

12-31-2007

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## Recommended Citation

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# **A CURVILINEAR MODEL OF THE RELATIONSHIP BETWEEN KNOWLEDGE DIVERSITY AND KNOWLEDGE CREATION**

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## **ABSTRACT**

Although organizational knowledge creation is a significant means by which companies generate value and derive competitive advantage, little is known about the knowledge creation process within corporations. A review of the literature uncovered an apparent disagreement pertaining to the relationship between knowledge diversity and knowledge creation. Specifically, one body of literature argues that knowledge creation correlates positively with knowledge diversity, suggesting that knowledge creation is maximized when knowledge diversity is maximized. Another body of literature, however, indicates that a high level of knowledge diversity restrains knowledge creation because it interferes with a group's ability to communicate and collaborate. In this paper, the two bodies of literature are reviewed and a model that attempts to further the dialogue regarding the relationship between the variables is presented. Unlike prior models that claim the relationship between the variables to be linear, the model presented in this paper proposes that the relationship between the variables is curvilinear. Specifically, the model advances the concept that a moderate level of knowledge diversity promotes knowledge creation while high and low levels of knowledge diversity restrain knowledge creation. Implications and future research directions are presented.

## **KEYWORDS**

Knowledge Management, Knowledge Creation, Knowledge Diversity

## **INTRODUCTION**

Knowledge creation is a significant means by which companies generate value and invent products and services that are superior to those offered by their competitors (Pawlowski & Robey 2004). Companies that are able to create knowledge quickly and effectively are likely to hold a competitive advantage over companies that cannot. As competition increases, the need for businesses to differentiate their products and services will also increase, placing even greater emphasis on organizational learning and knowledge creation (Bennet & Bennet 2003). There are many studies that underscore the importance of knowledge creation. For example, Cooper (2000) argued that knowledge creation is a key enabler to Information

Systems development and business process reengineering. Sethi, Smith, and Park (2001) stated that “[m]ultiple studies have found that the primary determinant of new product failure is an absence of innovativeness—the extent to which a new product provides meaningfully unique benefits” (p. 73). Notwithstanding the importance of knowledge creation within the corporate context, scant research has been performed to date on the topic (Mitchell & Nicholas 2006; Tiwana & McLean 2005; Un & Cuervo-Cazurra 2004).

By addressing a disagreement in the literature regarding the relationship between the variables of knowledge creation and knowledge diversity, this paper attempts to further our understanding of the knowledge creation process within companies. A review uncovered two primary positions within the literature. One body of literature argues that knowledge diversity correlates positively with knowledge creation, while another body of literature argues that a high level of knowledge diversity is deleterious to knowledge creation. Unlike prior studies, which indicate that knowledge diversity is either positively or negatively related to knowledge creation, the model presented in this paper proposes that the relationship between the variables is curvilinear. Specifically, it advances the concept that a moderate level of knowledge diversity promotes knowledge creation while high and low levels of knowledge diversity restrain knowledge creation. The role of shared knowledge in the knowledge creation process is also reviewed to bolster the theoretical framework of the model and its concomitant propositions.

The remainder of this paper is organized into five sections. In the next section, the relationship between knowledge diversity and knowledge creation is reviewed. The role of shared knowledge in the knowledge creation process is then discussed. The purpose of the discussion up until that point is to provide the theoretical and literary background for the model. The model is then reviewed in the context of the knowledge-based theory of the firm and analogical evidence offered by the literature. During that discussion, an explanation for the difference between the nature of the relationship between the variables of knowledge diversity and knowledge creation as found in prior studies and the nature of the relationship as proposed in this paper is offered. Lastly, future research directions are presented.

## **A REVIEW OF THE RELATIONSHIP BETWEEN KNOWLEDGE DIVERSITY AND KNOWLEDGE CREATION**

Several researchers have argued that knowledge diversity promotes knowledge creation, and that the relationship between the two variables is unbounded. Underlying the arguments presented in this body of literature is the concept that organizational units consisting of members with disparate knowledge sets will inherently cover and consider a wider range of ideas than will organizational units that consist of members with similar knowledge sets (Gray 2000; Porac et al. 2004; Thompson 2003). Consequently, the coverage of a broader range of ideas tends to increase creativity. This concept is empirically supported by a study conducted by Keegan and Turner (2001), who examined how project teams learn through the process of variation, selection, and retention. In their study, Keegan and Turner discussed how the Pillsbury Company generates new product ideas by encouraging variation via its Pillsbury bakeoff. In a Pillsbury bakeoff, contestants submit novel recipes using Pillsbury ingredients in the hope of winning a monetary prize. The best product is selected and oftentimes retained as an addition to Pillsbury’s product line. Similar to the Pillsbury bakeoff, Keegan and Turner observed that project teams learn through a process of considering various ideas and selecting the best ideas for implementation and retention. They observed that project teams consisting of members with disparate backgrounds considered a wider range of ideas than did project teams whose members had similar backgrounds. Similarly, Cummings (2004) observed that structurally diverse groups (i.e., groups comprised of members from disparate functional areas) exhibited greater levels of innovation and knowledge sharing compared to structurally homogeneous groups. Cummings argued that structural diversity exposes team members to more diverse sources of knowledge, thereby enhancing group creativity. In a study that provides guidance on increasing group creativity, Thompson (2003) stated: “The more heterogeneous a team is, the more likely that team

will excel in all measures of creativity. Indeed, teams in which members are diverse with regard to background and perspective outperform teams with homogeneous members on tasks requiring problem solving and innovation” (p. 102). In investigating the academic performance of two groups of researchers, Porac, Wade, Fischer, Brown, Kanfer, and Bowker (2004) found that a group of researchers with disparate backgrounds was more creative and productive than a comparative group of researchers with relatively homogeneous backgrounds. Likewise, Miller (2006) found that “diversified firms perform better as [their] technological diversity increases” (p. 616). Gray (2000) argued that “[i]mproved team knowledge diversity leads to more accurate and complete analysis of complex problems, improving the effectiveness of the solutions teams generate, and, ultimately, enhancing an organization's ability to adapt to its environment” (p. 176). Leonard and Straus (1977) argued that heterogeneous teams are likely to be more creative because innovation and creativity occur most often at the junction of two differing planes of thought. Based on their argument, they advised that companies should avoid the “comfortable clone” syndrome, a condition where managers assemble a team of likeminded people. The practice of hiring similar people may promote efficiency and harmony, but it may also prevent the process of creative abrasion. In contrast, hiring people with differing perspectives (e.g., right-brain and left-brain thinkers) promotes creativity because those groups are more likely to debate and consider a broader spectrum of ideas. These studies collectively support the position that knowledge diversity promotes knowledge creation. In a general sense, the premise of the need for knowledge diversity may be likened to the concept of knowledge Darwinism, which is the idea that varied inputs are necessary for the evolution of thought and to stave off “intellectual inbreeding.”

In contrast to studies indicating that knowledge creation correlates positively with knowledge diversity, another body of literature suggests that knowledge diversity may restrain knowledge creation. For example, Ancona and Caldwell (1992) examined 45 product teams and found that functional diversity, which is a proxy for knowledge diversity, had a negative effect on team innovation because a high level of knowledge diversity impaired group functioning. In a different study that corroborates the findings of Ancona and Caldwell, Scarbrough, Bresnen, Edelman, Laurent, Newell, and Swan (2004) observed that a high level of knowledge diversity impaired the knowledge creation ability of project teams because it caused the teams to balkanize. Scarbrough, Bresnen, Edelman, Laurent, Newell, and Swan noted that “the diversity of perspectives which project members brought to their tasks was seen as a handicap rather than a stimulus to learning. Project members spoke of the ‘silo mentality’ resulting from specialization and its damaging effects on collaboration” (p. 501). Dougherty (1992) found that collaboration and knowledge creation were inhibited by the different “thought worlds” that developed within the functional areas (e.g., engineering, manufacturing, marketing, and so on) of a corporation. Dougherty reasoned that the differences between thought worlds resulted in interpretative barriers that frustrated the ability of organizations to create knowledge. In sum, these studies support the position that a high level of knowledge diversity is deleterious to knowledge creation because it creates barriers to communication and collaboration.

## **THE ROLE OF SHARED KNOWLEDGE IN ORGANIZATIONAL KNOWLEDGE CREATION**

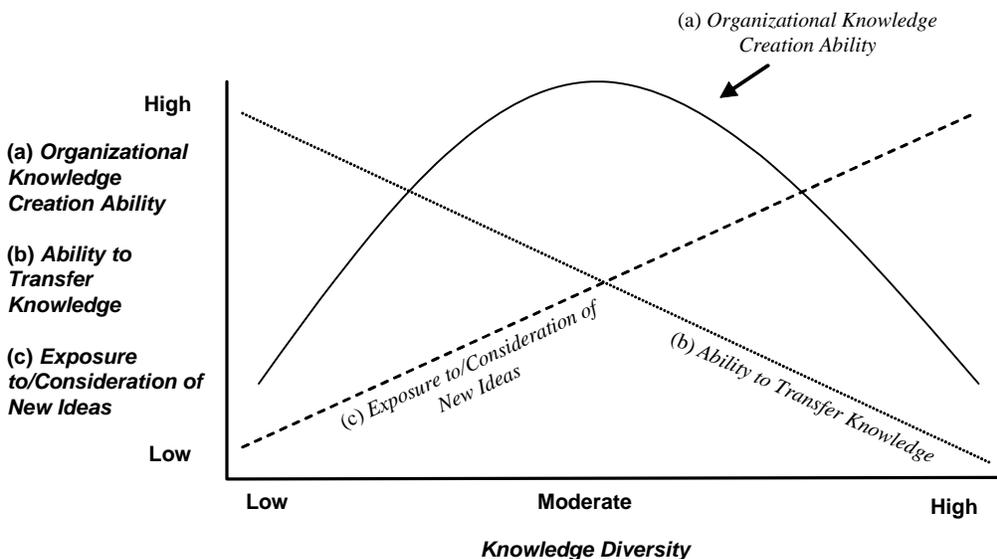
A moderate level of shared knowledge promotes organizational knowledge creation by enabling communication and collaboration among groups (Alavi & Leidner 2001; Alavi, Kayworth, & Leidner 2006; Nonaka 1994; Pawlowski & Robey 2004). For the purposes of knowledge sharing, it is important not only for people to share a common language but also for people to share common mental models (Senge 1990). Szulanski (1996) found that a lack of absorptive capacity was the most significant impediment to knowledge transfer. Absorptive capacity is defined as the ability to absorb new information, and it is largely determined by preexisting knowledge (Cohen & Levinthal 1990). Preexisting knowledge enables people to understand new ideas by enabling them to relate those ideas to familiar concepts (Smith, Collins, & Clark 2005). As Nonaka (1994) noted, the ability to transfer

knowledge is an integral function of organizational knowledge creation. It follows that individuals who possess shared knowledge will be readily able to transfer and create knowledge.

There is however a tradeoff to shared knowledge that must be considered. Although the research discussed above indicates that shared knowledge enables communication, collaboration, and consequently organizational knowledge creation, other research suggests that a high level of shared knowledge may restrain knowledge creation. For example, Leonard and Straus (1977) argued that knowledge creation tends to occur at the intersection of two opposing planes of thought. Scarbrough, Bresnen, Edelman, Laurent, Newell, and Swan (2004) observed that the existence of significant shared knowledge stocks tended to restrain learning achieved through reflection, noting that project teams preferred to use preexisting knowledge—if it was reasonably accessible and serviceable—rather than creating new knowledge via reflection. In addition, Scarbrough, Bresnen, Edelman, Laurent, Newell, and Swan found that a high level of shared knowledge also results in strongly held paradigms and biases, which may preclude the thoughtful consideration of new ideas, a state commonly referred to as groupthink (Esser, 1998). Based on the literature presented above, shared knowledge may be a double-edged sword. Specifically, shared knowledge is needed to facilitate knowledge transfer, but in high levels, shared knowledge may restrain creativity by depriving the group of differing planes of thought and leading to groupthink.

## A CURVILINEAR MODEL OF KNOWLEDGE DIVERSITY AND KNOWLEDGE CREATION

The following model attempts to situate the literature discussed above into an integrated model that explains knowledge creation ability as a function of knowledge diversity (Figure 1). It is argued by this author that a moderate level of knowledge diversity promotes knowledge creation more than high or low levels of knowledge diversity because moderate levels of knowledge diversity provide an optimal balance between a) the exposure to and the consideration of new ideas (Gray 2000; Keegan & Turner 2001; Porac et al. 2004), and b) the ability to transfer and communicate knowledge (Alavi & Leidner 2001; Nonaka 1994). The following describes and supports the relationships depicted in the model.



**Figure 1. A Curvilinear Model of the Relationship Between Knowledge Diversity and Organizational Knowledge Creation**

As noted previously, organizations that consist of members with disparate knowledge sets will consider a broader range of ideas compared to organizational units that consist of members with relatively similar knowledge sets (Gray 2000; Porac et al. 2004). The coverage and consideration of new ideas promotes knowledge creation, but this is only part of the picture. In order for groups to create knowledge collectively, they must be able to transfer and communicate knowledge (Hargadon & Bechky 2006; Nonaka 1994). In order to communicate, a group must possess shared knowledge, where the need for shared knowledge is likely proportional to the complexity of the ideas being communicated. Taken together, the ability to transfer and integrate knowledge opposes the necessity of the exposure to and consideration of new ideas, leading to the proposition that a moderate level of knowledge diversity promotes knowledge creation, while low and high levels restrain knowledge creation. A group with a low level of knowledge diversity is likely to suffer from groupthink. However, a group with a high level of knowledge diversity is likely to be deprived of the ability to communicate and collaborate, which is a necessary condition for organizational knowledge creation. In contrast, a group with a moderate level of knowledge diversity will have the benefit of being exposed to new ideas while retaining a serviceable ability to communicate and collaborate. The discussion above leads to the following researchable propositions:

Proposition 1a: Teams that exhibit a moderate level of knowledge diversity will be more creative than teams that exhibit either a high or low level of knowledge diversity

Proposition 1b: Teams that exhibit a low level of knowledge diversity will consider a narrower range of ideas than teams that exhibit a high level of knowledge diversity

Proposition 1c: Teams that exhibit a high level of knowledge diversity will experience more difficulty communicating, collaborating, and making decisions than teams that exhibit a low level of knowledge diversity

Proposition 2: Teams that exhibit a moderate level of shared knowledge will be more creative than teams that exhibit either a high or low level of shared knowledge

## DISCUSSION

The concept of a curvilinear model can be discussed through the theoretical lens of the knowledge-based theory of the firm. The theory of the firm is used to explain the existence of firms in the face of alternative forms of governance (e.g., markets) and to predict the behavior of firms. Although the theory of the firm is stated as a single theoretical perspective, there are many theories of the firm that explain organizational governance and behavior from different perspectives (e.g., resource-based view, transaction cost view, etc.) (Grant 1996). According to the knowledge-based theory of the firm, firms exist to facilitate the integration and creation of knowledge by providing a stable social context. Nonaka and Konno (1998) refer to the term *ba*—a Japanese word meaning “place”—to describe the shared social context necessary for knowledge creation. Shared social context provides the means to transfer and thereby integrate knowledge, which enables organizational learning and knowledge creation (Alavi & Leidner 2001; Nonaka 1994; Smith et al. 2005). As noted earlier, interpretative barriers, which are often coterminous with organizational boundaries, are a significant barrier to knowledge creation (Dougherty 1992). Without shared mental models, organizational knowledge creation is limited (Senge 1990). Based on the concept of bounded rationality (Simon 1991), shared and idiosyncratic knowledge are in opposition. Given the limited cognitive capacity of human beings, humans can only acquire a limited amount of shared and idiosyncratic knowledge, so teams must make tradeoffs between acquiring shared or idiosyncratic knowledge. Although shared knowledge enables communication and collaboration, idiosyncratic knowledge enables companies to produce unique products or services, which allows them to appropriate monopoly rents. From a profitability perspective, a rational company is motivated to acquire idiosyncratic knowledge, but at some point too much idiosyncratic knowledge without sufficient shared knowledge would prevent a firm from integrating the knowledge of specialists (Ancona & Caldwell 1992), which would violate the underlying premise of the knowledge-based theory of the firm (Grant 1996). Based on

this argument, the knowledge-based theory of the firm suggests that firms should seek a blend of idiosyncratic and shared knowledge, which would be consistent with the model presented in this paper.

Although a shared social context is arguably a necessary antecedent to organizational knowledge creation, the adage “moderation in all things” may apply. There is a significant amount of literature suggesting that knowledge diversity provides the innovative spark necessary for knowledge creation. For example, Rodan and Galunic (2004) found that managers with access to heterogeneous social networks would be more innovative because they tended to be exposed to a broader range of ideas. In addition, Nonaka (1994) suggested that, among other means, knowledge is created through the reconciliation of differing perspectives. It follows that without differing ideas (i.e., without knowledge diversity), the potential for organizational knowledge creation is diminished. The need for differing ideas suggests that a low level of knowledge diversity within the organizational context would be undesired from a knowledge creation perspective. Therefore, consistent with a knowledge-based theory of the firm, a rational firm would seek to maximize its knowledge creation potential by developing teams that exhibit moderate levels of knowledge diversity and shared knowledge.

The fact that prior studies found either a positive or negative linear relationship provides *prima facie* evidence against a curvilinear model. It is possible, however, that the prior researchers examined only a limited range of knowledge diversity when conducting their studies. If that is the case, then it is possible for the findings of linear relationships to agree with a curvilinear model over a restricted range of knowledge diversity. For example, a positive linear relationship over the range of low to moderate knowledge diversity would agree with the curvilinear model presented in this paper. Likewise, a negative linear relationship over the range of moderate to high knowledge diversity would also agree with the model presented in this paper. In sum, a curvilinear model could explain and unify the heretofore conflicting findings. Interestingly, Webber and Donahue (2001) in their meta-analysis of the diversity literature failed to find linear relationships between “two types of diversity attributes, highly job-related and less job-related, on work group cohesion and performance” (p. 141). In their analysis, they suggested that a reason why they failed to find a linear relationship is because the underlying relationship between the variables they explored may be curvilinear. Notwithstanding the fact that their study does not directly address the variables being discussed here, it is similar in nature to this study, and it does recognize the possibility of a curvilinear relationship that results from countervailing concerns.

This author noticed a greater number of studies in the literature that suggest a positive correlation between the variables of knowledge diversity and knowledge creation. This may be explained by the data on which the studies were based, as well as typical hiring practices. As noted by Tiwana and McLean (2005), many of the prior studies were based on data collected from industrial settings where knowledge creation may not be as important as production efficiency. In an environment that emphasizes efficiency, conformity and standardization would be prized. The data collected from these environments would be more likely to represent a low to moderate range of knowledge diversity rather than representing the full spectrum of knowledge diversity. In addition, managers tend to hire people who fit in with the culture of their organizations, a hiring practice which would result in relatively homogenous workplaces (Sethi, Smith, & Park, 2001). This practice may change as knowledge diversity increases in importance. Interestingly, Sethi, Smith, and Park, (2001) argued that knowledge diversity is likely to increase due to globalization and a shift toward knowledge intensive activities. Accordingly, it would be expected that studies based primarily on a moderate to high level of knowledge diversity would become more common. Perhaps the findings of a negative correlation between knowledge diversity and knowledge creation may become more common as well. Anecdotally, Tiwana and McLean (2005) recently found a negative (but nonsignificant) correlation between the variables of expertise heterogeneity and creativity even though they hypothesized that they would find a statistically significant positive relationship. The data for the study was collected from Information Systems development teams—groups that are arguably engaged in knowledge intensive activities. It is important to note that the points in this and the preceding paragraph are primarily speculative and are only provided to stimulate thought and further research.

The current discussion concludes with evidence found in the literature that supports a curvilinear model. Although an extensive review failed to uncover direct support for a curvilinear model, one study provides analogical evidence. In a study conducted by Sampson (2003), strategic alliances exhibiting a moderate level of technological diversity were more creative than alliances that exhibited either a high or low level of technological diversity. Knowledge creativity was measured by summing the number of patents produced by an alliance. Patents were weighted to account for their relative significance. Technological diversity was measured by analyzing the degree to which partners in an alliance cited patents other than their own or patents of a partner on their patent applications. When graphed on a coordinate system with creativity as the independent variable and technological diversity as the dependent variable, the data remarkably resembled a normal distribution with the mean centered on a moderate level of knowledge diversity. Although the study by Sampson provides compelling support for a curvilinear model, the study was based on an inter-firm unit of analysis. Therefore, it does not provide direct evidence for the effects of knowledge diversity at the team or organizational level.

## PROPOSED RESEARCH DIRECTIONS

There are several directions in which this research could be expanded. First, the model presented above should be empirically tested. Second, a more intensive comparison of the literature could be conducted to provide additional insight into the inconsistent results of previous studies examining the relationship between knowledge diversity and knowledge creation. Third, it may be interesting to investigate the tension between knowledge transfer and knowledge creation. The knowledge management literature tends to overlook knowledge creation, focusing on knowledge transfer instead (Un & Cuervo-Cazurra 2003). As noted above, the ability to transfer knowledge is enhanced through shared knowledge; however, the development of shared knowledge stocks may arrest knowledge creation at some point (Porac et al. 2004). The countervailing concerns of knowledge creation and knowledge transfer may call for a constrained optimization theory that provides guidance on how to balance these concerns appropriately.

## CONCLUSION

Although organizational knowledge creation is a significant means by which companies generate value and derive competitive advantage, little is known about the knowledge creation process within corporations. A review of the literature uncovered a disagreement about the relationship between the variables of knowledge diversity and knowledge creation. While one body of literature indicates that knowledge diversity correlates positively with knowledge creation, another body of literature suggests that a high level of knowledge diversity restrains knowledge creation. Unlike prior models that claim the relationship to be linear, the model presented in this paper proposes the relationship to be curvilinear. Specifically, the model advances the concept that a moderate level of knowledge diversity promotes knowledge creation while high and low levels of knowledge diversity restrain knowledge creation. Underlying the model is the argument that a moderate level of knowledge diversity provides a favorable balance between the countervailing concerns of a) exposure to new ideas and b) the ability communicate and collaborate. In addition to a *a priori* argument, analogical evidence was provided in support of the model. Although the model lacks direct empirical support, it does raise doubts about the linearity of the relationship between the variables of knowledge diversity and knowledge creation. In addition, the model provides a framework that is grounded in the literature and is capable of supporting future research.

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