Beyond the Dichotomy: Positive Causal Relationship between Exploitation and Exploration

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ABSTRACT

Based on a thorough review of recent theoretical developments on the relationship between technological exploitation and exploration, the complementary view is proposed in the form of testable propositions. Contrary to the dichotomic view that emphasizes trade-off relationship between exploitation and exploration, the complementary view leverages multi-domain nature of exploitation to show positive causal relationship between exploitation and exploration where exploitation facilitates exploration in two mechanisms. Firstly, as organizations focus on accumulating incremental improvements on existing technological knowledge, they nourish new knowledge that enables explorative technological developments. Secondly, exploitation reduces perceived risk associated with explorative endeavor, since its multi-domain nature a) allows synergistic relationship between exploitation and exploration to be formed, and b) enables organizations to probe uncertainties associated with exploration in quite low risk manner, so that the new knowledge could be fruitfully deployed without being crowded out by organizational inertia. Theoretical implications and future research directions are also discussed.

I. INTRODUCTION

Where dose the radical innovation come from? Although various typologies on innovation have been proposed and provided us deep understanding on how they differ among each other, the source of innovation or generative mechanism of novel elements is yet to be clarified.

Scholars have been thinking how organization generates innovation in the context of organizational learning. Particularly, the dichotomic distinction between exploitation and exploration (March, 1991) has been one of the most general and influential theoretical constructs to be leveraged for our understanding. This is because exploitation and exploration represent two

distinct and mutually contradicting modes of knowledge generation and utilization in the most general term, thus they could describe in holistic term how we generate and utilize new economically value-added knowledge. Recently, however, increasing number of scholars have expressed the need to modify long cherished dichotomic view on exploitation and exploration (Nooteboom, 2000; Katila & Ahuja, 2002; Lavie & Rosenkopf, 2006; Smith & Tushman, 2005; Levinthal & Rerup, 2006 among others). In their view, exploitation and exploration complement each other. Especially noteworthy is that exploitation, which has been said to crowd out exploration, is shown to have the potential to facilitate exploration. Therefore, these views promise us the potential to uncover the sources for radically new ideas and behaviors with substantial economic value, since they are the result of exploration.

Although these complementary views have provided us totally new perspective to understand our innovative activities, specific mechanism in which organizations generate and utilize explorative innovation as a result of exploitation is yet to be clarified based on the complementary views. Building on this stream of scholars, the current paper intends to address this missing link and contribute in proposing the direction of future works.

Particularly, our interests focus on technological exploitation and exploration. Building on diverse streams of related works, we intend to show certain type of technologically exploitive activities facilitates to realize explorative technological results. Among them, particularly based on preceding research that emphasizes the need to focus on multi-domain nature of exploitive behaviors, we specifically focus on such activities that are perceived as exploitive in one domain (for example, in technology), but have some variance-enhancing properties in other domains (for example, in customer value-added, business context, or complementary technology). For the current paper, we call such exploitation as *variance-enhancing exploitation.* This paper tries to show the process in which *variance-enhancing exploitation* leads to successful exploration by way of two path; i.e., knowledge generation and risk undertaking. As organizations focus on accumulating incremental improvements on existing technological knowledge, they nourish new knowledge that enables explorative technological developments (knowledge generation), while the variance inevitably experienced in value-added for customers, business contexts, or complementary technology, would reduce perceived risk associated with explorative resource allocation so that the new knowledge can be fruitfully deployed without being crowded out by organizational inertia (risk undertaking). Two testable propositions are deductively proposed from detailed review of current theoretical development, and some implications on future works are also discussed.

II. COMPETING VIEWS; CONTRADICTORY OR COMPLEMENTARY?

As is formalized by March's seminal work (1991) on exploitation and exploration, the relationship between these two models of organizational learning is defined as that of tradeoff. More precisely, exploitation is said to crowd out exploration (Abernathy, 1978; Argyris & Schon, 1978; Prahalad & Bettis, 1986; Henderson & Clark, 1990; Leonard-Barton, 1992; Levinthal & March, 1993; Sull, 1999; Sorensen & Stuart, 2000; Benner & Tushman, 2002). The underlying logic for this argument is that exploitation requires fundamentally different cognitive and behavioral patterns from exploration (Anderson & Tushman, 2001). Exploitation is usually related to improvements, efficiency, while exploration is closely linked with experiments, new possibility, search, and radical change (March, 1991). Therefore, although both of them are required for long-term organizational adaptation, organizations either over-exploit at the risk of losing major change opportunities, or over-explore not fulfilling efficiency increase potential. In actual, the odds are not evenly distributed. Initiatives associated with exploitation tend to be more preferably selected by organizations, since they involve less risk, and promise more certain benefit in the shorter-term. Exploitation is more cognitively favored, and from behavioral point of view, better fits with existing standard operating procedures.

Although these dichotomic views are parsimonious and pervasive, alternative view is emerging, which tries to emphasize complementary relationship between exploitation and exploration. One of the earliest efforts to theorize the complementary relationship between exploitation and exploration is Nooteboom and colleague's works (Nooteboom, 2000; Gilsing & Nooteboom, 2006). They proposed the "cycle of discovery" which shows dialectic process of exploitation and exploration. The spirit underlying this model is their belief that we have not devoted enough efforts to one of the most fundamental questions related to innovation, i.e., "where dose the innovation come from?".

"The interesting question next is how one gets away from the dominant designs in technology and from prevailing industry recipes regarding organization, for a next round of (radical) innovation. In the literature on innovation and evolution, this question has been neglected, relative to the question how novelty settles down into dominant designs and gets diffused (Gilsing & Nooteboom, 2006, p. 4)."

In other words, we know exploration opens the opportunities for ensuing exploitation, but we

still do not know how exploration starts at the very beginning[1]. Nooteboom and his colleagues tried to show the recurring cycle in which exploitation and exploration build on each other through the process of "consolidation," "generalization," "differentiation," and "reciprocation." Although Nooteboom's works show the potential to break away from the traditional dichotomic view, by calling attention to mutually complementary relationship between exploitation and exploration, the mechanism on how exploitation facilitates exploration was shown only in highly abstract terms.

Some other authors argue exploitation and exploration facilitate (and constrain) each other in organizational learning (Gavetti & Levinthal, 2000; Zollo & Winter, 2002; Gavetti, 2005), suggesting the necessity to modify dichotomic view. According to them, cognitive calculation (i.e., exploration) is based on the knowledge gained by local search (i.e., exploitation), while local search is directed by the results of cognitive calculation.

As for the empirical verification, authors who build upon ambidexterity hypothesis (Tushman & Romanelli, 1985; Benner & Tushman, 2003), which emphasizes the normative simultaneity between exploitation and exploration in order to overcome excessively dichotomic interpretation of punctuated equilibrium view (Astley, 1985), have shown us convincing thought framework where exploration and exploitation successfully complement each other. Building on Tushman and his colleagues' normative and static description, recent works have expanded the ambidexterity hypothesis with empirical supports and more dynamic perspective (Gibson & Birkinshaw, 2004; He & Wong, 2004).

Empirical verification on complementary relationship between exploitation and exploration is not limited to those who follow ambidexterity hypothesis. Studying incumbents' entry pattern into disk-drive product niches (including 14, 8, 5.25, and 3.5 inches), King & Tucci (2002) found industry participants with more "static experience," i.e., the experience in producing and selling products to its existing customers, are more likely to enter succeeding new generations of product niche. These firms were also found more likely to enjoy higher sales in the new market. Their findings are significant in that the technological evolution across disk-drive products of different sizes was characterized as "disruptive" (Christensen & Bower, 1996), where incumbents' competitive advantage is destined to be upset.

III. COMPLEMENTARITY VIEW

The ensuing stream of research could be classified into two separate camps from the

interests of current paper. Namely, the one that focuses on new knowledge generation and the other that focuses on risk undertaking. Both knowledge generation and risk undertaking is closely associated with explorative behavior, as exploration inevitably requires departure from existing routines and trials with unknown. In other words, knowledge generation corresponds to the aspect of idea creation required for radical technological innovation, while risk undertaking refers to decisions to commit substantial resources into significant changes in "configurations" (Miller & Friesen, 1980; Miller, 1986; Siggelkow, 2001; Lavie, 2006) of activities, capability, and strategy. Those who see complementary relationship between exploitation and exploration argue that exploitation is instrumental either for new knowledge generation, or for facilitation of risk undertaking.

1. Knowledge generation argument

The argument which primarily focuses on new knowledge generation based on exploitation of existing internal knowledge is the one focused on absorptive capacity. Originally proposed as a concept that shows the importance of basic research for successfully appropriating gains from efforts in applied research, absorptive capacity was defined as an organizational capability that recognizes, evaluates, assimilates and utilizes knowledge created by other organizations (Cohen & Levinthal, 1990). In order to properly evaluate the value of outside knowledge and fully utilize them, organizations need to accumulate its expertise in basic research that shares the foundational knowledge with the outside knowledge. One of the natural consequences of this theorizing was that the early works saw absorptive capacity as a source of local search (Levinthal & March, 1993). Although absorptive capacity enables organizations to absorb new knowledge, the scope of absorption is limited to neighboring or related field of originally accumulated knowledge.

Recent developments on absorptive capacity research are changing this rather constraining view. Namely, they have enhanced the role of absorptive capacity as a facilitator for more distant search, enabling more explorative learning (Lewin, Long & Carroll, 1999; Van den Bosch, Volberda & Boer, 1999; Deeds, 2001; Danneels, 2008; Lavie & Rosenkopf, 2006; Yayavaram & Ahuja, 2008). Calling reflective attention to the "reification" of absorptive capacity construct, Lane, Koka & Pathak (2006) emphasized the need to refocus on its potential to enlarge organizations' learning perspective (scope). Volberda (1996) echoed the same line of reasoning arguing for the positive explorative influence of re-deployable technology, which could be exploited in combinations with wide variety of technologies in various distinct fields. These

theoretical developments are closely related to the re-conceptualization of absorptive capacity as a unique branch of dynamic capability (Zahra & George, 2002; Jansen, Van Den Bosch & Volberda, 2005). Dynamic capability was originally proposed to grasp organizational capability appropriate for dynamically changing environments (Teece, Pisano & Shuen, 1997). Defined as a unique organizational capability that enables organizations to continuously create new sets of organizational competences, dynamic capability has been seen as distinct from more mundane (but no less important) organizational capabilities in gradually accumulating incremental changes. Thus defined, absorptive capacity based on incrementally accumulated internal knowledge is also expected to assist organizations to expand their knowledge in explorative manner. Although it might constrain the scope of outside knowledge that could be absorbed, the resulting recombination of existing knowledge and new knowledge, and even among existing knowledge, could be highly explorative, effectively negating drawbacks associated with constraints in scope. One of the most notable empirical examples showing these reasoning is Katila & Ahuja (2002).

Katila & Ahuja (2002) enhanced the complementary view emphasizing the need to think exploitation and exploration in multi-dimensional term. In other words, they showed exploitation and exploration differ not necessarily in scope (local versus distant), but also in depth, which means how extensively existing knowledge is re-used or exploited. The dichotomic view, as its name clearly indicates, locate exploitation and exploration at the polar extremes of one dimension. This uni-dimensional view inevitably leads contradictory relationship between exploitation and exploration. By operationalizing exploitation and exploration as "search depth" and "search scope" respectively, Katila & Ahuja showed how we could understand complementary relationship between exploitation and exploration in empirical setting. As is expected from this complementary perspective, they found an interaction of "search depth" and "search scope" is positively related with the number of new products introduced by global robotics industry participants. Based on these findings, they argued that exploitation is important not only in efficiency increase in existing technology, but also in absorbing new knowledge, and in "combini ng existing solutions to generate new combinations". Echoing basically the same argument, Yayavaram & Ahuja (2008) empirically showed knowledge recombination within the boundary of closely coupled knowledge cluster facilitates superior performance in knowledge recombination across knowledge clusters under intermediate level of inter-cluster integration.

Actually, the underlying phenomenon has already been succinctly described by Nelson & Winter (1982) when they stated accumulation of routines would be the basis of emergence of

novelty results (pp. 130-131). Reminding the less-mentioned significance of this description in one of the most frequently cited works, Levinthal & Rerup (2006) emphasized mutually complementary relationship where less-mindfulness (exploitation) facilitates mindfulness (exploration) with the colorful analogy; "the set of familiar routines is the fodder for rapid innovative action (p. 505)"

Based on these arguments, we deduce the first proposition on knowledge generation.

Proposition 1: *The more organizations exploit existing knowledge, the more knowledge deployable in explorative endeavors is accumulated.*

2. Rick undertaking argument

The argument which focuses on risk undertaking aspect is built on the assumption that the biggest obstacle for realizing exploration is *perceived* risk associated with it. Recent re-conceptualization proposal of exploration construct (Adner & Levinthal, 2008) clearly shows the insurmountable perceived risk as an inherent nature of exploration. Their proposal calls for re-conceptualization of exploration as "other-directed action," which is an act targeted at performance improvements in metrics not yet legitimatized in the organization. This definition is quite distinct from the conventional one, in that search scope dimension (i.e., local search versus distant search) is not emphasized. Defined as such, "exploration" is required to fulfill higher prospect standard for the acceptance of necessary resource allocation since it is not well aligned to the defined strategy. In other words, activities associated with quite distant search could be easily authorized for resource allocation, if they pursue improvements on established performance metrics[2]. The level of technological or market uncertainty may be expected to influence the real amount of risk, but what drives resource allocation decision is rather cognitive elements; the perception about the level of alignment between potentially explorative act and existing strategy. In other words, the difference between exploration and exploitation is whether the organization is *cognitively* prepared to take associated risk or not.

As for the risk undertaking perspective focused on perceived risk, one of the most noteworthy works on exploitation-exploration complementarity is Henderson & Stern (2004). They found out that internal and external selections on product portfolio complement each other, in that they reciprocally influence and coevolve. Since managers take risk when they internally select their products that remain viable in today's market and reallocate resources to other products aimed at future market, internal selection corresponds to exploration (pp. 46-47). On

the other hand, external selection is a consequence for managers' exploitation of today's product until its obsolescence, implying external selection corresponds to exploitation (pp. 46-47). What is particularly noteworthy with their findings is that accumulated experiences with external selection are more strongly associated with future increase in internal selection than the accumulation of current internal selection is. As organizations accumulate experiences of being forced to terminate its products as a result of market selection, they show stronger tendency to take initiative and voluntarily terminate before being forced. Their finding showed the underlying consideration has shifted from continue-versus-terminate comparison to voluntary-versus-involuntary termination, effectively changing the perceived risk associated with product termination. By empirically showing the mechanism in which exploitation reduces perceived risk associated with exploration, they effectively constructed a logical reasoning why accumulated exploitation could lead to exploration.

Providing the clue on how perceived risk associated with exploration could be reduced, some authors proposed a unique view, arguing exploitation should be thought as multi-domain construct. Multi-domain nature is important since it allows synergistic relationship between exploitation and exploration to be formed. It also enables organizations to probe uncertainties associated with exploration in quite low risk manner.

Multi-domain nature of exploitation is clearly shown by Lavie & Rosenkopf (2006), which argued organizations realize ambidexterity by pursuing exploitation and exploration separately among various domains, i.e., aspects of behavior. For example, they focused on 3 domains including "function", "structure" and "attribute" when they evaluate whether sample firms' alliance activities are exploitive or explorative. Therefore, the same unique alliance activity can be evaluated as exploitive in "function" domain since it aims to leverage existing knowledge in the form of marketing agreement, while it can be explorative at the same time, in that the new alliance "structure" or partner firm with new "attribute" is involved. The biggest contribution of their finding is showing the necessity to distinguish multiple aspects of exploitive activity as "domains". Even if exploitation and exploration contradict each other within a single domain (and thus, cannot be pursued simultaneously), organizations are able to pursue both of them at the same time among different domains. In other words, single exploitive activity could have explorative aspects, while organization pursue it as exploitation. Their reasoning sounds quite appropriate since our activity should have various aspects, which need to be taken into account separately. They argue the level of perceived risk is closely related to the underlying logic for their findings. Organizations control the balance of exploitive and explorative behaviors so that

the level of aggregated risk perceived would not be excessive. Once they feel the level of perceived risk gets greater than certain threshold, some domains are selected and existing behavioral patterns are exploited, rather than new patterns are explored.

An interesting observation on these types of activities, which is exploitive in some "domain" while explorative in others, is that actors feel they behave in quite exploitive manner. As recent proposal for re-conceptualization of exploration (Adner & Levinthal, 2008) argues, all activities are inherently exploitive in nature from actor's point of view. Actors try new possibilities not because they simply want something new and different, but because they explicitly expect some meaningful progress down the road. Therefore, what would eventually turn out to be exploration is triggered and implemented as exploitive activity. Some activities are judged as explorative ex post, but they are exploitive while they are in action, at least from the focal actors' subjective point of view. These activities would thus be called variance-enhancing exploitation to better capture actor's cognitive orientation, as well as their unintended explorative results[3].

One of the most far-reaching implications with exploitation's multi-domain nature, especially when exploitation is variance-enhancing, is that it enables us to understand how organizations identify synergistic relationship between exploitation and exploration, leading to the reduction of perceived risk associated with resultant exploration. Organizations do exploit in variance-enhancing manner, and consequently realize explorative results. In other words, organizations realize synergy between exploitation and exploration by pursuing *variance-enhancing exploitation*.

The argument that provides us with the avenue leading to the synergistic relationship between seemingly trade-off elements is that on contradiction management (Poole & Van deVen, 1989; Denison, Hooijberg & Quin, 1995; Lewis, 2000; Smith & Tushman, 2005; Luscher & Lewis, 2008)[4]. As is described above, exploitation and exploration are perceived to be on apparent contradictory relationship. Therefore, they are entitled to entertain the fruits of recent theoretical developments in contradiction management. Some authors who study paradox resolution in organizational context report that there are some unique characteristics shared among those who are good at paradox resolution (Eisenhardt & Westcott, 1988; Smith & Tushman, 2005; Luscher & Lewis, 2008). Among them, particularly noteworthy one is extensive exploitation of existing routine procedures, resulting in abandonment of either/or view, and in adoption of both/and view.

One of the most explicit efforts to tie contributions from the research on contradiction

management to the relationship between exploitation and exploration in strategy and technology is Smith & Tushman (2005). They argued contradiction between exploration and exploitation could be overcome by a unique cognitive frame and processing, called "paradoxical cognition." The underlining assumption for this argument is "a paradox is created when (1) tensions in a situation (explore/exploit) are (2) juxtaposed through actor's cognition (p. 526)." In other words, a paradox is not a label to objectively describe the particular situation, but a useful perspective to recognize complex and plural facts without excessive simplification and rationalization (Lewis, 2000). Under paradoxical cognition, differences between seemingly contradicting elements (in this case, exploitation and exploration) are thoroughly examined. As more understanding on how they differ accumulates, we will find how they could be integrated, or how could the synergy between them be realized. According to Smith & Tushman (2005), the key ingredient for integrating contradicting elements is the shift of the level of analysis. Exploitation and exploration are different at one analysis level, but may have something in common at another analysis level. Gaining thorough understanding on how exploitation and exploration are different at certain levels facilitates understanding how they are not different in another level, and thus could be integrated. Smith & Tushman's argument is particularly insightful in that they emphasize the potential of synergy between exploitation and exploration. If we could find an opportunity to realize synergistic results between exploitation and exploration, the perceived risk associated with explorative behavior would be effectively reduced. Also, their argument is resonant with Lavie & Rosenkopf (2006)'s emphasis on exploitation's multi-domain nature. As is indicated above, in order to realize synergy between exploitation and exploration, it is necessary to shift the analysis level, and that effectively means we need to think in terms of multiple domains when we try to integrate exploitation and exploration.

Another aspect of the linkage between exploration and multi-domain exploitation is shown in Barr, Stimpert & Huff (1992)'s careful longitudinal study on mental model and strategic changes; i.e., uncertainty probing. Barr, Stimpert & Huff (1992) showed incremental changes in top managers' mental models effectively unlearned previous mental model, and led to second order learning (Watzlawick, Weakland & Fisch, 1974). These incremental changes worked as experimental measures for better understanding new competitive environment, much like the experimental "probe" found in Brown & Eisenhardt (1997)'s inductive case study on continuously changing organizations. For example, these changes experimented new understanding on competitive dynamics, while other aspects were kept intact. In case new understanding on customer needs was tried, other aspects including competitive dynamics were kept unchanged. By

accumulating these incremental changes in mental model, their sample organization finally unlearned original mental model and realized explorative changes. Calling for the need to modify "the two-tiered models of learning (p. 32)," they argued that "neither the level nor the stages of learning were necessarily discrete for this company. Low level learning appears to lead directly to high level learning, as the C&NW makes minor changes in its understanding that is followed by related, but much more dramatic, change in mental models (p. 32)." Since these changes are multi-domain and variance-enhancing in that some aspects of existing mental model were incrementally changed while other aspects were exploited, changing competitive environment and appropriate adaptation approaches were better understood, effectively reducing perceived risk associated with explorative changes.

As has been discussed by several authors including Leonard-Barton, Bowen, Clark, Holloway, & Wheelwright (1994), Lynn, Morone & Paulson (1996), and Ahuja & Lampert (2001), experiments are quite effective means to try new possibilities in the context of established organizations. In other words, the fundamental characteristics of "experiments" is *variance-enhancing exploitation* in that it comes with solid basis of continuity and with controlled variance as is clearly shown in Brown & Eisenhardt (1997).

Based on these arguments, we deduce the second proposition on risk undertaking.

Proposition 2: *Activities that exploits one domain, while increases variance in other domains decrease the perceived risk associated with increased variances, consequently facilitating otherwise exploratory behaviors.*

IV. DISCUSSION

This paper intends to build on the stream of scholars who see complementarity between exploitation and exploration. Our major contribution is to propose testable propositions on the possibility that certain type of exploitive activities facilitate to realize explorative results. By focusing on *variance-enhancing exploitation,* which is perceived as exploitive in one domain, but has some variance-enhancing properties in other domains, the current paper tries to show the process in which *variance-enhancing exploitation* leads to successful exploration. Explorative novelty is generated from exploitation because necessary knowledge is efficiently accumulated, and because associated risk is effectively reduced. The risk reduction is due to the fact that exploration is carried out in synergistic manner with exploitation, and associated uncertainty is

sufficiently probed.

The complementarity perspective we have discussed contributes to our thinking on the source of innovation in two ways. First and foremost, it shows us the potential that exploitation facilitates exploration, which is an antecedent for radical innovation. Traditionally, exploitation has been said to crowd out exploration. The straightforward corollary for this traditional argument is that organizations are required to prepare fundamentally different management approach for exploitation and exploration respectively (Cooper & Smith, 1992; Christensen & Bower, 1996; Gilbert, 2005), which definitely is very difficult. With exploitation's potential for facilitating exploration is now convincingly indicated, organizations would be provided more attainable approach for pursuing explorative endeavors, since incremental daily efforts to build on existing competences could be leveraged for both short-term and long-term adaptation purposes. Related to the first one, the second contribution of current work is logically explaining how exploitation facilitates exploration. The proposed explanation is solidly based on well-established theoretical accumulations. Rich theoretical accumulation, which enables logical construction of the complementary view, testifies its soundness as theoretical development.

Notwithstanding those views that ascribe exploratory results to such exogenous factors like change in customer demand or in governmental regulation, traditional explanations on the source of exploration are significantly limited in that they only clarifies how something different is created, but not how something *useful* is created. Novelty is often ascribed to such factors like being an entrant (Cooper & Schendel, 1976; Abernathy & Utterback, 1978; Tushman & Anderson, 1986), flexible (Burns & Stalker, 1961) or diversely composed (Burgelman, 1983; Chesbrough & Teece, 1996). Those factors certainly assure something different from existing ones would be created, but the argument left the critical question unanswered. Unfortunately enough, there are no logical explanations that "something" would be useful or economically beneficial. Recombination of existing elements free from incumbent's constraints only promises us something which incumbent would not be able to realize. Needless to say, unstated critical assumption when we talk about innovation is that it not only needs to be new but also useful. Being entrant, flexible or diversely composed does not mean the focal organization is entitled to be able to create something useful.

Other arguments that focus on distinguished leadership roles (Tushman & Romanelli, 1985; Tushman, Newman & Romanelli, 1986 among others) for innovative performance is also unsatisfactory from current paper's interests. Leadership might be instrumental for initiating and implementing major changes, but the question we need to answer is how he/she gets the idea

and belief about the focal innovation. The argument featuring structural separation (Cooper & Smith, 1992; Christensen & Bower, 1996; Gilbert, 2005) shares the same problem. It builds on the assumption that the roadmap of exploratory efforts are already laid out, and that the only issue left to be solved is allocating enough resources. When we ask for the source of innovation, the issue of resource allocation should be only remotely relevant, since it is only the means to implement seed ideas. We are asking why organizations could intend to take substantial risk in particular innovation, but not how they implement.

In contrast to these traditional views, our proposed propositions aspire to be both sufficiently reductive and encompassing. Organizations know intended innovation's usefulness since it is built on their own accumulated knowledge. The process featured in these propositions is quite impersonalized and systematical one, where no roles and responsibilities are reserved for distinctively superior individual's intervention. Also, these propositions focus directly on the source of novelty, not on how to ascertain resource allocation.

Apparently enough, propositions set forth in this paper need supports from more formal empirical verification. It should require detailed and longitudinal case studies, possibly accompanying participant observations, which enable scholars to evaluate the level of perceived risk in relation with *variance-enhancing exploitations*. Statistical analysis on large sample data should play supplementary role in verifying the first proposition on new knowledge generation.

Science is the art to explain complicated phenomena in parsimonious terms, while at the same time continuously scrutinizing the cost of simplification, i.e., the discrepancy between complexity in real life and parsimonious model. Starting with the trial to understand very simplified picture, we gradually add more complications in order to close the gap between parsimonious model and complicated reality. Simple dichotomic view on exploitation and exploration has made its fair contribution to our understanding on innovation and organizational learning. Now is the time to swing back the pendulum away from one-way simplification in order to deepen our understanding on the actual creation of novelty.

NOTES

1) Another less mentioned, but convincing reason why we need to care about the causal link from exploitation to exploration is related to organizational survival. While exploration is indispensable for long-term adaptation, organizations are required to secure its adaptation to its environment in the short-term in order to survive (Miller, Zhao, & Calantone, 2006), which requires organizations exploit current resources and core capabilities rather than explore new possibilities. Needless to say, unless they survive in short-term, whether they can adapt in long-term or not is totally

irrelevant. In other words, organizations need to successfully exploit, in order to explore. Therefore, the issue of actual concern should not be how to balance exploitation and exploration, but how to leverage exploitation to enhance exploration. Exploitation is an absolute must, while exploration is hoped-for luxury for most organizations.

2) One could recall Christensen (1997)'s analysis on incumbents' continuing superiority in "sustaining innovation" with radical technological development as a verification of this argument.

3) Conventionally, exploitation has been characterized as mean-enhancing, while exploration is variance-enhancing (McGrath, 2001). When organizations explore, the locus of activities lies in preparing the "requisite variety" (Ashby, 1956; Van de Ven, 1986) of technology, routines, or performance achieved. On the other hand, exploitation requires organizations to focus on existing resources and capabilities so that the alignment to the competitive environment at hand is maximized. This conceptual dichotomy is parsimonious enough. However, this view misleads us to believe exploration is undirected random search, while in actual, actors are clearly directed by specific goals. Recognizing the possibility that organizations exploit in variance-enhancing manner is significant since it means some organizations enhance variance, while they feel they exploit existing technology or routines. "Semi-structure" and "probe" found at continuously changing organizations (Brown & Eisenhardt, 1997) are eloquent proofs for such behavior's existence. From theoretical development point of view, our conceptualization of variance-enhancing exploitation might be against the parsimonious principle. However, in order to more properly understand real acts of novelty generation, it is the price we should be glad to pay.

4) The research on "high reliability organizations" also emphasizes the attention to contradictory information as one of the sources for mindfulness required for effective adaptation in turbulent and unpredictable environment (Weick, Sutcliffe & Obstfeld, 1999; Fiol & O'Connor, 2003). Their reasoning validates our interests on contradiction management for the antecedent of exploration.

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