Turning Knowledge Into Action:

The Role of Incentives in Organizational Capabilities

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Abstract

An organization's ability to achieve certain outcomes requires both effective incentive systems and the appropriate knowledge and processes. However, the capabilities literature has focused almost exclusively on knowledge and processes, implicitly assuming that organization members are motivated to create and exploit knowledge to achieve organizational goals. Building on an emerging literature relaxing that assumption and trying to integrate motivational issues into capabilities thinking, we suggest that organizational capabilities should be conceptualized as bundles of knowledge, incentives, and processes. We suggest that these three components are highly interdependent, which may limit the insights that can be gained from research that focuses on knowledge and processes or on incentives in isolation. Our discussion implies that superior organizational capabilities are characterized by a "fit" between incentives, the knowledge base of the organization, and the processes required to achieve a particular outcome. We illustrate the conceptual discussion by drawing on recent empirical research on innovative capabilities.

INTRODUCTION

Strategy research typically conceptualizes organizational capabilities as being formed by organizational routines and processes, as well as knowledge residing at different levels in the organization (e.g., Iansiti, Clark 1994; Kusunoki, Nonaka, Nagata 1998; Dosi, Nelson, Winter 2000; Pisano 2000). The fact that organization members have to be motivated to exploit that knowledge and to engage in the required activities is often ignored and the motivation of organizational members is implicitly assumed[1]. More recently, scholars have realized that an exclusive focus on knowledge and processes is insufficient if we want to understand organizational capabilities and if we seek to explain why some organizations are better at doing certain things than others. Teece, Pisano and Shuen, for example, state that "recognizing the congruences and complementarities among processes, and between processes and incentives, is critical to the understanding of organizational capabilities" (1997, p. 520). However, research actually trying to integrate incentives into the capabilities perspective is still rare. The primary objective of this paper, therefore, is to gain a better understanding of organizational capabilities and, in particular, of the role that individual-level incentives play in capabilities.

To the extent that incentives have been addressed in the capabilities literature, the dominant approach is to consider incentive alignment as a distinct resource or capability that can potentially convey a competitive advantage (cf. Williamson 1999; Makadok 2003; Gottschalg, Zollo 2004). This approach assumes that knowledge, incentives, and processes are independent from each other, but jointly affect organizational performance. While this approach is an important step in the right direction, we will argue that knowledge, incentives,

[1] A look at the large body of agency literature, transaction cost economics, and the literature on organizational control suggests that the motivation of organization members to pursue organizational goals should not simply be assumed (e.g., Ouchi 1979; Prendergast 1999; Williamson 1975).

and processes are not independent but are related in various ways. An understanding of these interdependencies, in turn, may be more important for understanding organizational capabilities than understanding the role of knowledge, incentives, and processes in isolation. We suggest, therefore, that organizational capabilities be conceptualized as bundles composed of knowledge, incentives, and processes. An effective organizational capability not only requires certain levels of each of the three components, but it also requires that these components be consistent with each other. In other words, they have to "fit". Consequently, a superior capability – and competitive advantage – may not only stem from high levels of any of the components, but also from a high level of consistency between knowledge, incentives, and processes[2].

In line with the prior literature, we define an incentive as an expected reward that motivates certain behaviors (e.g., Pfeffer 1990; Gibbons 1998; Prendergast 1999). Most treatments of incentives in the economics and strategy literature have considered one abstract type of incentive, which could be called "pecuniary incentives". Pecuniary incentives are typically assumed to be context-independent, transferable, divisible, provided by the organization, and instantaneously available. Understanding the role of incentives in organizational capabilities, however, requires a richer notion of incentives. Drawing on the literature in psychology and organizational behavior, we will discuss two additional types of incentives, social and intrinsic incentives. Pecuniary, social and intrinsic incentives are qualitatively different, and we argue that these differences have important implications for organizational capabilities.

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[2] The objective of our paper is not a systematic integration of the control and governance literatures with the capabilities literature, but rather to draw on the literatures concerned with incentives to advance our understanding of organizational capabilities. More theoretical discussions of the intersections of these streams of research can be found in, among others, Foss (1996), Langlois and Foss (1999), and Williamson (1999).

Overall, our paper arrives at three key propositions. First, incentives are not only important for organizational capabilities, but they are related in complex ways to the two components on which the capabilities literature has traditionally focused, knowledge and processes. Second, an effective capability requires not only the presence of, but also the consistency between the three components. Third, if we want to understand the role of incentives in organizational capabilities, we need to consider different types of incentives, including pecuniary, social, and intrinsic incentives, because these incentives interact in different ways with knowledge and processes.

In order to make our discussion more tangible and to tie it to a coherent body of empirical literature, we focus on a particular kind of capability: the capability to innovate new products and processes (Research and Development capability). The capability to perform effective R&D is an interesting choice because of the dominant role innovation plays in most of today's markets. In addition, the innovative capability is an important dynamic capability (cf. Pisano 2000; Zollo, Winter 2002) and our paper therefore not only addresses the role of incentives for static capabilities, but also for organizational development and renewal.

In the next sections, we discuss the two components of capabilities that the literature has traditionally focused on: knowledge and processes. Subsequently, we provide a discussion of the dimensions and characteristics of incentives in the organizational context. On that basis, we discuss how incentives are related to knowledge and processes and how the three components together form an innovative capability. In addition, we discuss the notion of "fit" between incentives, knowledge, and processes and develop general propositions about conditions of fit. After presenting a brief summary of the conceptual discussion, we illustrate our model by discussing recent empirical research on a particular process related to innovation, the acquisition of knowledge from outside the organization. In our discussion

section, we highlight some of the areas of research that may benefit from a conceptualization of capabilities as bundles of knowledge, incentives, and processes.

INNOVATIVE CAPABILITIES AS KNOWLEDGE AND PROCESSES

The dominant literature on capabilities, in particular innovative capabilities, emphasizes the role of knowledge and of particular innovation processes.

Knowledge

Substantive Knowledge. Substantive knowledge, i.e., knowledge of facts, events and propositions, serves as the key input into the innovation process (Iansiti, Clark 1994; Leonard-Barton 1995; W. M. Cohen 1995)[3]. There is a growing body of research suggesting that large knowledge stocks in particular technological areas are associated with high innovative output in these areas, reflecting the important role of knowledge as an input factor (e.g., Henderson, Cockburn 1996). Furthermore, some authors investigated how existing knowledge shapes innovation processes such as search or the assimilation of new knowledge. The literature on organizational search suggests that organizations search in areas closely related to their current expertise (Nelson, Winter 1982; Helfat 1994; Stuart, Podolny 1996). W. M. Cohen and Levinthal (1990) argued that current knowledge stocks are important determinants of a firm's ability to "absorb" outside knowledge and to put it to use. If organizations do not already posses a certain amount of knowledge in a technological area, they may be unable to assess available external knowledge and to integrate it into their existing knowledge base. While much of this research has treated knowledge as a property of the organization, substantive knowledge is primarily embedded in organization members and

[3] Some authors refer to this kind of knowledge as "declarative knowledge" (e.g., M. D. Cohen, Bacdayan 1994).

thus distributed throughout the organization (Langlois, Foss 1999; Leonard-Barton 1995; Grant 1996).

Procedural Knowledge. Substantive knowledge in technological areas is crucial for innovation. However, the organization also must have knowledge about how to acquire such knowledge and how to integrate and use it (Iansiti, Clark 1994). More generally, *procedural knowledge* is needed about how to perform innovative activities and processes[4]. Argote and Darr (2000) suggest that procedural knowledge can reside in three different repositories. It can be kept by individuals (in particular tacit knowledge), embodied in technology, and incorporated in organizational structure and routines. The latter repository is emphasized by Dosi et al. (2000) who think of know-how as primarily embedded in the organization's activities and routines.

Directive Knowledge. While all processes are based on procedural knowledge, not all of the procedural knowledge in an organization is implemented in actual activities and processes at any one point in time. Instead, the body of procedural knowledge determines the activities organization members could *potentially* perform. In line with prior research, we call the set of potential activities and processes the *repertoire* of organization members (Nelson, Winter 1982; M. D. Cohen 1991). Not all elements of the repertoire will be appropriate at all times, and some may even be detrimental to innovative performance. A third type of knowledge that is therefore needed is knowledge of which activities should be performed and when (Nelson, Winter 1982). While this type of knowledge is an explicit element in Nelson and Winter's theory, it is rarely distinguished from procedural knowledge in the more recent capabilities literature; we will call this knowledge *directive knowledge*[5]. For illustration,

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[4] Procedural knowledge is equivalent to what Kogut and Zander (1992) termed "know-how".

[5] Procedural and directive knowledge will be highly interdependent with substantive knowledge; the larger the amount of substantive knowledge, the better should procedural and directive knowledge be. However, procedural and directive knowledge do not always require substantive knowledge. Historically, many

assume a scientist who knows how to isolate certain proteins from a sample, how to electronically access the latest research in his field, how to conduct a Polymerase Chain Reaction, and how to clone mammal cells. These pieces of procedural knowledge form the scientist's personal repertoire. However, not all of these activities may be useful for a particular research objective (e.g., identifying a new drug compound), some activities might have to be performed at particular points in time, or in certain combinations. Directive knowledge about what to do in order to achieve the desired objective is needed[6]. The directive knowledge available to organizations is often limited, especially in the innovation context. A lack of directive knowledge has important implications for organizational capabilities and will be discussed in more detail below.

Insert Figure 1 about here

Organizational Processes

An innovative capability involves certain organizational processes, which in turn can be defined as sets of activities performed by organization members. Activities conducted by organization members are thus the smallest building blocks of innovation processes and of an innovative capability. Our notion of process is similar to the notion of a "routine" as discussed by Nelson and Winter (1982); however, we do not use the term "routine" because our focus is not on the regularity and rigidity of organizational processes that is so central to

technologies were developed on the basis of experimentation and observation rather than on the basis of fundamental research and an understanding of why they worked (cf. Mowery, Rosenberg 1989).

[6] This example illustrates that directive knowledge at one level of analysis is procedural knowledge at a higher level of analysis: if we consider the separate activities in this example, knowing which activity to choose in order to identify a new drug compound is directive knowledge. At the next higher level of abstraction, "identifying a new drug compound" is a process in itself and knowing "how to do" so is procedural knowledge, subsuming the lower-level directive knowledge.

Nelson and Winter's theory. In fact, we will suggest that an innovative capability may be characterized by less "routinized" processes than most other organizational capabilities. Organizational processes (and routines) can be thought of at different levels of aggregation (cf. Winter 2000; Dosi et al. 2000). For example, "integrating knowledge within the organization" is a higher-level process, "exchanging knowledge between R&D and manufacturing" is a lower-level process, and "meeting weekly in cross-functional teams" is one possible activity involved in these processes.

The concrete processes and activities that are most effective for innovation are contingent on the particular setting, e.g., the specific innovation task, the organizational context, and certain industry conditions (Iansiti 1995; Hobday 1998). However, while these processes take different concrete forms in different contexts, they always require that motivated organization members engage in certain activities and behaviors. To illustrate, we will briefly discuss two of processes that have received much attention in the literature as important elements of innovative capabilities[7].

Integrating knowledge within the organization is often required for innovation because relevant knowledge is held by specialized individuals and groups within the organization (Argote, Ingram 2000; Iansiti 1995). Several studies have found that knowledge integration processes are important determinants of innovative performance. For example, Clark, Chew and Fujimoto (1987) studied new product development in the world auto industry and showed that intensive and timely information exchange between development stages increased performance along a variety of dimensions. Iansiti (1995) systematically investigated innovation processes in the mainframe computer industry and found that routines

[7] Some authors define the innovative capability more broadly than others. For example, Burgelman, Maidique, and Wheelwright (1996) include processes such as "understanding competitor's innovative strategies and industry evolution" and Christensen (1997) pays particular attention to the integration of information on demand conditions. The concrete delineation of an innovative capability is of little relevance to our discussion.

aimed at technology integration within the organization had positive performance effects. Finally, Ettlie (1995) studied the interface between product development and manufacturing and found that processes that integrate knowledge between these organizational units contributed to better performance. Empirical studies such as these reveal that knowledge integration processes are in turn comprised of activities of individuals; for example, working in cross-functional teams, job rotation, or informal discussions at the water cooler.

A second important innovation process is the *acquisition of knowledge from outside the organization*. Several modes of knowledge acquisition have been discussed in the literature, including mergers and acquisitions, strategic alliances, university-industry collaboration, scanning of the relevant environment by gatekeepers, and informal information exchange between individuals (e.g., Leonard-Barton 1995; Von Hippel 1987). Empirical research suggests that firms differ in the degree to which they have effective knowledge acquisition processes in place and that more effective processes are related to better innovative performance (e.g., Henderson, Cockburn 1994; Zucker, Darby, Armstrong 2002). Again, these studies suggest that effective knowledge acquisition processes are the result of appropriate activities performed by organization members. Examples are researchers and scientists collaborating with university scientists on joint projects (Zucker et al 2002.; Henderson, Cockburn 1994) and individuals engaging in informal knowledge exchange with employees from other organizations (Von Hippel 1987). Even seemingly "institutional" acquisition modes such as licensing or mergers and acquisitions can only be effective if the potentially available knowledge is actually acquired and absorbed through a variety of lower-level processes and activities.

Interdependencies between Knowledge and Processes

The different forms of knowledge and organizational processes are closely related. First, as discussed above, procedural knowledge defines the repertoire of potential activities and processes. Second, directive knowledge specifies which activities should be performed and how activities should be combined into processes in order to achieve the organization's objectives. Third, innovation processes are primarily concerned with the production and integration of knowledge, which is therefore the basic input into innovation processes. Finally, existing knowledge can also be a determinant of the effectiveness of organizational processes. For example, existing knowledge may determine how well organization members are able to understand and make use of outside knowledge (W. M. Cohen, Levinthal 1990).

While knowledge is a critical basis for innovation processes, it is also an output of effective innovation processes (Iansiti, Clark 1994; Pisano 2000). The increase in the knowledge base of the organization as a result of innovative activities may concern substantive knowledge as well as procedural and directive knowledge (e.g., "learning by doing"). The accumulation of knowledge as a result of innovation processes and the use of that knowledge as the basis for subsequent innovation processes is a potential source of path dependencies in innovation (cf. W. M. Cohen 1995; Helfat 1994; Stuart, Podolny 1996).

INCENTIVES AS THIRD COMPONENT OF INNOVATIVE CAPABILITIES

The dominant literature on organizational capabilities focuses on knowledge and processes as the primary components of capabilities. However, such a perspective implicitly assumes that organization members are motivated to exploit the available knowledge to achieve organizational objectives. But are organization members always motivated to act in the organization's interest? If not, could the appropriate incentives be a source of superior organizational capabilities? If so, how does the optimal incentive system look like?

Interestingly, Nelson and Winter (1982), on which much of the capabilities literature is based, explicitly distinguished between cognitive and motivational aspects of organizational capabilities. They argued that performance is a function of whether members know what to do and how to do it (directive and procedural knowledge) as well as whether members are willing to do what is required (p. 107). Although the motivational aspect has been neglected in most subsequent writings on capabilities, more recent work has shown renewed interest in incentives. Several authors conceive of the ability to align incentives and to govern transactions within the organization as a distinct organizational resource or capability (cf. Williamson 1999; Makadok 2003; Gottschalg, Zollo 2004). Others argue that incentives and knowledge are intertwined within a given capability (cf. Leonard-Barton 1995; Teece et al. 1997; Coriat, Dosi 1998). For example, in her discussion of core capabilities, Leonard-Barton (1995) argued that the incentive system serves as a channeling mechanism that directs knowledge-related behaviors and processes and that it is an integral part of a (technological) capability. Along the same lines, Coriat and Dosi (1998) suggested that routines are at the same time mechanisms for coordination and problem-solving and a way of codifying incentives and constraints. The authors illustrated these two aspects of routines by discussing the "co-evolution" of business processes and incentive systems in Taylorism and Ohnism (Japanese production practices). We believe that the latter approach, which considers incentives an integral element of *any* organizational capability, is particularly promising, because it can capture the interdependencies between knowledge, incentives, and processes. These interdependencies, in turn, may have important implications for organizational performance, development, and competitive advantage. We hope to contribute to this emerging literature by systematically analyzing the interdependencies between knowledge, incentives, and processes and by developing a model of capabilities as consisting of these

three components. First, however, it is necessary to discuss in more detail the nature and characteristics of incentives in organizations.

Incentives in Organizations

We define an incentive as an expected reward that motivates certain behaviors. Thus, an organization member engages in particular behaviors if these behaviors are believed to lead to a desired reward (cf. Lawler 1994; Ambrose, Kulik 1999). In the following sections, we discuss three important dimensions of an incentive: its direction, strength, and type[8]. In doing so, we focus on incentives perceived by individual organization members. While rewards are sometimes given to groups, behaviors are ultimately driven by the individual-level incentives group members perceive.

Direction of Incentives. Incentives are perceived for specific activities and processes or for achieving particular outcomes. Accordingly, the *direction* of an incentive refers to the specific behavior for which it is perceived or to the outcome on which it is contingent. We discussed above that innovation processes can be thought of at different levels of aggregation. A similar hierarchy of levels exists with respect to the *specificity* of an incentive; i.e., an incentive can be directed at higher-level processes and outcomes or at specific lower-level activities. For example, an incentive that is contingent on some aggregate measure of innovative performance (e.g., patent applications) or even organizational performance (e.g., profit) would be very general. In contrast, an incentive that is contingent on conference attendance would be more specific. If an incentive has a very specific direction, the organization member has little autonomy with respect to choosing the activities from his or her repertoire. If an incentive has a more general direction, the organization member can

[8] For simplicity, we focus on incentives that are associated with a positive utility for the individual. The incentive system may also entail sanctions or punishments; work behaviors are then motivated by the desire to avoid these "negative" rewards.

decide which particular activities or sets of activities are most suitable for following the direction of the incentive. For example, if an incentive is contingent on innovative performance, it is up to the organization member to decide if attending conferences is useful or if another activity is more effective towards achieving high innovative performance. If the incentive is directed at attending conferences, the organization member has to attend conferences in order to obtain the reward.

Insert Figure 2 about here

Strength of Incentives. Not all incentives have the same motivating power or strength. If an individual simultaneously perceives several incentives that have conflicting directions, the individual will primarily engage in the behavior for which the stronger incentive is perceived. The strength of an incentive is determined primarily by two factors, the size of the expected reward (e.g., the dollar value of a bonus) and the preferences of the individual for the reward (Lawler 1994). There is a large literature showing that individuals differ in their preferences for certain types of rewards such as monetary bonuses or recognition (e.g., Amabile et al. 1994; Pelz, Andrews 1976). Accordingly, the strength of an incentive also depends on its type, i.e., what kind of reward the individual expects[9].

Types of Incentives. Although important, pecuniary incentives are by no means the only incentives operating in organizations. Drawing on the literature in psychology and organizational behavior, we will briefly characterize a more exhaustive set of incentives, grouped into three types: pecuniary incentives, social incentives, and intrinsic incentives.

[9] Motivation research has produced a large body of work over the last century and a number of other factors have been found to affect the strength of incentives. For reviews, see Lawler (1994) and Ambrose, Kulik (1999).

Distinguishing these types of incentives is important because different types of incentives interact in different ways with knowledge and may have qualitatively different effects on individual activities and organizational processes (see below).

Pecuniary incentives. Pecuniary incentives are based on monetary or tangible rewards and have been the traditional focus in the economics literature (e.g., Williamson 1975; Prendergast 1999; Lazear 2000)[10]. These rewards are valued by individuals because of the purchasing power they represent (monetary rewards) or because of the utility that can be derived from the reward itself (tangible rewards). In the organizational context, pecuniary incentives are usually provided by the management of the organization using the compensation system (cf. Baron, Kreps 1999).

Social Incentives. The broad class of social incentives encompasses expected nonpecuniary rewards that stem from a particular social system. One type of social incentive is recognition and approval from valued others (Fehr, Falk 2002). The desire to reciprocate favors from others or to avoid negative sanctions from peers (peer pressure) can be another powerful incentive to engage in certain behaviors (Osterloh, Frey 2000). Not always is the social system that underlies social incentives identical with the focal organization. For instance, many researchers perceive social incentives such as recognition and eminence stemming from the "scientific community", composed of individuals from a large number of organizations (Merton 1973; Pelz, Andrews 1976; Dasgupta, David 1994). Social incentives may also transcend the interpersonal level, e.g., when employees identify with the organization as a whole and internalize organizational norms and values. Social incentives are then perceived for adhering to organizational norms and for furthering the organizational objective even in the absence of any monitoring by others (cf. Kreps 1997; Ryan, Deci 2000;

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[10] Incentives might not always have been called "pecuniary" or "monetary" in that literature. However, the characteristics of the typical incentive in that literature are the characteristics of pecuniary incentives.

Akerlof, Kranton 2005). Social incentives of this kind are the key element of "cultural" or "clan" control discussed in the control literature (Ouchi 1979). Most social rewards are contingent on performance (e.g., peer recognition for achievements, feeling of having made a valuable contribution to organizational objectives). Organizations can to some extent provide or induce social incentives using mechanisms such as formal recognition programs or socialization programs (Koning 1993; Saks, Ashforth 1997).

Intrinsic incentives. The motivation to work on something because it is interesting, exciting, satisfying, or personally challenging is called intrinsic motivation (Amabile 1993; Ryan, Deci 2000). Intrinsic rewards are perceived as a result of engaging in certain behaviors (e.g., task enjoyment) or as a direct result of the task outcome (e.g., feeling of achievement); in the latter case, the reward is performance-contingent. Intrinsic incentives are often a function of the match between characteristics of the task (e.g., scientific areas involved) and the individual (e.g., interest in certain scientific areas). However, organizations can to some degree also provide and influence intrinsic incentives. Organizations can increase the interestingness of work and the ability of work to provide individuals with a feeling of self-achievement by means of work design (cf. Hackman, Oldham 1976). Moreover, managers can find informal ways to create "excitement" among employees, thereby increasing task enjoyment and intrinsic motivation (Manners, Steger, Zimmerer 1997).

While we make a conceptual distinction between pecuniary, social, and intrinsic incentives, different types of rewards are often provided simultaneously. For example, a publicly announced year-end bonus involves both pecuniary elements (additional financial resources) and social elements (recognition). To some extent, the three types of incentives can be substituted for each other: a given level of motivation for a particular activity can result from different mixes of types of incentives.

There is a growing body of literature on the relative importance of different types of incentives. Empirical studies suggest that employees consider social and intrinsic incentives very important, often more important than pecuniary incentives (General Social Survey 1994; Heath 1999). Due to both selection effects and socialization processes, the importance of various types of rewards varies across occupations and professions (Ritti 1968; Saks, Asforth 1997; Sauermann 2005). Studies of professional and knowledge workers suggest that these groups have particularly strong preferences for social and intrinsic rewards (Pelz, Andrews 1976; Dasgupta, David 1994; National Science Foundation 2001)[11]. Figure 3 summarizes our discussion of the three dimensions of incentives.

Insert Figure 3 about here

Sources of Incentives and Incentive Conflict

Not all the incentives that drive organization members' behaviors are under the control of the organization and its management. Therefore, as emphasized by agency and control theorists, members may perceive incentives that are directed at activities that conflict with an effective organizational capability or may perceive incentives to "shirk" activities that are required (Ouchi 1979; Prendergast 1999). In these cases, the choices organization

[11] The National Science Foundation (2001) sponsored a survey asking over 30,000 holders of doctorate degrees in science and engineering fields about the relative importance of a variety of job characteristics when thinking about a job. Of the respondents, 79% considered intellectual challenge very important, 54% considered contributions to society very important, and 43% considered salary as very important. Since most of the respondents were employed, such results do not necessarily suggest that money per se is less important than nonpecuniary factors (few people could afford a job that doesn't pay money but is interesting). Rather, survey results such as these suggest that nonpecuniary factors are more important *conditional* on the individual having certain endowments of money and other assets (e.g., a job). However, it is exactly these "conditional preferences" that are relevant when thinking about incentives in the organizational context.

members make with respect to their activities and behaviors depend on the relative strength of the conflicting incentives.

While incentive conflict should not be ignored, it is too simplistic to assume that the incentives individuals perceive independently from the organization always conflict with the organization's interests. Certain incentives that stem from sources other than the organization (extra-organizational incentives) may in fact be supportive of organizational objectives. For example, a researcher might be intrinsically motivated to solve a particular problem and the solution might contribute to innovative performance of the organization. Similarly, if individuals have an intrinsic desire to challenge themselves and to achieve something, it may matter little which particular objective they pursue; most individuals will then probably engage in those activities that are supported by the organization. Finally, organization members may perceive incentives from outside the organization, e.g., social incentives resulting from within the professional community. Although these incentives may conflict with organizational goals (Miller 1967; W. M. Cohen, Sauermann 2005), many organizations are able to "free ride" on them by selecting new members whose professional orientation is in line with the requirements of the organization. In fact, organizations may purposefully select members with strong social incentives originating outside of the organization because the benefits of the resulting motivational processes (e.g., involvement with academia, knowledge sharing) outweigh the cost resulting from incentive conflicts (cf. Henderson 1994).

Overall, it is important to recognize that organizations do not provide or control all the incentives individuals perceive. Conflicts between incentives from other sources and organizational interests are possible but may be less frequent and detrimental than sometimes assumed.

Interdependencies between Incentives and Processes

We argued above that the pool of procedural knowledge determines an organization's repertoire of activities and processes and that only a subset of this repertoire will actually be executed. In other words, organization members do not do everything they can do. The critical mechanism that determines which activities are actually performed and which processes emerge are the incentives individuals perceive. Incentives motivate individuals to engage in one activity versus another and to exert high effort; incentives are thus a major determinant of an organization's ability to achieve certain outcomes (Nelson, Winter 1982; Leonard-Barton 1995). More specifically, we suggest that the direction of an incentive determines which activity from the repertoire an organization member is motivated to choose. If an incentive is very specific, the organization member will select the activity at which the incentive is directed. If an incentive is directed at higher-level processes or outcomes, organization members will choose the activities they believe will most effectively follow the direction of the more general incentive. If an organization member perceives conflicting incentives, the choice depends on the relative strength of these incentives. Similarly, the effort an individual is willing to exert depends on the absolute as well as relative strength of the incentive (Jenkins et al. 1998; Prendergast 1999).

Proposition 1: *Incentives moderate the relationship between knowledge and processes.*

If incentives are the crucial link between knowledge and processes, as we suggest, certain characteristics of organizational processes may be explained by the structure of organizational incentives. A particularly interesting question is what role incentives play in the "routinization" of organizational processes. Based on our discussion thus far, we suggest that incentives that are directed at lower-level processes and activities result in more repetitive, routinized processes, because the component activities are essentially pre-specified through the incentive system. In contrast, if incentives are more general, they allow

organization members to choose from a larger set of activities; depending on the specifics of the task and situation, organization members may choose different activities. For illustration, consider an organization that rewards individuals for attending scientific conferences (a very specific incentive) because it is believed that attending scientific conferences is an effective way to acquire outside knowledge. As long as these incentives remain stable, and assuming they are strong enough, attending conferences will be a routine activity. On the other hand, if the organization rewards individuals for acquiring outside knowledge (a more general incentive), the specific activities by which knowledge is acquired may change. Conference attendance may be chosen by organization members as a particular activity in some situations but not in others. While the higher-level process (knowledge acquisition from outside) will be routine, the lower level activities may be less routinized. Interestingly, in their seminal work on organizational routines, Nelson and Winter (1982, p. 97) suggest that their model of organizational routines may be less applicable in innovative organizations than in other business organizations. We suggest that one possible explanation is that incentives in innovative organizations are less specific and thus allow for more variation in the patterns of individual activities over time. We will return to this issue below.

Proposition 2: *The structure of incentives shapes characteristics of organizational processes.*

Interdependencies between Incentives and Knowledge

We argued above that incentives link knowledge and processes by determining which of the activities in their repertoire organization members choose to perform. For an effective innovative capability, the incentives should be directed at the most suitable activities or outcomes. Providing incentives therefore requires directive knowledge about which activities and processes are most effective for the particular objective. However, not all incentives require the same amount of directive information. In particular, the required directive

knowledge depends on how specific vs. general the direction of the incentive is and on the type of the incentive[12].

If an incentive is very specific and directed at a particular activity (e.g., going to scientific conferences), a large amount of directive knowledge is needed; the provider has to know that this particular activity is most effective for innovation. If the incentive is directed at a set of activities or at higher-level processes (e.g., acquiring knowledge from the academic sector), directive knowledge is needed that these are effective sets of activities or processes; the provider does not need directive knowledge about which particular activities in this set are most effective. In the latter case, where the incentive has a general direction, the directive knowledge that is still needed to decide which specific activity should be undertaken has to be supplied by the organization member at the time an activity has to be chosen. The general direction of the incentive constrains the choices the member has: he or she has to choose an activity that falls in the larger set of activities at which the incentive is targeted or that promises to lead to the outcome on which the incentive is contingent[13].

Instead of providing specific incentives that require that management have directive knowledge, management could simply tie incentives to some general measure of innovative performance; if the organization can specify an adequate performance objective, the organization member will perform the necessary activities and there is no need for the organization to prescribe or monitor these activities. If performance-contingent incentives are

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[12] Not all directive knowledge is directly tied to incentives. Some directive knowledge is codified in rules and procedures and individuals may not be rewarded for each instance of rule following or punished for not following these rules. However, some aggregate measure of rule-following will be tied to rewards that are either provided by the organization (e.g., in the form of promotions, threat of job loss) or that stem from other sources (e.g., social incentives based on internalized norms and values; cf. Kreps 1997).

[13] The organization member might possess the required directive knowledge already at the time that the incentive is specified, reflecting a knowledge advantage vis-à-vis management. Alternatively, the directive knowledge may emerge in the process of working on a project. Sometimes, even the organization member may not have the necessary directive knowledge at the time the decision has to be made. In that case, the organization member may have to experiment, still pursuing the avenues that appear most likely to follow the more general direction of the incentive.

effective, the availability of directive knowledge to management is irrelevant. The agency and control literatures have discussed performance-contingent incentives in considerable detail (e.g., Ouchi 1979; Eisenhardt 1985; Prendergast 1999) and highlight two conditions for their effectiveness. First, performance-contingent incentives shift risk to the organization member to the extent that factors beyond his or her control affect performance. The larger the uncertainty involved or the larger the risk-aversion of organization members, the more costly are performance-contingent incentives to the organization and the less motivating is a reward of a given size (Gibbons 1998). Second, for performance-contingent incentives to be effective, management has to be able to specify performance objectives ex ante and to measure performance reliably. If performance cannot be measured reliably or if individual effort is not reflected in performance due to high uncertainty, the causal link between individual effort and reward is weak and organization members will therefore only perceive weak incentives to perform the required activities and to exert high effort.

Proposition 2a: *The higher the specificity of an organizationally provided incentive, the more directive knowledge is needed by management.*

Proposition 2b: *The higher the measurability of the targeted activity or outcome of an incentive, the higher the effectiveness of the incentive*[14].

Proposition 2c: *The higher the uncertainty involved in a task, the lower is the effectiveness of a performance-contingent reward.*

Optimal Incentives: Fit With Knowledge and Processes

The model developed thus far suggests that incentives play a crucial role in organizational capabilities by motivating organizational members to tap into the

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[14] Effectiveness is defined with respect to the organizational goal (e.g., innovation), not with respect to eliciting just any behavior from organization members.

organization's knowledge sources and to exert high effort in the required activities. Consequently, it would be important to understand the factors that condition the effectiveness of incentives and, on that basis, which incentive systems are superior under particular conditions. In studying these questions, we can draw on a large body of existing research in economics and management. While an exhaustive discussion is beyond the scope of this paper, we will provide a brief overview of central issues leading us to a key proposition: an effective capability requires the *fit* between the direction, strength, and type of incentives with the knowledge base of the organization and with the characteristics of the desired organizational processes.

Direction of incentives. The direction of incentives refers to the specific outcome or activity at which the incentive is directed. For an effective capability, the incentives should be directed at those outcomes or activities that are most beneficial to the organization's objectives. As discussed above, if performance can be measured reliably and is clearly linked to individuals' effort, performance-contingent incentives can also be effective (Ouchi 1979; Prendergast 1999). If performance cannot be measured reliably, organizations can try to provide incentives that are targeted at lower-level processes and activities. However, the more specific incentives are, the more directive knowledge is needed about which lower-level processes and activities are appropriate.

For some organizational capabilities (e.g., the manufacturing capability), managers possess a large amount of directive knowledge and organizationally provided incentives are usually directed at very specific activities and processes. For example, total quality management (TQM) entails that the organization specifies explicitly which activities employees have to perform; these directions are typically codified in large manuals (Hackman, Wageman 1994; Sitkin, Sutcliffe, Schroeder 1995). The directive knowledge related to innovative capabilities is less well developed; effective innovation activities and

processes are more idiosyncratic and the underlying "production function" is usually not known in detail ex ante (cf. Ouchi 1979; March 1991; Sitkin et al. 1995). While certain higher-level processes are generally important for innovation (e.g., knowledge integration), it is often less clear what the appropriate lower-level activities are. Due to the relative lack of directive knowledge, organizations and their managers will be unable to identify necessary activities ex ante and to provide specific incentives for these activities.

As discussed above, a lack of directive knowledge might be irrelevant if the organization is able to provide performance-contingent incentives. However, several problems of performance-contingent rewards are particularly salient in the context of innovation (Ouchi 1979; Kerssens-van Drongelen, Cook 1997). First, most R&D projects, especially ones that involve basic research, are long-term in nature and performance may be affected by many factors that are not under the influence of organization members. Second, many projects involve technological nonseparabilities and teamwork such that the contributions of individuals cannot be distinguished by managers (cf. Alchian, Demsetz 1972). Third, it is difficult to establish objective criteria for output measurement ex ante since the concrete nature of the desired output is unknown. Overall, reliable performance-measurement in innovation is very difficult and performance-contingent incentives are unlikely to be very effective.

Proposition 3: *In R&D, organizationally provided incentives with a medium level of specificity will be more effective than incentives with a high or low level of specificity.*

Strength of incentives. According to agency theory, performance-contingent rewards are less efficient if the organization member exhibits high risk aversion and if there is high uncertainty concerning the relationship between effort and the outcome-measure (Gibbons 1998; Prendergast 1999). The more risk-averse an agent is or the more risk is involved in the

task, the larger (and more costly) does an incentive have to be for a given level of motivation. In such cases, organizationally provided contingent rewards are not an efficient means of motivation and the optimal strength of rewards is low. Another conditioning factor for the optimal strength of incentives is the presence of a "multitask problem". A multitask problem arises when multiple activities are required from the same organizational member but some activities can be more easily motivated with organizationally provided incentives than others (Kerr 1985; Prendergast 1999). If strong rewards are offered for only a subset of activities, the organization member will focus on the behaviors for which stronger incentives are perceived and may neglect other important activities for which strong incentives cannot be provided. In such cases, it might be necessary to avoid strong incentives even for those behaviors that could easily be rewarded in order to not encourage the neglect of unrewarded tasks (cf. Holmstrom and Milgrom 1994). Innovation activities are inherently risky and performance measurement is problematic (Kerssens-van Drongelen, Cook 1997). The multitask problem plays an important role in innovation, because some activities such as conference attendance can be easily monitored and rewarded, while others such as knowledge sharing and "thinking" cannot.

Proposition 4: *In R&D, the optimal strength of incentives is low.*

Types of incentives. Different types of incentives (i.e., pecuniary, social, and intrinsic) have different requirements with respect to directive knowledge and to the observability of effort and performance. Accordingly, some types of incentives may be more effective in some settings than in others. With respect to performance measurement, pecuniary incentives provided by the organization have the strongest requirements; performance has to be measurable by management (Prendergast 1999). In contrast, some social incentives only require that performance be observable by certain other persons, not by

management. These other persons, e.g., team-members or professional peers, may be in a better position to assess the performance of organization members than management (Alchian, Demsetz 1972). Social incentives based on internalized organizational objectives can be effective at even lower levels of performance measurability; they only require organization members themselves to be able to form some assessment of performance. If the organization member has identified with the organization and perceives a social incentive to do what is best for the organization, the member will engage in those activities that he or she believes (on the basis of directive knowledge) will be most beneficial to the organization (Ouchi 1979). Similarly, if an organization member perceives intrinsic motivation to achieve something, self-assessment of performance by the member is sufficient. The relatively low informational requirements of social and intrinsic incentives suggest that these incentives are relatively effective in the innovation context (cf. Ouchi 1979; Perrow 1967).

Different types of incentives have also been found to differ with respect to certain psychological processes that are relevant in the context of innovation, in particular creativity. While pecuniary incentives that are directed at creative performance can increase creative output, intrinsic motivation is more conducive to creativity than motivation based on pecuniary incentives (cf. Amabile 1993; Eisenberger, Rhoades 2001). One possible reason for this disadvantage of pecuniary incentives is that rewards that are contingent on other's evaluations indirectly constrain creative thought processes because they are tied to implicit or explicit standards (Amabile 1993). Accordingly, argues that intrinsic incentives should dominate in the problem presentation and idea generation stages of R&D projects, which require much creativity. As the project enters the idea validation and implementation stages, creativity is less important and more weight on pecuniary incentives may be appropriate.

Proposition 5: *In R&D, social and intrinsic incentives are more effective than pecuniary incentives.*

Summary: The Trinity of Innovative Capabilities

We argued that an organizations ability to achieve certain outcomes requires the appropriate knowledge, incentives and processes. Accordingly, organizational capabilities should be considered as bundles of these three components (Fig. 2). Knowledge is relevant in three forms. Substantive knowledge ("what is") is the primary input into innovation processes, which are generally concerned with the acquisition and integration of knowledge. Procedural knowledge ("how to do") defines the repertoire of potential activities and processes organization members can perform as part of an innovative capability. Directive knowledge is the knowledge about "what to do" and essentially specifies which of the activities in the repertoire ought to be performed at a particular time. While knowledge is a necessary component of capabilities, knowledge alone is not sufficient for organization members to actually choose to engage in the required activities and for effective innovation processes to materialize. In order for knowledge to be translated into organizationally desirable activities and processes, organization members have to perceive the appropriate incentives. Incentives are defined as expected rewards that motivate certain behaviors and are characterized by three dimensions. The direction of an incentive refers to the activity or outcome on which the underlying reward is contingent, the strength of an incentive refers to its motivating power, and the type of an incentive refers to the nature of the underlying reward. The three types of incentives we distinguished are pecuniary incentives (e.g., money), social incentives (e.g., peer recognition), and intrinsic incentives (e.g., task enjoyment). We suggest that the effectiveness of an organizational capability depends upon the degree to which the direction, the strength, and the type of incentives fit with the knowledge held by organization members and by management and with the particular characteristics of the desired organizational processes.

Effective innovation processes not only result in new products and processes for downstream operations (e.g., a new drug, a new manufacturing process), but also in new substantive knowledge, new knowledge about innovation processes (procedural knowledge), and new directive knowledge.

Insert Figure 4 about here

THE CASE OF EXTERNAL KNOWLEDGE ACQUISITION

In this section, we will illustrate the conceptual discussion by reviewing selected empirical studies on the acquisition of external knowledge by R&D organizations. This discussion highlights the critical role of incentives for innovative capabilities and provides some evidence for several of the propositions developed in this paper.

Rebecca Henderson and Ian Cockburn have developed an extensive research program on the drivers of productivity in pharmaceutical research. One of the key factors they considered was the degree to which organizations encourage and maintain an extensive flow of information across firm boundaries (e.g., Henderson, Cockburn 1994; Cockburn, 1998). The primary measure they used was PROPUB, a measure assessing to what extent an individual's standing in the larger scientific community and publication record was a dominant criterion in promotion decisions. Henderson and Cockburn hypothesized that an emphasis on standing in the scientific community would lead to increased interaction with peers in the scientific community, and the associated increased acquisition of outside knowledge would increase innovative performance. Throughout a number of analyses, the PROPUB measure was found to be significantly related to innovative performance.

In terms of our model, the scientists' repertoire includes a multitude of activities other than attending scientific conferences and publishing research findings. However, explicit incentives directed at publishing and at obtaining a high standing in the scientific community have arguably led scientists to publish papers and to engage in related activities believed to increase standing in the scientific community. These activities resulted in knowledge flows across organizational boundaries, which in turn improved innovative performance. Henderson (1994) conducted a series of interviews with managers in pharmaceutical research and reports that the managers were well aware that encouraging involvement in the scientific community was critical to research productivity. Managers had the directive knowledge that knowledge exchange was needed, but not all firms succeeded in implementing the processes required for knowledge exchange. In her description of a firm that was successful in doing so, Henderson writes, "The founder announced his intention to hire scientists who were every bit as good as those in academia and he encouraged both publication and the presentation of results outside the firm. As a result, the firm soon developed a reputation for scientific excellence and was able to hire unusually 'academic' scientists" (p. 618). This description suggests that some employees ("academic scientists") did not have to receive additional incentives from the organization directed at exchanging knowledge with the scientific community because they already perceived social or intrinsic incentives doing so. This is consistent with research that studies how certain norms in academia motivate extensive knowledge sharing activities (e.g., Dasgupta, David 1994). Social and intrinsic incentives that are perceived independently from the organization can apparently substitute for organizationally provided incentives and organizations can try to benefit from these incentives. Stern (2004) quantified such a substitution effect; he found that firms who allowed their scientists to publish extracted on average a 20% wage discount relative to firms that did not. At the same time, these organizations may enjoy higher research productivity

resulting from more extensive knowledge exchange between their scientists and the scientific community.

In a joint paper, Cockburn, Henderson, and Stern (1999) focused more explicitly on the incentive systems used in biotechnology R&D. First, they suggested that effective innovation processes in biotechnology require that the same individuals engage in both the acquisition of upstream knowledge and in more applied research. Building on the theoretical literature on the multitask problem, Cockburn et al. then hypothesized that organizations will provide balanced incentives for both sets of activities. Their data supported this hypothesis; organizations that promoted employees based on their involvement in the scientific community also rewarded these employees for more applied work.

Overall, the research of Henderson, Cockburn, and Stern illustrates that innovative activities require individual-level incentives that are directed at these activities, consistent with our Proposition 1. These incentives are not always pecuniary and may not be under the direct control of the organization. Incentives from other sources (e.g., certain social and intrinsic incentives) also had effects on knowledge sharing activities, and thus, innovation processes and capabilities. Interestingly, and consistent with our conceptual discussion, organizationally provided incentives in Henderson and Cockburn's studies were given for a class of activities, e.g., those activities that increase individuals' "standing in the scientific community". The incentive systems reflected management's directive knowledge that involvement in the scientific community is generally an important process for innovative performance. However, management did not prescribe individual activities by using more specific incentives, nor did management only rely on very general incentives directed at innovative performance. In other words, PROPUB reflects incentives with a medium level of specificity, consistent with our Proposition 3. To the extent that an organization has institutionalized such incentives, involvement in the scientific community becomes part of

the "innovation routine" of the organization (cf. Nelson, Winter 1982). However, the specific activities within that routine (e.g., attending conferences vs. joint publications etc.) may vary depending on the directive knowledge organization members hold and by their extra-organizational incentives directed at specific activities.

DISCUSSION

The primary objective of this paper was to provide a systematic discussion of the role individual-level incentives play in organizational capabilities. We suggested that, while knowledge determines the repertoire of potential activities and processes in an organization, incentives are needed to motivate organization members to engage in the required activities, thereby turning knowledge into action. The incentives organization members perceive – some being more under the control of the organization than others – determine which activities and processes are actually performed. It is important to recognize that the incentives that drive behaviors in organizations are of different types, including pecuniary, social and intrinsic, and we suggest that these different types may interact in different ways with knowledge and processes. If the direction, strength, and type of incentives are consistent with the knowledge base of the organization and with the desired organizational processes, an effective capability can result. In contrast, if the incentives organization members perceive motivate dysfunctional behaviors, performance will be low, regardless of the knowledge an organization holds. Because of this important function of incentives, research that focuses on knowledge and processes alone may miss an important element of organizational capabilities.

Several of the relationships between the three components of capabilities have been empirically investigated in prior research. For example, the literature on organizational control has studied the relationship between directive knowledge, output measurability, and organizationally provided incentives (e.g., Eisenhardt 1985; Cardinal 2001). Creativity

research has studied the effectiveness of different types of incentives for creative and innovative processes (Amabile 1996). Another large body of empirical work has investigated the relationship between particular innovation processes such as knowledge integration and innovative performance (e.g., Clark et al. 1987). However, more empirical research is needed on the "fit" between the three components of a capability and on the effects of fit on innovative performance. In order to keep such studies manageable, it may be useful to study specific processes related to innovation rather than trying to capture a complete innovative capability (cf. Ray, Barney, Muhanna 2004). For example, empirical research could investigate how knowledge stocks, incentives, and individual activities and processes jointly affect measures of knowledge acquisition from outside the organization and how they interact in doing so.

Conceptual as well as empirical work is needed on the relative importance of the components of a capability and how it differs across task environments. For example, how important are the various kinds of knowledge relative to an "appropriate" incentive system? One might argue that knowledge may to a large extent be endogenous to incentives; if organization members have an incentive to perform well (a general incentive that requires little directive knowledge), they will try to acquire the necessary knowledge and skills to perform well. In other words, "getting the incentives right" might be all that matters.

A model of organizational capabilities that explicitly incorporates the role of incentives may not only inform research on firm performance, but it may also help in addressing other fundamental questions about innovative capabilities and capabilities more generally. First, we suggest that looking at individual incentives may reveal subtle but significant influences on the directions organizations take in their innovative efforts. While organizations can "manage" and control incentives to a considerable degree, individuals also perceive incentives originating from other sources. These others incentives may drive

innovative activities in directions that could not be predicted or explained by looking at firm-level factors alone. The literature has documented many cases where the intrinsic and social incentives individuals perceived led to pathbreaking innovations in firms, sometimes despite active *dis*couragement by management. In some firms, such “bootleg” development has even become an accepted and valued part of the organizational culture (cf. Katz 1993; Bartlett, Mohammed 1995).

Second, our model could guide future research on the dynamics of capabilities. In particular, it could help understand the factors that constrain the reconfiguration of organizational processes and inhibit organizational change. Nelson and Winter (1982) already pointed to incentives as a possible cause of inertia; they suggested that routines involve a fragile “truce in intraorganizational conflict”, reflecting the diverging member interests. Change is then inhibited not only by the fear to disturb that truce, but also by the defensive alertness of organization members seeking to protect their interests (p. 111). If incentives are an element of organizational capabilities, as suggested in this paper, changes in a capability may require changes in the incentive structure, especially if incentives are very specific. In such a case, incentives have to be disconnected from obsolete activities and have to be directed at the activities and processes that are required in the new capability. Different types of incentives, however, are likely to exhibit different degrees of flexibility. The recent shift of major pharmaceutical firms from primarily inhouse-R&D to an open innovation model (cf. Chesbrough 2003) could be an intriguing case to study to what extent changes in capabilities involved changes in incentives and if certain incentive structures facilitated or inhibited change.

Third, considering incentives an integral part of innovative capabilities suggests that competitive advantage may not only be based on superior knowledge but also on a valuable and rare incentive system. Several authors have begun to consider incentive systems as a

strategic resource. For example, Gottschalg and Zollo (2004) discussed when a superior "interest alignment capability" can provide the basis for competitive advantage. The strategic human resource management literature has begun to study if and how the human resource management system can be a source of competitive advantage (e.g., Lado, Wilson 1994; Wright, Dunford, Snell 2001). Our discussion of the interdependencies between the components of a capability suggests that future research should investigate how knowledge, incentives and processes *as a system* may be a source of competitive advantage. It is conceivable that interdependencies between system components make "fitting" systems potentially rare and that these interdependencies lead to causal ambiguity and social complexity that can serve as important isolating mechanisms against imitation (cf. Dierickx, Cool 1989). A related question is, does the imitability of the three dimensions differ, and if it does, to what extent can firms compensate weaknesses in one dimension with strengths in another. Such a multidimensional perspective on resources and imitation can already be found in some of the research on the diffusion of Japanese management practices (e.g., Ichniowski, Shaw 1999) and appears to be a very promising approach.

Many areas of strategy research may benefit from considering incentives an integral component of organizational capabilities. We hope that this paper will contribute to the literature by providing a model of capabilities that accounts for the fact that high performance requires both various kinds of knowledge and the incentives for organization members to exploit and develop that knowledge in the pursuit of organizational goals.

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FIGURE 1

Types of Knowledge

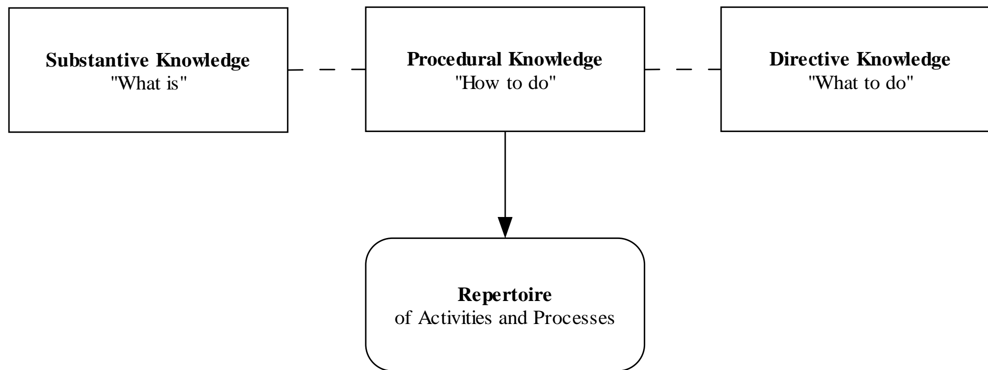

FIGURE 2

The Direction of Incentives

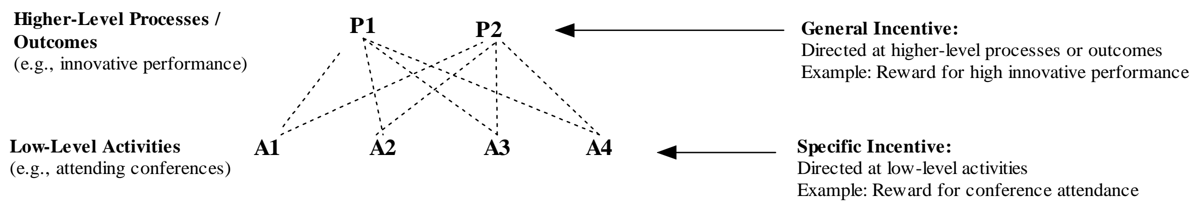

FIGURE 3

Dimensions of Incentives

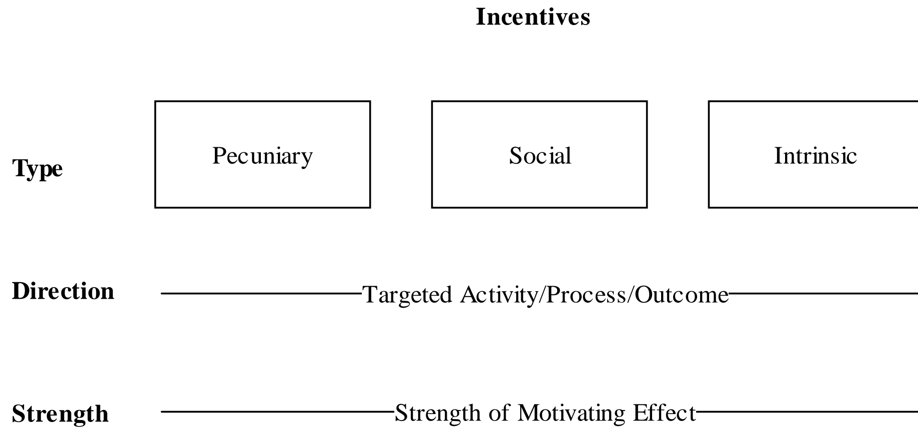

FIGURE 4

The Trinity of Innovative Capabilities: Knowledge, Incentives, Processes