowledge base, and organizational structure. It is impractical and impossible to thoroughly explore all these factors in one dissertation. In the dissertation, we limit our consideration to the following factors: business events, organizational knowledge base, cognitive maps, and information technology support for organizational learning, will be majorly addressed. Other factors will also be discussed whenever necessary. The meaning of and the relationship among these factors will be discussed in detail in Chapters 2 and 4.

(5) The measurement of organizational learning is difficult, but research in this area is emerging (Garvin, 1993; Luthans et al., 1995). In this dissertation, we use the expansion of organizational knowledge base as a way of measuring organizational learning.

As a summary, in this dissertation, we define organization learning as follows.

*Organizational learning is a process of expanding and updating organizational knowledge base where many factors are involved such*

*as theories-in-use and business events. This process is initiated by the identification of a variety of business events. Discovery-driven organizational learning is the path from business events to the expansion of organizational knowledge base.*

The meaning of organizational knowledge base, theories-in-use, and business events will be further explained and discussed in Chapters 2 and 4, in association with the previous studies on organizational learning and the discovery-driven organizational learning model.

## **2. The Research Problem and the Purpose of Study**

There is no organization that is not learning. Every organization may have a natural learning system that may go undetected. Actually, many management programs for enhancing implicitly or explicitly an organization's learning capability have been in place for a long while. For example, the well-known TQM programs essentially return knowledge to workers and make them capable of doing process improvement in small groups, without relying on traditional staff experts (Bohn, 1994). Bohn (1994) further pointed out that quality improvement programs represent a systematic way of learning to deal with business problems, which are basically those at front-line and more explicit. Senge and his colleagues (Senge et al., 1994) also pointed out that organizations seriously committed to quality management must be learning organizations.

Of primary concern in this dissertation is that the process of organizational learning needs to be supported and managed. Organizational learning can be directed activities of an organization (Bohn, 1994). Successful companies like Honda, General Electric and Corning actively manage the process of organizational learning to ensure that learning occurs by design rather than by chance (Garvin, 1993). Creating formal organizational information systems to support the process of organization learning is an important step in approaching the effective and efficient management of organizational learning. By the term "effective," we mean how well an organization can learn from its (or others') experiences and correct errors in its theories of action. By the term "efficient," we mean how fast an organization can learn. The learning rate of an organization has become crucial for the organization to be competitive and world-class in the global marketplace (Lee and Zhang, 1993).

Organizational learning can happen of course without the involvement of information technology. However, it is argued in this dissertation that applying information technology to support organization learning can greatly enhance the efficiency and effectiveness of organizational learning. Without the support of information technology, it is difficult for an organizational learning process to spread across the entire organization from top to bottom and across functions.

However, it is difficult to apply information technologies to support organizational learning. There are few previous studies that address this problem. For example, in Peter

Senge's well known book, "The Fifth Discipline" which consists of 21 chapters, there is only one chapter devoted to the issue of applying information technology to supporting organizational learning. In chapter 17, entitled "Microworlds: The Technology of the Learning Organization," Senge described building a learning laboratory - a microcosm of how real organizations function - to support organizational learning (Senge, 1990). According to Senge, human beings can learn well from doing only when the feedback from our actions is rapid and unambiguous. Microworlds enable managers and management teams to begin "learning through doing" about their most important systemic issues. This is because microworlds can compress time and space so that it becomes possible to experiment and to learn when the consequences of our decisions are in the future and in distant parts of the organization. Microworlds are computer-based. This makes it possible to deal productively with complexity and to integrate learning about complex team interactions with learning about complex business interactions. But, essentially, microworlds as described by Senge are artificially made learning environments which consist of computer simulation programs built on the basis of certain system dynamics principles. How to integrate microworlds into the fabric of daily business activities isn't well addressed.

This dissertation explores the application of information technology to organizational learning through the operationalization of the concept of organizational learning and the development of the discovery-driven organizational learning model. Specifically, the basic research problem of the dissertation is:

*Can we operationalize the concept of organizational learning so that information technology can be applied to support daily organizational learning activities?*

In this dissertation, an attempt is made at using information technology to support daily organizational learning activities. Specifically, we want to make every business event an opportunity for organizational learning so that the organizational knowledge base will be expanded. Throughout this dissertation, the central theme is the exploration of the application of information systems to support the process of organizational learning. It is the purpose of this dissertation to operationalize the concept of organizational learning and to implement the concept of organizational learning by creating information systems which can be woven into the fabric of daily organizational activities.

### **3. Discovery-driven Organizational Learning**

As described in the first section of this chapter, discovery-driven organizational learning can be a path to achieve the goal of organizational learning. The term "discovery" means the discovery of knowledge from our previous experiences, the discovery of errors in our theories of action, norms, and strategies, the discovery of various opportunities for organizational learning, and the discovery of solutions for present business events or problems. The core idea is learning through discovery. Under discovery-driven organizational learning, we view business events and problem solving processes as