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# Routine-Based Choice in the Sample Space of an Organizational Problem: An Extension of Local Search*

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〈목 차〉



I propose a model of routine-based choice, where an organization selects its niche to serve and chooses its way to serve the chosen niche. On the basis of local search (Cyert & March, 1963) and absorptive capacity (Cohen & Levinthal, 1989, 1990), I first define the knowledge base of an organization by a random variable on the problem space, whose feature is compared with fitness in the landscape (Levinthal, 1997). I then examine the performance implications of the model along the extended dimensions of the problem space, i.e., lugged, incomplete, and friction landscapes, which lead to sequential choice. Finally, I discuss the intensity and direction of organizational choice as being driven by the concern for the tendency of sequential choice.

## Ⅰ. Introduction

In this paper, I propose a routine-based model for organizational choice. Following the evolutionary economics (Nelson & Winter, 1982) and the

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behavioral theory of the firm (Cyert & March, 1963; March & Simon, 1958), I assume that firm behavior is stochastically generated by a set of organizational routines. Following a knowledge-based view of the firm (Grant, 1996; Demsetz, 1988; Kogut & Zander, 1992), I also assume that economic constraints in firm behavior result from resource heterogeneity, which is characterized by the knowledge base of each firm. Given these two assumptions, I take a reductionist approach to firm behaviour - organizational choice - as a way of avoiding the risk of anthropomorphic organizations, and propose a model of routine-based choice to discuss the intensity and direction of organizational choice and their impacts on firm performance.

The paper is organized as follows. First, I review studies on organizational choice and summarize models in three types. Second, building on Garicano (2000), I propose a model of organizational choice, where the knowledge base of an organization is defined by a random variable on the problem space. The performance implications of the model are examined along the extended dimensions of the problem space, i.e., lugged, incomplete, and frictional landscapes. Finally, the intensity and direction of organizational choice are discussed.

## Ⅱ. Organizational Choice and Problem Space

Organizational choice refers to collective action that draws possible solutions from internal or external resources, and matches those solutions to a perceived problem that threatens organizational performance. This paper thus does not examine, firstly, individual action that is outside 'the discretion of the organization to control' (Pfeffer & Salancik, 1978) and, secondly, collective action that is independent of efforts to solve a perceived problem. In what follows, I briefly review the literature on organizational choice along two groups, studies on

collective action and those on solutions, and position this paper against them.

An organization is able to consume resources, make up contracts, and own properties (Coleman, 1990; Scott, 1992). These legally or socially granted rights do not, however, mean that an organization is an identifiable, independent physical entity. An organization is a social construction, which is taken for granted in everyday life as reality, and it is the actions of individuals that objectify and internalize those rights of an organization. One theoretical challenge for any model of organizational choice is thus to theorize the way that the actions of individuals constitute the decisions of an organization.

Students of organization theory as well as of economics have explored basically three types of models in a bid to cope with the above mentioned challenge. The first type of models assumes that organizational choice is a decision process for one manager with limited resources. Organizational choice is then equivalent to a decision-making problem solved by a representative manager in the organization, a case to which most of neoclassical economic models belong. A representative manager of rationality computes a cost minimizing combination of inputs, including capital and labor, and decides what to employ and to produce and how to reward (e.g., Alchian & Demsetz, 1972; Williamson, 1975; Jensen & Meckling, 1976). Scholars who place a strong emphasis on the role of a leader such as transformational leadership in fact reduce organizational choice to a single person decision process (Selznick, 1957; Bass, 1985; House, Spangler, & Wyocke, 1991).

Unlike the first type, the second type of models assumes that organizational choice is a decision process for multiple managers with their own resource constraints. Managers of bounded rationality, who consume resources to compute administrative tasks, act on exogenously imposed decision rules. The normative model of this kind attempts to identify a decision rule that minimizes organizational costs incurred by managers under a specific organizational structure and environmental conditions (Radner, 1993; Van Zandt, 1999). Similarly,

empirical research on top management team (TMT) regards firm behavior mainly as an outcome of TMT in the organization and attributes firm performance to the characteristics of TMT members (Hambrick & Mason, 1984; Finkelstein & Hambrick, 1990).

In contrast, the third type of models assumes that organizational choice is a decision process for multiple managers and workers with resource constraints. In particular, workers are also involved in the process of decision-making in the organization. For example, a political model of this kind assumes that behavioral rules guiding decisions in the organization are endogenously generated during strategic interactions of managers and workers such as a bargaining and learning process (March, 1962; Cyert & March, 1963; Pfeffer, 1981). The degree to which behavioral rules govern the actions of managers and workers in the organization varies across different models. An extreme case, such as a garbage can model (Cohen, March, & Olsen, 1972), views a bargaining and learning process as free of externally imposed rules. Most studies, however, acknowledge that in the short term the actions of managers and workers are subject to previously executed rules, i.e., organizational routines (Cyert & March, 1963; March & Simon, 1958; Nelson & Winter, 1982).

The model I propose here is an extension of the third type of models, yet it is different from previous models for the following aspects. First, resource constraints, hardly examined explicitly before, are characterized by the knowledge base of an organization. Following a knowledge-based view of the firm (Grant, 1996; Demsetz, 1988; Kogut & Zander, 1992), I construe an organization as a set of technical solutions, namely, a knowledge base. Second, a decision process is represented by organizational routines and is investigated at the firm level. Lower, i.e., individual or small group, levels of mechanisms for generating these routines are not examined except for the aspiration level of an organization. In the model, I am thus concerned about the links between organizational routines and firm behavior, rather than those between individual behavior and organi-

zational routines. Third, tasks that an organization performs are defined on the sample space of solutions to an organizational problem. An organizational problem has different infinite states, each of which is corresponded by a set of continuous solutions. The relationship between the state of a problem and its solutions is defined as a random variable. Finally, the purpose of the model is to examine the intensity and direction of organizational search – a process that leads to the selection of a specific course of action, which is organizational choice – and their impacts on firm performance. After developing a language for organizational choice, I will explore the performance implications of intensity and direction of search in the interest of an organization that attempts to maintain or develop its knowledge base.

1) Elements of Routine-Based Choice

A knowledge-based view of the firm views an organization as a carrier of social and technical knowledge (Grant, 1996; Kogut & Zander, 1992, 1996). For example, Kogut & Zander (1992) argue that the primacy of the firm over the market comes from higher order organizing principles such as values and shared language, which allow the firm to do better in transferring individual knowledge (Grant, 1996; Von Hippel, 1994; Szulanski, 1996). Similarly, Demsetz (1988) note that specialized knowledge is more easily developed in an organization through the continuing association of the same persons. Although organizational knowledge is not a simple sum of individual knowledge, however, there has been little research done on how an organizational knowledge emerges from the aggregation of individual knowledge. Recently, Garicano (2000) presents an interesting model that describes transition from individual knowledge to organizational knowledge. After defining the knowledge set of a worker on the sample space of a production problem, Garicano (2000) demonstrates that the division of labor, or a set of specialized knowledge, minimizes coordination or communication costs in transferring or integrating individual knowledge.

Building on Garicano (2000), I propose a model of organizational choice, where resource constraints are characterized by the knowledge base of an organization and a decision process is represented by organizational routines. Tasks that an organization performs are based on the following assumptions. First, an organization chooses which production problem to solve. That is, an organization decides which niche to serve. Second, given a problem, an organization draws from its knowledge base a set of solutions. In what follows, I define three elements of the model separately: an organizational problem, the knowledge base of an organization, and a probability measure for the knowledge base.

An organization produces goods or services in exchange for resources from its environment. The fact that an organization produces means that it knows how to solve technical and administrative problems related to production. In this respect, an **organizational problem** is defined as a set of technical problems that must be solved in order to produce a product or service and denoted by $\Omega \subset R^{+}$. Once an organization decides which market to serve, it comes to face a specific organizational problem to solve. Unless explicitly specified, a set of technical problems is assumed to be infinite.

Although an organization is assumed to know which problem to solve, it does not necessarily mean that it knows solutions to all possible states of the problem. A set of problems whose solutions are known to an organization is defined as $A$ such that $A \subset \Omega$. The **knowledge base** of an organization is the sum of these solution-known problems.

The knowledge base of an organization consists of the knowledge of individuals in the organization and depends on the ability of these individuals to solve a set of organizational problems. The likelihood that the organization provides a solution to a state of an organizational problem is increasing in the size of workers and managers, who know the solution to the state. Yet, the sum of individual knowledge is not equal to the knowledge base of the organization. In general, the relationship between individual knowledge and the knowledge

base of the organization satisfies the following inequality:

**Proposition 1.** $\mathrm{x}_{i \in P} A_i \subseteq \mathrm{x}_{i \in P} X_i$

where $P$ is a set of organizational members and $X$ is the set of problems whose solutions are known to at least one of these members.

This inequality is due to the partial control of the organization over the actions of individuals (Pfeffer & Salancik, 1978). Managers and workers bring their knowledge into their organization so as to perform their assigned tasks. Yet, the organization does not have full control over its employees, who still keep a substantial portion of their knowledge behind intact or use in their interests. In other words, if all the knowledge of managers is relevant to an organization problem and all managers know the relevance of their knowledge and are willing to bring their knowledge to solve an organizational problem, then organizational knowledge is a simple sum of individual knowledge. Nonetheless, even employees of good-will may fail to supply their task-related knowledge to the organization because it is frequently difficult for them to locate and judge which part of their knowledge is helpful to solve an organizational problem.

One way to mitigate this inequality is the provision of a relevant organizational structure. Suppose that the knowledge base of an organization is 'tacit' if some managers do not know the relevance of their knowledge to an organizational problem. When ignoring the cost to implement, a simple way of reducing the tacitness of the knowledge base is to restructure tasks procedure among managers. If managers 1 and 2 have direct communication with manager 3 and not between themselves, a new procedure that allows interaction between managers 1 and 2 is more likely to reduce the tacitness of the knowledge base when manager 1 knows a problem whose solution manager 2 wants to know. In this respect, the density in $A^{I \times T} \cdot S^{I \times R}$ matrix in PCANS model (Krackhardt & Carley, 2000) will be correlated with the tacitness of the knowledge base, where A and S are adjacency matrices and I is a set of employees, T is a set of tasks, and R is a set of

resources or skills.

In reality, an organizational problem occurs in varying states with different probability. Accordingly, the success of an organization to solve the problem is contingent upon the probability of states to occur, whose solutions it knows. Hence, a **probability measure** for an organizational problem is a real-valued function, $f(\bullet)$, defined on a set of possible states of the problem with an interval $[s, t]$.

Note that, for simplicity of discussion, the states of the problem are represented by an arbitrarily chosen interval $[s, t]$. By definition, $\int_s^t f(y)\,dy = 1$, where $y \in \Omega$. Given a probability measure for an organizational problem, the knowledge base of an organization satisfies the following propositions.

**Proposition 2**. The knowledge base of an organization is a partition of the sample space of an organizational problem such that $s \leq z_l < z_u \leq t$ and $[z_l, z_u] \in Z$.

The process of solving an organizational problem incurs costs, which are basically expressed by time spent away in providing solutions to the problem. As Demsetz (1988) points out, the presence of the firm reflects the non-trivial cost of knowledge acquisition, which is independent of transaction costs and underlies firm heterogeneity with respect to the cost of production. Thus, when an organization chooses its knowledge base, it attempts to minimize the costs of running a chosen knowledge base and at the same time tries to maximize the success of the problem-solving. Throughout the discussion, the constant marginal cost of processing known solutions, $[z_l, z_u] \in Z$ is denoted by $c$, which is assumed to be proportional to the length of the interval. This cost constraint gives rise to a continuous knowledge base on the sample space of an organizational problem for the following reasons.

First, it is more efficient for an organization to spend scarce resources on a most frequent state of the problem. When an organization invests as its

knowledge base two disconnected intervals, $[s, z_l]$ and $[z_u, t]$, and the first derivative of $f(\bullet)$ is nonpositive [1], then it comes to spend its scarce resources on $[z_u, t]$, an interval that is less frequent than $[z_l, z_u]$. Hence, if possible, an organization that attempts to solve most frequent states will have an incentive to explore and invest intervals that are more frequent than $[z_u, t]$. In other words, this concern for frequency leads the organization to end up with a continuous interval as its knowledge base (Garicano, 2000). That is, $s = z_l < z_u \leq$ t and $[z_l, z_u] \in Z$.

Second, both the absorptive capacity of an organization (Cohen & Levinthal, 1989, 1990) and its coordination costs (Stinchcombe, 1990) constrain the choice of the knowledge base in a way that $A$ is compact, i.e., organizations may specialize in a certain state of the problem. For example, some firms focus on manufacturing a product and other firms are involved only in distributing this product to customers in the market. This implies that similar activities are grouped together and conducted by one administrative unit (Stinchcombe, 1990). One of possible benefits of such specialization is reduction in coordination costs, which is consistent with a knowledge-based view of the firm (Kogut & Zander, 1992). Apart from coordination costs, the growth in the knowledge base of an organization also leads to grouping of similar activities, or solutions to the problem. The current knowledge of an organization, i.e., absorptive capacity, facilitates the acquisition of new knowledge in the subsequent period (Cohen & Levinthal, 1989, 1990). As a result, newly acquired knowledge is related to prior knowledge of an organization. That is, $s < z_l < z_u \leq t$.

**Proposition 3** (Boundary of the Firm). When the constant marginal cost of processing known solutions, $c$, is proportional to the length of the knowledge base, an organization will outperform the market if $E[\int \cdots \int_p g(x_1, \cdots, x_j) dx_1 \cdots$

1) This assumption simply indicates that the states of an organizational problem are placed in a decreasing order of frequency.

$dx_j] \leq E[\int \cdots \int_p f(a_1, \cdots, a_j) da_1 \cdots da_j]$ and $j \in P$, $g(.) \neq f(.)$.

In other words, the firm will exist only when its probability of problem-solving is larger than that of its members' independent problem-solving. This in turn means that the firm should obtain tools to improve its expected success of problem-solving.

**Proposition 4** (Choice of Knowledge Base). If an organization maximizes the expected value of problem-solving, then it will choose its knowledge base up to the state, where $z_l = s$, $z = z_u - z_l$, $f'(z) <= 0$, $f(z) = c/v$ and $v$ is the marginal value of problem-solving.

The unit profit function of the first case is such that $\pi = v\int_Z f(z)dz - cz$. F.O.C. with respect to $Z$ is: $f(z) = c/v$. This makes the case for the first case. The basic intuition of proposition 4 is simple: an organization will increase its knowledge base if the marginal value of problem-solving increases, whereas it will decrease its knowledge base if the marginal cost of problem-solving increases.

2) Problem Space and Fitness in Landscape

Researchers, whose interests are to examine the relationship between organizational adaptation and survival, introduce a concept of fitness landscape so as to specify environmental conditions that affects successful adaptation (Levinthal, 1997; McKelvey, 1999; Kauffman, Lobo, & Macready, 2000). In what follows, I will show that the random space of an organizational problem is one variant of fitness landscape and extend a basic model proposed above to a multidimensional random space, which is characterized by lugged, incomplete, and frictional landscape.

The notion of fitness landscape, which was initially developed for biological evolution, refers to a vector of organizational attributes and their fitness values. Basically, a fitness landscape describes how a set of organizational attributes

is related to the survival of an organization. In particular, a set of organizational attributes comprises a certain organizational form and the survival of an organization indicates the survival of a certain organizational form. One benefit of using fitness landscape in organization theory is its ability to show that some key findings in organizational theory, such as the path dependency of firm behavior and the imprinting of an organizational form at founding, are present when a fitness landscape is rugged, a state that draws on both non-concavity in fitness value and complementarity among organizational attributes (Levinthal, 1997). Given a rugged landscape, a small change in a part of organizational attributes may lead to substantial change in the fitness of an organization form. As a result, the initial organizational form will direct the direction of subsequent changes of the form. In addition, firm behavior becomes path-dependent in the sense that only a minor change or local search in the neighborhood of initial organizational attributes is attempted.

The sample space of an organizational problem can be thought of one variant of models of fitness landscape for the following reasons. First, organizational form in the fitness landscape is understood as a knowledge base of an organization in the sample space. An organization in the fitness landscape is assumed to search a better combination of organizational attributes, i.e., an organizational form, which increases its fitness value. Similarly, an organization in the sample space of an organizational problem is assumed to search and choose a better knowledge base so as to increase its likelihood of problem-solving.

Second, the fitness value of an organizational form is partly specified as the marginal value of problem-solving, $v$, in my model. As a higher value of fitness indicates that a certain organizational form is more likely to survive the environmental selective pressure, a higher marginal value of problem-solving implies that efforts made to solve a chosen problem are rewarding in terms of firm performance.

Lastly, like the landscape, the problem space describes the interface between

organizational choice and its consequences. The structure of a fitness landscape, which reflects exogenously given environmental characteristics, will influence the consequences of organizational choice in a specific organizational form. The structure of the problem space plays a similar role in my model.

Compared with the model of landscape, my model further emphasizes the choice of a problem to solve as the basis of firm behaviour. Simon (1997: 124), in this respect, notes that an organization's structure is a representation of tasks or problems that the organization tries to solve. Similarly, Stinchcombe (1990: 29) contends that the structure of an organization is closely related to the structure of information that the organization tries to process. The model of the problem space allows researchers to treat both organizational attributes and organizational problems as decision variables for the organization.

When an organization selects a problem and chooses a knowledge base accordingly, organizational diversity will be observed if problem definition, i.e., what is a right problem to be solved, differs across organizations. Leaving the determinants of problem definition to institutional analysis such as neo-institutionalism (Powell, 1991: esp. 189-194), I will limit my attention here to the relationship among various organizational problems and its impact on the effectiveness of problem definition.

The possible relationships among organizational problems are rugged, incomplete, and frictional landscapes. Although the problem space is a proper word, I use the word, landscape, to address the relationship among organizational problems since rugged landscape is widely used in literature to explain interactions among organizational attributes. The setting is as follows:

Let a problem space be $S$ such that $S = \mathrm{x}_{i\in P}\,\Omega_i$ or $\prod_{i\in P}\Omega_i$. Then, a problem space, $S$, is said to be rugged if $\int\cdots\int_p f(x_1, \cdots, x_i)dx_1 \cdots dx_i \neq \int\cdots\int_p f(x_1) \cdots f(x_i)dx_1 \cdots dx_i$. It is said to be incomplete if $\prod_{i\in P}\Omega_i \neq \prod_{i\in Q}\Omega_j$ where $i \in P$, a set of firm I's members, and $j \in Q$, a set of members of firm J that is the rival of firm I. It is said to be frictional if $\int_{\Omega 1 \in S} f(x_1, \cdots, x_i)\, dx_1 \cdots dx_i \neq \int_{\Omega 2 \in S} f(x_1, \cdots, x_i)$

$dx_1 \cdots dx_i$.

When a problem space is lugged, the occurrence of an organizational problem A is not independent of the occurrence of an organizational problem B. In this case, an organization, which succeeds in solving the problem A, needs to prepare for the other problem B if the joint occurrence of A and B is sufficiently high. An incomplete problem space describes a case, in which two competitors have different types of problems. What I mean by competitors is organizations whose niche is identical. If organizations in the same niche have different problem spaces, this indicates that either one of them has an incomplete, or wrongly defined problem space. Of course, it is possible that organizations whose problem spaces are identical may still define their problem space incorrectly. They are, however, subject to equally unknown problems so that the competitive effects of the mistakenly defined problem space will be absent. Organizations in a frictional landscape have a varying cost structure depending on a chosen organizational problem. Managers and workers in these organizations may be good at performing some problems and, at the same time, poor at others.

The three types of landscapes, alone or jointly, influence the effectiveness of problem definition in the following ways. First of all, as Levinthal (1997) shows, a rugged landscape leads an organization to search locally for alternatives to a current organization form. A small change in problem definition may result in a large increase in concurrent organizational problems that need to be handled with. As a result, an organization tends to modify its problem definition in a way that keeps tractable the number of organizational problems to solve. Second, competition between organizations with incomplete landscapes is weighted in favor of an organization whose problem definition is superior to the other if they are homogenous with respect to the marginal cost of problem-solving. If neither of organization holds problem definition superior to the other's, the consequence of competition will swing at the mercy of luck. In this case, organizations in competition will tend to mistakenly attribute the success to

an easily observable attribute of a winner (see Boyd & Richerson, 1985). Third, other things being equal, organizations will select an organizational problem, which incurs less cost to them. Moreover, local search is more likely to occur if a problem space is frictional and rugged because the exploration of a new and uncertain organizational problem will be risky and costly.

In particular, local search in the problem space, rugged, incomplete, or frictional, is characterized by sequential choice, where temporal order in search produces different outcomes. Specifically, sequential choice is defined as follows:

Let a temporal search sequence of organizational problems be $S_t$ such that $S_t = <\Omega_1, \Omega_2, \cdots, \Omega_t>$ and $\Omega_t$ is a chosen organizational problem at time $t$. Let the total unit profit be $\pi(S_t)$ such that $\pi(S_t) = \pi(\Omega_1) + \pi(\Omega_2|\ \Omega_1) + \cdots + \pi(\Omega_t|\ \Omega_1, \cdots, \Omega_{t-1})$. Then, **sequential choice** is a temporal search sequence such that $\pi(\Omega_j|\ \Omega_j) \neq \pi(\Omega_j|\ \Omega_j)$ for $i$ and $j \in \{1, 2, \cdots, t\}$.[2)]

Sequential search thus indicates that the profits obtained from search will differ depending on the temporal order that the problems are searched and solved. It is the case against 'equifinality' in organizational choice. The following example illustrates the logic of sequential search.

Suppose there are two firms, A and B, that have identical cost structures and plan to enter a new market. Suppose also both A and B know a priori that success in three years after entry depends on three organizational problems, $\Omega_1$, $\Omega_2$, $\Omega_3$. Let two investment plans be $I_a$ and $I_b$ such that $\Omega_t \in I_a, I_b$ for any $t = \{1, 2, 3\}$ and $NPV(I_a) = NPV(I_b)$, where $NPV(I_a)$ is the net present value of investment plan by firm A. The two investment plans are said to be sequential choice if $NPV(\Omega_t|\ \Omega_u) \neq NPV(\Omega_u|\ \Omega_t)$ for $t$ and $u = \{1, 2, 3\}$. Assume that the early phase of investment plan A includes organizational problems that are more rugged and frictional than plan B, yet not incomplete.[3)] Then, even when

2) The author is grateful to W. Chan. Kim for discussions related to this idea.

3) In other words, NPV of a plan is correctly computed by a firm. Yet, the qualitative interpretation of arguments proposed above will not change even if a problem is incomplete. If organizational problems are incomplete, then unobserved heterogeneity in

both firms will earn the same amount of money after three years, firm A, which selects investment plan A, will suffer more and experience more hazards of exit than firm B does. This difference in early risk may result in early termination of investment plan A for the following reasons.

First, firms suffering substantially in the early phase of investment will be highly vulnerable to the pressure from their shareholders via the stock market. Therefore, if the short-term oriented shareholders evaluate the NPV of a given plan in a way that differs from that computed by a firm, then this firm will have a great difficulty in financing required resources through the capital market.

Second, inexperienced managers and workers in firm A are more likely to commit mistakes in processing organizational problems in the early phase. In the presence of organizational learning, such an experience will benefit firm A in the later phase. Yet, the liability of newness will work against investment plan A, rendering the risk-averse management in firm A to abandon the plan. For example, a project manager, whose incentive is tightly aligned with investment plan A, will lose her credibility after a series of experimentation and mistakes in judgements and fail to obtain from her bosses additional support that helps to complete investment plan A.

Third, if competitor B implements investment plan B relatively easily in the early stage, this may signal to the market that a product developed by firm B is superior to and reliable than one by firm A. Moreover, firm B may use its temporal resource advantage to precipitate firm A into financial turmoil such as price competition.

Another example is as follows. If opinion leaders in the target customer are in fact highly sensitive to the price of a product, then an investment plan, which places more emphasis on quality in the early phase and on price in the later stage, will takes more time to reach critical mass that justifies investments.

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the environment will supply unexpected success or failure to an organization.

This means that a firm, which focuses on price competition as an entry strategy, will take the bulk of market share in the end if customer switch rates are low.

In sum, sequential choice in rugged, incomplete, and frictional landscapes demonstrates two issues. First, the marginal value of problem-solving itself does not reflect the fitness of an organizational choice. Rather, the competitive response from other organizations needs to be incorporated. Second, since the temporal order of chosen organizational problems is important, which organizational problem to be addressed first and when to move on another question needs to be investigated. In order to provide a general framework for discussing these two issues, I will look at the intensity and direction of local search and its performance implications.

## Ⅲ. Intensity and Direction of Local Search

The structure of this section is as follows. First, I will examine the definitions of intensity and direction of local search. Second, I will look into the factors that affect the intensity and direction of local search. Finally, I will explore the effectiveness of local search by using the notions of intensity and direction.

The intensity of local search refers to the degree that an organization searches possible organizational problems as well as their solutions in the neighborhood of current problems and solutions. An intensive local search is likely to find a new problem or solution, which is technically closer to the current problem and solution. In March (1991)'s term, a less intensive local search is explorative and a more intensive local search is exploitative. The intensity of local search is different from the intensity of search since the latter describes the propensity of an organization to initiate a new local search. According to March & Simon (1958:48), the intensity of search is decreasing in the satisfaction of an organization, which in turn is increasing in the difference between the expected

income and the target income, i.e. the level of aspiration. In what follows, I assume the intensity of search as one determinant to the intensity of local search yet examine additional factors that affect the intensity of local search.

The direction of local search refers to the mode of search routine that an organization uses when selecting a problem or choosing a knowledge base. The possible modes of search routine include internal development, the collaboration of extant business networks, the creation of new networks, and imitation. The first two are called here search-inside and the next two are called search-outside. As the definition of local search implies (Cyert & March, 1963; Nelson & Winter, 1982), the mostly frequently used mode is a class of search-inside. In particular, a problemistic search always starts to look for alternatives by using a class of search-inside. Yet, if a class of search-inside does not produce a satisficing outcome, then an organization switches into a class of search-outside. In what follows, I show the direction of local search is 'oscillating' between search-inside and search-outside.

1) Determinants of the Intensity and Direction of Local Search

The behavioral theory of the firm and the evolutionary economics characterize organizational choice as local search in the sense that an organization searches for its alternatives in the neighborhood of current alternatives (Cyert & March, 1963; Nelson & Winter, 1982). Since local search is problemistic search in nature, the intensity of search increases as an organization perceives its current performance to be problematic. In this respect, the intensity of local search is positively related to the intensity of search, other things being equal.

The purpose of search is twofold. One is to select a new problem and the other is to choose a new knowledge base. Choosing a new knowledge base is a simple search in the sense that there is no change in problem definition. In contrast, choosing a new problem is a complex search since it involves a change in problem definition of varying degrees. In all cases, a simple search is

exploitative, which means that an organization tries to know a given problem better than before. A complex search is, however, either exploitative or explorative, depending on the intensity of local search.

The direction of local search has two basic properties. First of all, local search is the first response that an organization will take when responding to the current or new organizational problem. Intensive local search is the first organizational response to a certain perceived problem because it is less costly to search in the neighborhood of a current problem or solution and an organization will take less costly search first and move on more costly search. Second, an organization stops using a certain search mode when it is dissatisfied with the outcomes of the search mode. As discussed above, the intensity of local search is decreasing in the satisfaction of the outcomes of search. That is, once an organization is not satisfied with the outcomes of search, it continues to search for another alternative. In the context of the direction of local search, this indicates that the use of each search mode depends on the satisfaction of a selected problem or chosen knowledge base. From these two properties, propositions 5 to 7 are derived. For simplicity, I denote internal development, the collaboration of extant business networks, the creation of new networks, and imitation by i-search, r-search, p-search, and n-search, respectively.

Let the intensity of local search, D, be conditional on the aspiration level, $\gamma$, such that $D(\Omega, \gamma) = \pi^*(\Omega, \theta, \gamma) - \pi(\Omega, \theta)$, where $\pi$ is the actual profit in a given period and $\theta$ is the amount of search resources. Let also the time spent away in search for a problem or solution be $\tau$ such that $\tau = \{\tau_L, \tau_H\}$ and $\tau_L$ and $\tau_H$ are short and long search time, respectively. Denote the probability of choosing a certain search mode, *i*, by $g(i)$.

**Proposition 5** (Simple Search). If $Z(\Omega)$ is an increasing function of $D(\Omega_j, \gamma)$, then $g(\text{i-search}|\ \tau_L) > g(\text{r-search}|\ \tau_L) \geq g(\text{n-search}|\ \tau_L) > g(\text{p-search}|\ \tau_L)$.

An aspiring organization is more likely to use search-inside when looking for

a new knowledge base to a given problem. Since the intensity of local search is highest for internal development in short search time, i-search is mostly likely to occur. If an organization with bounded rational members uses a search mode with a higher probability of finding a solution at a lower search cost, then intensive local search, which is relatively inexpensive, is more likely to produce a satisficing solution. In this respect, n-search and p-search are the least search mode that an organization will use in short search time.

**Proposition 6** (Complex Search). If $Z(\Omega)$ is an increasing function of $D(\Omega_j, \gamma)$, then $g(\text{i-search}|\ \tau_H) \geq g(\text{p-search}|\ \tau_H) > g(\text{r-search}|\ \tau_H) \geq g(\text{n-search}|\ \tau_H)$.

A complex search involves changes in problem definition. As the problem in consideration becomes not directly related to the current problem, local search has a character of exploration, rather than exploitation. As a certain search mode chosen earlier fails to locate the relevant problems and their solutions, an aspiring organization will eventually rely on its own resources or new capable partners so as to facilitate new problem definition. That is, for less intensive local search that requires longer search time, i-search and p-search are mostly likely to be used. Note that i-search in shorter search time is intensive local search; whereas i-search in longer search time is less intensive local search. For example, a firm will look for its previous experience when it initially attempts to improve the current situation. Yet, over time this firm will contrive new experimentation using existing resources such as redesigning of task flows or changing incentive systems when its previous experience turns out less useful for dealing with a new situation. Note also that an organization can use more than one mode simultaneously. This can happen whenever transaction costs of using more than one search mode are lower than using the market mechanism, i.e., relying on upstream or downstream organizations in the market. The level of transaction costs of each search mode is not examined in this essay. Yet, when discussing the performance implications of each

search mode, I will use slack resources and tacit knowledge bases as factors that are related to transaction costs of search modes.

**Proposition 7** (Search Time). $\partial g(\text{i-search}|\tau)/\partial\tau > 0$, $\partial g(\text{p-search}|\tau)/\partial\tau > 0$, $\partial g(\text{r-search}|\tau)/\partial\tau < 0$, $\partial g(\text{n-search}|\tau)/\partial\tau < 0$ and $\partial^2 g(\text{i-search}|\tau)/\partial\tau^2 < 0$, $\partial^2 g(\text{p-search}|\tau)/\partial\tau^2 < 0$, $\partial^2 g(\text{r-search}|\tau)/\partial\tau^2 > 0$, $\partial^2 g(\text{n-search}|\tau)/\partial\tau^2 > 0$.

The use of each search mode is more likely to terminate as the search time of a chosen mode gets longer. In this respect, the direction of local search is oscillating among four different modes of search. An organization keeps switching its search direction until it finds a relevant problem and solutions. From propositions 5 and 6, a more general pattern could be derived: search-inside → search-outside → search-inside. That is, at the early stage of local search, search-inside is mostly preferred. Over time, search-inside is switched to search-outside if initial search does not produce solutions. Finally, search-inside is back in use until it stops searching for alternatives in the problem space.

## Ⅳ. A Closing Note

One important implication of this routine-based choice deserves a further note. That is, the following factor is conceivable as moderating the relationship between the intensity of local search and that of search: slack resources. As mentioned above, an organization first selects its niche and chooses its way of serving the niche. Local search in an organization characterizes how an organization changes its niche (i.e., problem definition) and modifies its solutions (i.e., knowledge acquisition). In a world, where information on the problem space is incomplete and economic resources of acquiring such information are scarce, the act of searching for alternative problems and solutions is costly. Hence, if there is a prohibitive cost of search, then search tends to be highly

local or, in some cases, infeasible even though an organization perceives that current solutions given a problem are performing less. That is, the level of search cost moderates the relationship between the intensity of local search and the intensity of search. Search cost, exogenously given, is said to be 'relatively' high if an organization has few slack resources or if an organization has a highly tacit knowledge base.

An organization, which has sufficient slack resources, is more able to pay a given search cost than is an organization with few slack resources. Slack resources are initially defined as the difference between payments made to organizational members and contributions made by the members (Cyert & March, 1963). In this essay slack resources refer to under-utilized firm resources such as a set of solutions whose marginal value is more than the marginal cost of problem-solving or a group of managers and workers 'in excess' In other words, an organization has managers or workers, who are less needed at this moment. They might be overqualified or have totally different backgrounds relative to the operation of their company.

An organization, which is efficiently organized at this knowledge base, may not have resources to be redeployed for different purposes such as search for alternative problems and solutions. That is why most profit organizations do not invest more resources on the pure scientific activity and prefer to run their R&D investments on the commercial basis (Hounshell, 1996). If highly intensive local search requires fewer resources, then the presence of slack resources will make the relationship between local search intensity and search intensity much weaker. In other words, an organization with sufficient slack resources is more likely to search for distal alternatives, i.e., less intensive local search.

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# 조직문제의 표본 공간에서 발생하는 관행선택에 관하여: 국지적 탐색의 확장 모형*

배 종 훈**

**요 약**

조직 내에서 반복적으로 발생하는 작업과정을 '관행'이라고 정의할 때, 본 연구는 관행선택이라는 모형을 이용하여, 조직이 자신의 목표시장을 선별하고, 그곳에서 사업을 영위하는 방식을 선택하는 활동을 설명하고자 한다. 우선, Cyert & March(1963)의 국지적 탐색 모형과 Cohen & Levinthal(1989, 1990)의 흡수역량 모형을 활용하여, 본 연구는 특정 조직이 가지고 있는 지식기반을 조직이 일상적으로 접하는 의사결정 문제에 대한 확률변수로 정의하고, 이를 Levinthal(1997)의 적합도 지형의 차원에서 비교 설명하였다. 그 다음, 본 연구는 관행에 따른 의사결정이 복잡지형, 불완전지형, 마찰지형 등 세 가지의 적합도 지형에서 어떠한 조직성과를 낳는지 살펴보았다. 이를 통해 복수개의 의사결정 과제를 해결하는 순서에 따라 조직성과가 달라 질 수 있음을 '순차적 선택 효과'라는 개념으로 살펴보았다. 마지막으로, 본 연구는 순차적 선택 효과로 인하여 개별 조직이 의사결정 과정에 투여하는 노력의 양과 그 선택대안들이 달라 질 수 있음을 논하였다.

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