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Knowledge Creation for Competitive Advantage: An Organizational Networks Perspective

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ABSTRACT

The importance of knowledge as a key organizational resource contributing to competitive advantage is undisputed in research and in practice. Yet, the way in which such knowledge is created in organizations is relatively poorly understood. This paper develops a theoretical model elucidating how organizations create knowledge for the purpose of gaining competitive advantage. I have cast this investigation within the context of organizational networks, arguing that knowledge creation indeed occurs in such networked structures in organizations.

Particular knowledge resources that are competitively advantageous to the firm change, as the basis of competition itself changes over the organization's life. Therefore, I have distinguished between two different competitive situations faced by organizations- relatively stable periods of competition, and turbulent periods of radical change. I have compared and contrasted the antecedents and processes of organizational knowledge creation under these two competitive modes, highlighting the differential role of information technology in the process.

Keywords

Knowledge creation, organizational networks, competitive advantage, Information Technology.

INTRODUCTION

The importance of knowledge as a key organizational resource contributing to competitive advantage is undisputed in research and practice (Kogut and Zander, 1992; Liebeskind, 1996; Spender, 1996; Tsoukas, 1996). Yet, the way in which such knowledge is created in organizations is relatively poorly understood (Argote, McEvily and Reagans, 2003a). One reason for this has been the divergence of the field of knowledge management itself among many different fields of study, including psychology, sociology, economics, organizational theory, and information systems, each bringing its own perspectives and theoretical foundations to the study of this phenomenon. As the literature on knowledge management has diverged into different disciplinary sub-fields, researchers have studied the creation of knowledge in a variety of different contexts, such as the properties of units (e.g., individuals, groups) involved in knowledge creation (Zellmer-Bruhn, 2003), the properties of the relationships between these units (Rulke and Galaskiewicz, 2000; Uzzi and Lancaster, 2003), environmental factors influencing knowledge creation (Lee, Lee and Lee, 2003; Sorenson, 2003), as well as the properties of the knowledge itself (Nonaka, 1991; Zander and Kogut, 1995). Nevertheless, the literature indicates that it is not simply these individual contexts in isolation, but rather a fit between these contexts that is actually a better predictor of knowledge creation (Argote, et al., 2003b)- more holistic understanding of the phenomenon of knowledge creation would, therefore, require simultaneous consideration of multiple contexts within the same study. However, much earlier work on knowledge creation has focused on these contexts in isolation of each other, thereby contributing to a fragmented understanding of this phenomenon.

Attempting to maintain a multi-context focus in this paper, I have taken a network perspective on how organizations create knowledge under different environmental conditions. The network perspective allows me to simultaneously consider the antecedents and processes of knowledge creation in terms of the intra-organizational units (individuals) that are responsible for knowledge creation, as well as the relationships between these units through which knowledge is created- the significance of the latter in the study of knowledge creation is well documented (Argote et al., 2003b).

Furthermore, as an organization's environmental context changes, the contributing factors and processes it deploys to create knowledge can also be expected to change in response. Therefore, I have focused on studying how the antecedents and processes of knowledge creation change with changes in the level of turbulence in the competitive landscape of the organization. Sorenson (2003) has shown that the level of turbulence in the environment affects the success of learning strategies in organizations. The concept of turbulence has also been studied from the related viewpoints of incremental versus radical/disruptive change (Gersick, 1991; Romanelli and Tushman, 1994), and first-order versus second-order change (Levitt and March, 1988; Virany, Romanelli and Tushman, 1992). In exploring these dimensions, I have also considered how different types of information technologies impact these knowledge creation processes under different environmental conditions. In this manner, I have maintained an integrated, unified view of organizational knowledge creation in light of the fit between various facilitating contexts.

My key objective in this paper is to understand how knowledge is created in organizational networks for the purpose of gaining competitive advantage. In addressing this question, I have: a) studied knowledge creation from a network perspective, and b) elucidated the differences between the antecedents and processes of knowledge creation under stable versus turbulent environmental conditions, thereby presenting the process of organizational knowledge creation as a phenomenon contingent on the external environment.

The rest of the paper proceeds as follows. In the next section, I have explicated the basic idea of network analysis and justified the appropriateness of studying organizational knowledge creation in the context of networks. I have then discussed, in further detail, the two different environmental conditions, stability versus turbulence, under which notable differences in the antecedents and processes of knowledge creation have been proposed, framing this discussion within the punctuated equilibrium paradigm. This framework is intended to serve as the foundation for subsequent theoretical investigation of my research objective, highlighting the distinctions between the antecedents and processes of knowledge creation under stable versus turbulent environmental conditions.

ORGANIZATIONAL KNOWLEDGE CREATION IN NETWORKS

Networks provide a structural and analytical framework that has been used in the study of various relational phenomena, such as communication, friendship, and knowledge-related processes, such as knowledge creation or transfer (Borgatti and Cross, 2003a; Borgatti and Foster, 2003b; Monge and Contractor, 2000). Communication networks represent patterns of communication between members of different types of communities, such as organizations or schools, and are an important subject of study in the social sciences. Spurred by information technologies (IT), another network phenomenon that is gaining widespread attention in present times is the knowledge network, which represents the location and flow of knowledge among a network of agents (Monge et al., 2000). Relevant structural properties of knowledge networks are briefly described next.

Organizational knowledge creating networks

In the context of knowledge creation in organizations, a network represents the configuration of ties that employees in the organization use for the creation of knowledge, with each configuration having many characteristic properties. The strength of ties is one such network property at the dyadic level of analysis. Employees, representing nodes in the network, could form strong or weak ties between each other depending on their frequency of interaction or the level of emotional closeness they share with one another (Monge et al., 2000; Nelson, 1989). Strong ties allow the transfer of complex knowledge and are usually formed between similar nodes (Hansen, 1999; Nelson, 1989). Weak ties, on the other hand, are better conduits for the purpose of searching for knowledge from relatively distant sources (Ahuja, 2000; Burt, 1992, 2004; Constant, Sproull and Kiesler, 1996; Hansen, 1999).

At the nodal level of analysis, another property of network structures is the range of a node, which is defined as being high when the node has a number of direct ties (strong or weak) with dissimilar others in the network (Monge et al., 2000).

While knowledge creation has been studied in the literature from a variety of different perspectives, such as the individual, team, or inter-unit levels of analysis, yet the network perspective provides some unique advantages absent in earlier perspectives. The advantages of studying organizational knowledge creation in networks are elaborated next.

Why study organizational knowledge creation in networks?

There are several reasons justifying the appropriateness of using a network perspective in studying organizational knowledge creation. First, while other frameworks of investigation may focus on individual, team, or organizational levels of analyses, the distinctive power of networks lies in their focus on the relations between such units, instead. Many features of organizational knowledge and its creation suggest the importance of relationships in these processes, thereby highlighting the appropriateness of studying organizational knowledge creation from a network perspective. Firms have been described as distributed knowledge systems (Spender, 1996; Tsoukas, 1996), such that the total knowledge of the firm cannot be fully known nor specified by a single human agent. The overall knowledge of the organization consists of multiple smaller knowledge components that are distributed over a number of agents in the organization, who need to interact with each other in order to share or gain knowledge.

Scholars have also suggested that any piece of knowledge is meaningful only in a context-specific manner (Monge, et al., 2003). In other words, a given piece of knowledge can be interpreted only in the context of its relationship to other pieces of knowledge- the idea of fit with a pre-existing schema of knowledge is important for any new knowledge to be meaningfully created. Therefore, as knowledge acquires meaning in networks, these networks of relationships become vital in its creation.

Within these networks, the way in which knowledge is created depends on the extent of turbulence in the competitive environment facing the organizations. These environmental factors are discussed next.

STABLE VERSUS TURBULENT ENVIRONMENTAL CONDITIONS

The punctuated equilibrium theory of organizational change considers the process of organizational change as long periods when stable infrastructures permit only incremental adaptations, punctuated by major discontinuities that represent breakthroughs in process/product (Gersick, 1991). This conceptualization of change as a punctuated equilibrium extends beyond the domain of organizations, and has been applied in various fields and at different levels of analyses.

An application of the punctuated equilibrium paradigm closely related to the present study pertains to the domain of technological change. In this context, technological changes have been classified as competence-enhancing versus competence-destroying (Burkhardt and Brass, 1990). Competence-enhancing adjustments appear during long periods of stability in the organizational environment, when firms build on current know-how to consolidate existing market positions. Competence-destroying discontinuities, on the other hand, are associated with alternating phases of rapid change and are triggered by the uncertainty introduced by fundamentally different technologies, leading to disruptive structural changes in the industry.

Similar to technological change, radical competitive changes in an organization's environment, can also introduce elevated levels of uncertainty in its immediate environment. As such, the *competitive* changes in the environment of an organization can be expected to proceed through similar stages, as the *technological* changes it experiences. Accordingly, I have defined stable competitive environments as those that allow the organization to make incremental adjustments in its work processes, for the purpose of serving its existing markets with greater efficiency, effectiveness, and timeliness. In contrast, turbulent environments demand radical transformations in current structures and functions within the organization, and require the firm to venture towards new markets, competitors, and/or collaborators.

As the competitive environment of the organization changes from stable to turbulent, so do the kinds of knowledge resources that become important to the organization for competitive survival. Under stable conditions, the firm already has a good fit with its environment. Although competitive pressures exist under these conditions, they manifest themselves as opportunities for incremental change, when the firm's primary goal is to continue serving existing markets more efficiently and effectively by building on existing competencies. Therefore, knowledge about existing products/services and how to improve their quality and profitability would be of competitive value under stable conditions.

In contrast, under turbulent environmental conditions, the firm experiences lack of fit with its current environment, suggesting the need for radical change in the markets it serves and, therefore, in its competitive positioning and internal processes. In these stages, the firm does not know what an appropriate response to its competitive environment should be- for instance, the organization may not know if it should continue serving the same markets as before, or venture into new markets in response to the turbulent trigger. Consequently, under these conditions, routine production and delivery of existing products/services to current markets may be of little competitive value to the organization, in and of itself. Rather, the organization needs to gain deeper understanding of the root cause of its current lack of fit with the environment; the

capabilities and resources it would need to regain this fit, either with the current environment or a new one; as well as the processes by which it could acquire these capabilities and resources.

As the competitive environment of the organization changes, so do the antecedents and processes through which it creates new knowledge. Antecedents are factors driving the creation of knowledge and processes refer to particular mechanisms by which knowledge is created in a network, when antecedent conditions are met.

The distinctions between the antecedents and processes underlying the creation of competitive knowledge under stable versus turbulent environmental conditions are explicated next.

KNOWLEDGE CREATION UNDER STABLE VERSUS TURBULENT ENVIRONMENTAL CONDITIONS: ANTECEDENTS AND PROCESSES

The previous section used the punctuated equilibrium paradigm to discuss the differences between stable versus turbulent environmental conditions facing organizations. The differences in the way organizations create knowledge in response to these two contrasting environmental conditions can be best understood from the theoretical framework of exploitation and exploration of knowledge assets (March, 1991). Exploitation involves the application of old certainties and includes activities such as refinement, efficiency, implementation. Exploration, on the other hand, refers to the search for new possibilities and includes activities such as search, experimentation, flexibility, discovery (March, 1991).

Under stable environmental conditions, firms would tend to exploit existing knowledge, while under turbulent conditions; they would tend to explore new knowledge. Under stable conditions, the goal of the organization is to make incremental improvements to existing products/services. The organizational infrastructure required to accomplish this is currently already established within the firm. So, the firm would need to continue exploiting known capabilities afforded by a stable infrastructure, under these conditions. However, under turbulent environmental conditions, when existing capabilities do not appear to be competitively sustainable, the firm would be motivated to explore a range of feasible alternatives, in order to identify one that may now be suitable for implementation. These exploitation and exploration activities would then lead to the creation of new knowledge in the organization.

Building on this fundamental difference between knowledge exploitation versus exploration under stable versus turbulent environmental conditions as the theoretical foundation, the rest of this section highlights the distinctions that follow, between the antecedents and processes of knowledge creation under the two competitive situations.

Construct definitions are provided in Table 1.

Antecedents

Under stable conditions, knowledge sharing between nodes within the organizational network would transfer knowledge about already established organizational practices from one node to another. Any localization or adaptation to this existing knowledge that may become necessary over time would be more akin to incremental refinements, rather than to radical transformations of existing processes. The goal of the organization under these conditions is to continue performing current practices with greater efficiency and effectiveness, involving repeated transfers of existing knowledge through established conduits of interaction. This would require the presence of strong ties between individuals, as they engage in frequent interactions with the same network of colleagues, while carrying out standardized organizational processes, under stable environmental conditions. In general, strong ties have been shown to form between 'similar others'- individuals who are similar along various dimensions, such as functional capabilities, expertise, etc (Nelson, 1989).

The nature of interactions between individuals in the organization would be quite different under turbulent environmental conditions. The firm must now identify new processes/products, exploring different feasible alternatives to decide the optimal course of action, without knowing for sure what would work, given the turbulence in its competitive environment. Weak ties would be required to facilitate this exploratory search for new knowledge about alternative processes/markets/products that the firm must now engage in (Hansen, 1999). Just as strong ties tend to form with similar others, weak ties, in contrast, could be expected to form with dissimilar others. Such interaction between individuals who have different functional capabilities, expertise, etc., through the formation of weak ties, would increase the chances of finding new, potentially useful, information under turbulent conditions.

Construct	Definition
Tie Strength	The strength of a tie between two actors is defined as the amount of time, emotional intensity, intimacy or reciprocal services between them. A strong tie occurs with greater frequency or could involve more than one relationship between actors. (Monge *et al.*, 2003)
Range	The range of an actor is the number of links to different others. Others are defined as different to the extent that they are either not themselves linked to each other or that they represent different groups or statuses. (Monge, *et al.*, 2003)
Functional modularity	When the functional sub-components comprising a composite piece of knowledge have little or no inter-dependence between each other, then the composite knowledge is defined as having a high degree of functional modularity. For instance, if the marketing, financial, product development and other aspects of developing a new product can be done relatively independently of each other, then the knowledge embedded in that product is modular (Sanchez, *et al.*, 1996).
Centrality	This is defined as the degree to which an actor is central to a network. It is measured variously, in terms of the number of direct links to other actors, the extent to which the actor is close to or can easily reach many other actors in the network, or mediates the relationship between other actors. Centrality of IT, refers to the degree to which the particular information technology is central to the network (Monge *et al.*, 2003).
Automating IT	Information technology that helps to mechanize previously manual processes or activities are defined as automating IT.
Informating IT	IT that provide additional information relevant to the task at hand are defined as informating IT.

Table 1: Construct Definitions

> Proposition 1: Formation of strong ties with similar others under stable environmental conditions would lead to greater exploitation of existing knowledge, while the formation of weak ties with dissimilar others under turbulent environmental conditions would lead to greater exploration for new knowledge.

Repeated interactions with similar others through strong ties with them are characteristic of stable environmental conditions, when the goal of the organization is to ensure optimal exploitation of current knowledge through standardized work processes. This, in turn, reduces the range or diversity of individuals that each person gets to interact with during the course of their work, in times of stability. The considerable investment of resources required for building strong ties to similar others should leave very little resources for simultaneously forming ties to dissimilar others (who, by definition, are more diverse in their functional capabilities, expertise, etc.) under stable conditions in the network (Nelson, 1989).

Under turbulent conditions, however, as individuals engage in exploration for new knowledge possibilities, they would prefer forming ties with a more diverse set of other nodes in the network, in hopes of gathering unique insights by exposing themselves to new, varied perspectives. Under this condition, forming ties with similar others would not be particularly valuable, since it may lead to redundant information that wouldn't be of much decision-making value under conditions of high uncertainty. As such, the range or diversity of interaction would be higher for individuals under turbulent (rather than stable) environmental conditions in order to facilitate exploration of new knowledge under these conditions.

> Proposition 2: Lower range of ties would lead to greater exploitation of existing knowledge under stable environmental conditions, while higher range of ties would lead to greater exploration for new knowledge under turbulent conditions.

Value-adding roles and types of IT would also be different under stable versus turbulent environmental conditions. Under stable conditions, automating technologies, which help automate otherwise manual tasks, would play an important role in helping the firm standardize its internal operations by mechanizing its processes. For instance, IT has been shown to automate knowledge integration across groups by acting in brokerage positions (Pawlowski and Robey, 2005). Under turbulent conditions, however, the goal of the firm is to quickly collect and process large volumes of information about possible courses of future action, in response to environmental turbulence. Under these conditions, therefore, informating technologies, such as data warehouses, expert systems, etc., which help firms generate and process large volumes of information, could help by increasing the scope and speed of information collection and analysis. Greater network centrality of automating IT, as reflected by their being widely accessed by other nodes in the network, would, therefore be value-adding under stable environmental conditions. Under turbulent conditions, centrally located informating IT would be more value-adding.

> Proposition 3: Higher centrality of automating IT under stable environmental conditions would lead to greater exploitation of existing knowledge, while higher centrality of informating technologies under turbulent conditions would lead to greater exploration for new knowledge.

Processes

The strength and range of ties as well as the centrality of different kinds of technology drive the creation of knowledge by different processes under stable versus turbulent environmental conditions. These processes serve as mediating mechanisms through which organizations exploit or explore knowledge under stable versus turbulent conditions respectively, which leads to the creation of new organizational knowledge.

The low range of nodes under stable conditions implies that ties tend to form between individuals similar in terms of their knowledge content. Such individuals should, therefore, enjoy considerable cognitive overlap between each other, which should allow them to understand each other's tacit knowledge relatively easily. This implies that the transfer of tacit knowledge between these nodes could occur quite smoothly, without much need for the difficult intermediate conversion to explicit knowledge for the purpose of transfer. Under these conditions, therefore, less knowledge would be created through the process of externalization, the conversion of tacit-to-explicit knowledge. Under turbulent environmental conditions, however, the opposite is true, since nodes have higher range, and therefore, lower cognitive overlap. Under turbulent conditions, therefore, the effect of high range on knowledge exploration (P2) is mediated by the process of externalization, leading to the creation of new knowledge.

> Proposition 4: Lower range of nodes under stable environmental conditions leads to less knowledge creation through externalization, while higher range of nodes under turbulent conditions leads to more knowledge creation through externalization.

The ability of individuals to get away with not converting much of their tacit knowledge to explicit form, which is afforded by the high cognitive overlap between them, is thwarted by the presence of automating technologies. As these types of technologies strive to automate and standardize work processes under stable conditions, individuals interacting with the technology would need to externalize what they know tacitly, so that this knowledge can be used to devise appropriate technological systems that can standardize the use of the knowledge from one cycle to the next. The impact of high centrality of automating technologies on knowledge exploitation under stable conditions (P3) is therefore mediated by the process of externalization, leading to new knowledge creation under these conditions.

Under turbulent environmental conditions, however, weak ties are formed between individuals with diverse expertise and unrelated background knowledge domains. As each individual seeks new types of knowledge in order to survive previously unknown challenges presented by turbulent environmental conditions, they will come in contact with new knowledge content about which they may have little prior understanding and may also find themselves having to communicate with others who have poor understanding of their own knowledge domains. Effective exchange of knowledge between such individuals would, therefore, require them to explicitly articulate their innate knowledge on multi-disciplinary issues of common interest

to them. Under turbulent environmental conditions, therefore, knowledge creation through the process of externalization is already high owing to the high range or diversity of interaction that each individual experiences. The presence of automating technologies would, consequently, not have any additional effect on these processes over and above the effect that already exists due to higher range of interactions.

> Proposition 4a: Higher centrality of automating technologies under stable environmental conditions would offset the impact of lower range by increasing knowledge creation through externalization in times of stability, but not in times of turbulence.

High cognitive overlap between nodes under stable environmental conditions, as implied by their lower range, would allow these individuals to easily understand, and therefore, internalize, each other's explicit knowledge, thereby facilitating the creation of knowledge through internalization, the conversion of explicit-to-tacit knowledge. The process of internalization would therefore mediate the way in which low range of nodes leads to greater exploitation of existing knowledge by organizations (P2), leading to new knowledge creation in times of stability. The relatively poor cognitive overlap between individuals under turbulent conditions, due to their high range of interactions, implies that it would now be more difficult for these nodes to easily understand each other's explicit knowledge, and would lead to less knowledge creation through the process of internalization.

> Proposition 5: Lower range of nodes under stable conditions would lead to greater knowledge creation through internalization, while higher range of nodes under turbulent conditions would lead to less knowledge creation through the process of internalization.

Informating technologies offset the effect of high range under turbulent conditions, much as automating technologies offset the effect of low range under stable conditions. Informating technologies, such as knowledge repositories or expert systems, can, under turbulent conditions, provide supplemental background information on the subject to people involved in knowledge exchange. Thus, even though interacting individuals may not themselves possess a strong background understanding of each other's knowledge domains, informating technologies, such as query-based knowledge repositories or expert systems, make relevant cross-disciplinary information easily accessible to them in readily usable form. This helps artificially increase the cognitive overlap between otherwise dissimilar individuals, thereby allowing them to more readily internalize each other's knowledge content. The process of internalization, therefore, mediates the way in which high centrality of informating technologies impacts knowledge exploration under turbulent conditions (P3), leading to new knowledge creation. Under stable environmental conditions, when interactions primarily occur between similar others, individuals already possess this common background knowledge that is important for successful internalization of new knowledge. The presence of informating technologies would, consequently, have little additional effect on knowledge creation through internalization under stable environmental conditions.

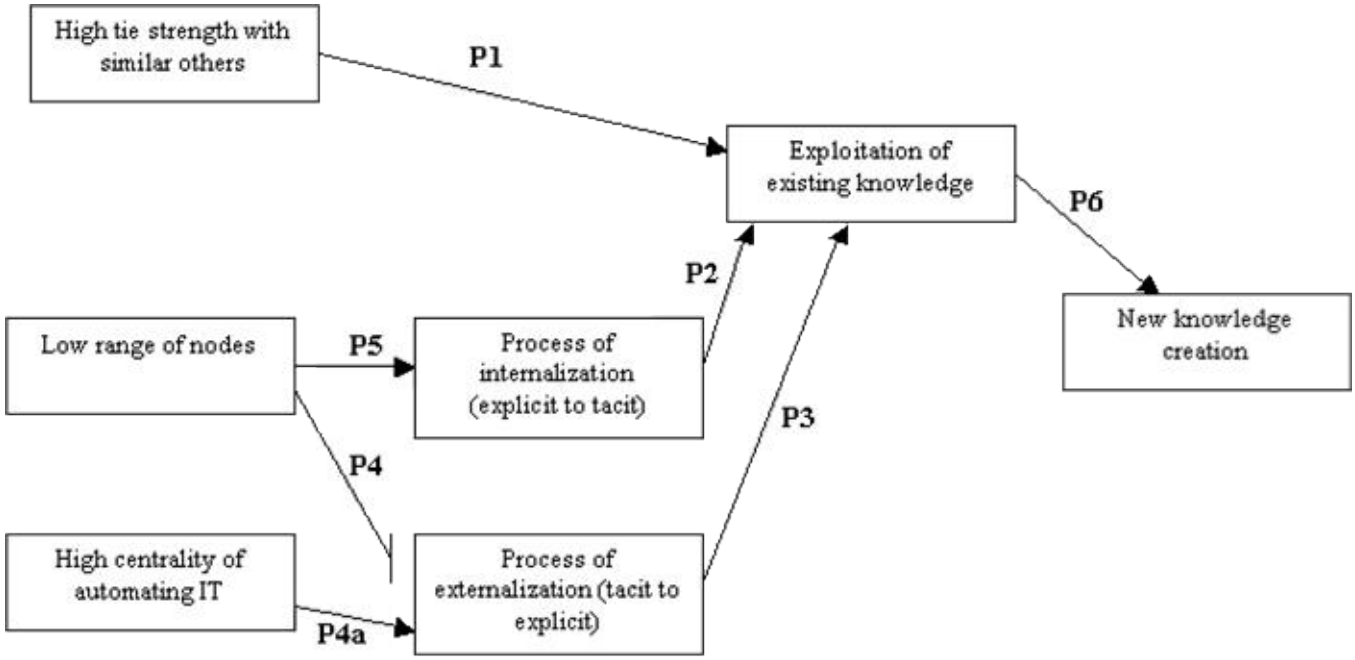
> Proposition 5a: Increased centrality of informating technologies under turbulent environmental conditions increases knowledge creation through internalization, thereby offsetting the impact of high range on knowledge creation under turbulent, but not under stable conditions.

As discussed in the theoretical development for the earlier propositions, the processes of exploitation of existing knowledge under stable conditions and exploration for new knowledge under turbulent conditions lead to new knowledge creation under each condition.

> Proposition 6: Exploitation of existing knowledge under stable environmental conditions as well as exploration for new knowledge under turbulent conditions leads to new knowledge creation under each condition respectively.

Figure 1 depicts the conceptual model pictorially.

Stable environmental conditions:



Turbulent environmental conditions:

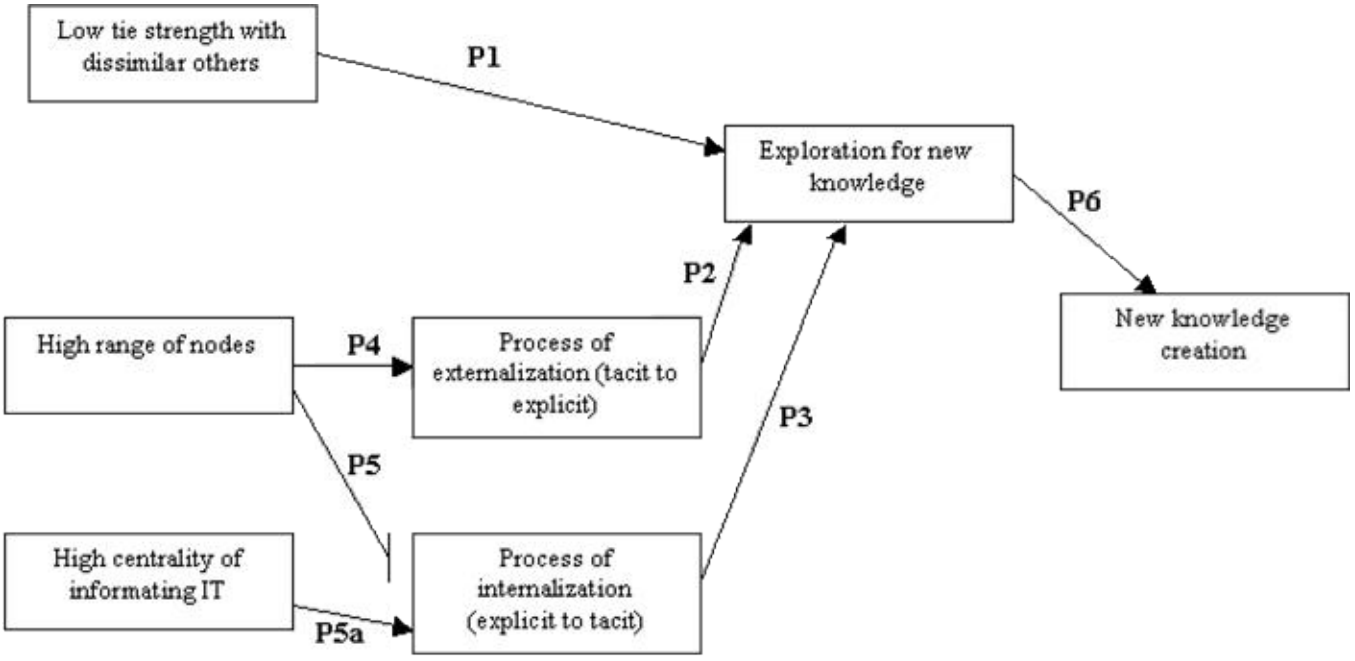


Figure 1: Conceptual Model

CONCLUSION

In this paper, I have theoretically investigated how organizational networks create knowledge that leads to competitive advantage, presenting knowledge creation as contingent on the level of turbulence in the organization's competitive environment. I have drawn on the exploitation/exploration framework to discuss the differences between antecedents and processes of knowledge creation in response to stable versus turbulent environmental conditions.

REFERENCES

1. Ahuja, G. (2000) Collaboration networks, structural holes, and innovation: A longitudinal study. *Administrative Science Quarterly*, 45, 3, 425-455
2. Alavi, M and Leidner, D.E. (2001) Review: Knowledge management and knowledge management systems: Conceptual foundations and research issues. *MIS Quarterly*, 25, 1, 107-136
3. Almeida, P., Song, J. and Grant, R.M. (2002) Are Firms Superior to Alliances and Markets? An Empirical Test of Cross-Border Knowledge Building, *Organization Science*, 13, 147-161.
4. Argote, L, McEvily B. and Reagans R. (2003a) Introduction to the special issue on managing knowledge in organizations: Creating, retaining, and transferring knowledge. *Management Science*, 49, 4, V-VIII
5. Argote, L, McEvily B. and Reagans R. (2003b) Managing knowledge in organizations: An integrative framework and review of emerging themes. *Management Science*, 49, 4, 571-582
6. Barley, S.R. (1990) The Alignment of Technology and Structure through Roles and Networks. *Administrative Science Quarterly*, 35, 1, 61-103
7. Borgatti, S, and Cross R. (2003a) A relational view of information seeking and learning in social networks. *Management Science*, 49, 4, 432-445
8. Borgatti, S, and Foster, P.C. (2003b) The Network Paradigm in Organizational Research: A Review and Typology, *Journal of Management*, 29, 6, 991-1013.
9. Brass, D.J. (1984) Being in the Right Place: A Structural Analysis of Individual Influence in an Organization, *Administrative Science Quarterly*, 29, 4, 518-539
10. Brown, J.S, and Duguid, P. (1991) Organizational Learning and Communities-Of-Practice: Toward a Unified View of Working, Learning, and Innovating. *Organization Science*, 2, 1, 40-57
11. Brown, J.S, and Duguid, P. (2001) Knowledge and organization: A social-practice perspective. *Organization Science*, 12, 2, 198-213
12. Burkhardt, M.E., and Brass, D.J. (1990) Changing patterns or patterns of change: The effects of a change in technology on social network structure and power. *Administrative Science Quarterly*, 35, 104-127
13. Burt, R.S. (1992) Structural holes : the social structure of competition. Harvard University Press: Cambridge, Mass.
14. Burt, R.S. (2004) Structural Holes and Good Ideas. *American Journal of Sociology*, 110, 2, 349-399
15. Constant, D, Sproull, L, and Kiesler, S. (1996) The kindness of strangers: The usefulness of electronic weak ties for technical advice. *Organization Science*, 7, 2, 119-135
16. Fleming, L. (2001) Recombinant Uncertainty in Technological Search, *Management Science*, 47, 1, 117-132
17. Gersick, C.J.G. (1991) Revolutionary Change Theories: A Multi-level Exploration of the Punctuated Equilibrium Paradigm. *Academy of Management Review*, 16, 1, 10-36
18. Grant, R.M. (1996) Prospering in dynamically-competitive environments: Organizational capability as knowledge integration. *Organization Science*, 7, 4, 375-387
19. Hansen, M.T. (1999) The search-transfer problem: The role of weak ties in sharing knowledge across organization subunits. *Administrative Science Quarterly*, 44, 1, 82-111
20. Hanssen-bauer, J and Snow, C.C. (1996) Responding to Hypercompetition: The Structure and Process of a Regional Learning Network Organization, *Organization Science*, 7, 4, 413-427
21. Henderson, R.M. and Clark, K.B. (1990) Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms. *Administrative Science Quarterly*, 35: 9-30.
22. Katila, R. and Ahuja, G. (2002) Something old, something new: A longitudinal study of search behavior and new product introduction. *Academy of Management Journal*, 45, 6, 1183-1194

23. Kogut, B. and Zander, U. (1992) Knowledge of the Firm, Combinative Capabilities, and the Replication of Technology. *Organization Science*, 3, 3, 383-397
24. Lee, J., Lee, J. and Lee, H. (2003) Exploration and exploitation in the presence of network externalities. *Management Science*, 49, 4, 553-570
25. Levitt, B. and March, J. (1988) Organizational learning. *Annual Review of Sociology*, 14, 319-340
26. Liebeskind, J.P. (1996) Knowledge, strategy, and the theory of the firm. *Strategic Management Journal*, 17, 93-107
27. Liebeskind, J.P., Oliver, A.L, Zucker, L. and Brewer, M. (1996) Social networks, Learning, and Flexibility: Sourcing Scientific Knowledge in New Biotechnology Firms. *Organization Science*, 7, 4, 428-443
28. March, J.G. (1991) Exploration and exploitation in organizational learning. *Organization Science*, 2, 1, 71-87
29. Monge, P.R. and Contractor, N.S. (2000) Emergence of Communication Networks. In FM Jablin, LL Putnam (Eds.), *The New Handbook of Organizational Communication: Advances in theory, research, and methods*: 440-502. Sage Publications Ltd.: Thousand Oaks, CA
30. Nelson, R.E. (1989) The Strength of Strong Ties - Social Networks and Intergroup Conflict in Organizations. *Academy of Management Journal*, 32, 2, 377-401
31. Nonaka, I. (1994) A Dynamic Theory of Organizational Knowledge Creation. *Organization Science*, 5, 1, 14-37
32. Nonaka I. (1991) The knowledge-creating company. *Harvard Business Review*, 69: 96-104
33. Pawlowski, S.D. and Robey, D. (2005) Bridging user organizations: Knowledge brokering and the work of information technology professionals. *MIS Quarterly*, 29, 1, 1-27
34. Romanelli, E. and Tushman, M.L. (1994) Organizational transformation as punctuated equilibrium: An empirical test. *Academy of Management Journal*, 37, 5, 1141-1166
35. Rulke, D.L. and Galaskiewicz, J. (2000) Distribution of knowledge, group network structure, and group performance. *Management Science*, 46, 612-625
36. Sanchez, R. and Mahoney, J.T. (1996) Modularity, flexibility, and knowledge management in product and organization design. *Strategic Management Journal*, 17, 63-76
37. Sorenson, O. (2003) Interdependence and adaptability: Organizational learning and the long-term effect of integration. *Management Science*, 49, 4, 446-463
38. Spender, J.C. (1996) Making knowledge the basis of a dynamic theory of the firm. *Strategic Management Journal*, 17, 45-62
39. Spender, J.C. and Grant, R.M. (1996) Knowledge and the firm: Overview. *Strategic Management Journal*, 17, 5-9
40. Tsoukas, H. (1996) The firm as a distributed knowledge system: A constructionist approach. *Strategic Management Journal*, 17, 11-25
41. Uzzi, B. and Lancaster, R. (2003) The role of relationships in interfirm knowledge transfer and learning: The case of corporate debt markets. *Management Science*, 49, 4, 383-399
42. Virany, B., Tushman, M.L. and Romanelli, E. (1992) Executive succession and organization outcomes in turbulent environments: An organization learning approach. *Organization Science*, 3, 1, 72-91
43. Zander, U. and Kogut, B. (1995) Knowledge and the speed of transfer and imitation of organizational capabilities: An empirical test. *Organization Science*, 6, 76-92
44. Zellmer-Bruhn, M.E. (2003) Interruptive events and team knowledge acquisition. *Management Science*, 49, 4, 514-528.