



The contingent value of exploratory and exploitative learning for new product development performance

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ABSTRACT

This study endeavors to extend research on organizational learning by investigating the complicated effects between exploratory – exploitative learning and new product performance in a single new product project. Specifically, premised on contingency theory the authors investigate the negative nonlinear and interaction effects of project-level exploratory and exploitative learning behaviors on product development performance, and examine internal organizational and external environmental factors to recognize their differential moderating effects between the two learning behaviors and new product performance. Most of the hypotheses are supported based on questionnaire survey results of 253 new product projects. The results indicate that the two type of learning have curvilinear (inverted U-shaped) effects on new product performance, and suggest that product development performance will be enhanced when one learning is at higher level and the other is at lower level. Furthermore, the authors discover that process-based reward, encouragement to take risk, and environment dynamics strengthened the benefits of exploratory on new product performance. On the other hand, the advantages of exploitative learning on new product performance is further enhanced when output-based reward, project development formalization, and environment competitiveness is high. Finally, this study suggests that project managers should pay careful attention to employ the two learning behaviors during new product development.

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1. Introduction

For several years, many scholars have dedicated considerable effort on further understanding the nature of exploratory learning versus exploitative learning (e.g., Levinthal & March, 1993; March, 1991). Thus, an accumulating body of research has established that exploratory and exploitative learning leads to better performance in new product development (NPD) and organizations (e.g., He & Wong, 2004; Katila & Ahuja, 2002). On the other hand, some studies have examined the antecedents (i.e., market orientation or top management team's social capital etc.) and consequences (i.e., innovativeness or new product performance etc.) of exploratory and exploitative learning (e.g., Atuahene-Gima & Murray, 2007). Despite this growth of exploratory and exploitative learning literature, there are some oversights in the extant empirical research; and thus, the purpose of this study is an attempt to address these oversights.

The first research gap is that prior research has focused on the more macro levels of analysis (i.e., firm to inter-firm). For instance,

Atuahene-Gima and Murray (2007) studied the two types of learning at the firm level and found that the top management team's social capital was the key antecedent. Using patent data, Katila and Ahuja (2002) found that the firm's search depth and search scope were related to new product innovation at the firm level. As Gupta, Smith, and Shalley (2006) noted, empirical studies that examine exploratory and exploitative learning at a more micro level are relatively scant. The second research gap concerns the relationship between exploratory and exploitative learning and NPD performance. Although several studies have examined the nonlinear impact of exploratory and exploitative learning on NPD performance and the interaction effect of exploratory and exploitative learning at the firm level, empirical findings have been ambiguous on both fronts (e.g., Atuahene-Gima & Murray, 2007; He & Wong, 2004; Katila & Ahuja, 2002; Nerkar, 2003). The unclear findings may have resulted from previous studies that took the firm or business unit as a unit of analysis and ignored the fact that the two learning behaviors might not have suffered from the constraint of scarcity due to the accessibility of potential external resources (Gupta et al., 2006) at the firm or business unit level. Perhaps, the two learning behaviors may explicitly differentiate the processing conditions and their mechanisms at the level of a single new product project. Although few previous studies has asserted that organizational antecedents differentially influence exploration and exploitation (Raisch &

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Birkinshaw, 2008), few if any studies in exploratory and exploitative learning literature have examined internal organizational factors that moderate the relationship between exploratory learning or exploitative learning and NPD performance.

For these reasons, in this study, we focus particularly on the project level in an attempt to contribute to the exploratory and exploitative learning literature in three ways. First, we argue that given the potential risks involved in achieving an inappropriate level of exploratory or exploitative activities and the possibility of diminishing returns on their contribution to the NPD project, it is likely that the level of explorative or exploitative activities that is either too low or too high may harm performance; and a reasonable level may be optimal. From the perspective of contingency theory, we examined the nonlinear relationship between explorative or exploitative activities and NPD performance at the project-level unit of analysis. Second, based on the argument of Gupta, and Smith et al. (2006), we also examine if high (low) exploration needs to be associated with low (high) exploitation to enhance NPD performance at the project level. By focusing on a single new product development project, this study implies that the interaction effect for the two learning processes on performance will be negative. Finally, our study adds to the existing body of knowledge concerning exploration and exploitation literature by examining the moderating effect of the internal organizational factors between the two learning behaviors and new product performance. Given that the two learning behaviors involve complex information-processing tasks, we highlight process and system factors such as the reward system and the work environments (encouragement to take risks and project development formalization), all of which affect the information-processing capacity of the project members as internal organizational moderators between the two learning behaviors and NPD performance. Finally, we advance the extant literature through testing a contingent model (Hofer, 1975) by using a single new product project as unit of analysis, which stresses that competitive advantage is conditional upon external environmental conditions. Following this insight, we investigate two sources of external factors (environmental dynamics and competitiveness) so as to recognize their differential moderating effects between the two learning behaviors and new product performance. Through this richer framework and empirical assessment, we attempt to respond to Gupta, and Smith et al. (2006) call for research that examines a more micro level model of exploratory and exploitative learning.

Consequently, this study addresses these oversights in the literature by investigating (1) nonlinear relationships between exploratory and exploitative learning and NPD performance, (2) their interaction effect on NPD performance, and (3) internal organizational and external environmental factors that moderate their effects on NPD performance.

2. Theoretical background and hypotheses

2.1. The nature of exploration and exploitation

Originally introduced by March's (1991) research, these twin concepts "exploration" and "exploitation" have emerged as the dominant underlying issue in organizational learning, technological innovation, strategic management, NPD and marketing strategy (e.g., Benner & Tushman, 2003; Jansen, Van Den Bosch, & Volberda, 2006; Kyriakopoulos & Moorman, 2004). In this seminal paper, exploration was defined as "experimentation with new alternatives, that its returns are uncertain, distant, and often negative" and exploitation was defined as "the refinement and extension of existing competences, technologies, and paradigms" (March, 1991). In addition, based on the logic of March (1991) and according to Gupta and Smith et al.'s (2006) comprehensive discussions, this study argues that the two concepts are discriminated by differences in the type or amount

of learning rather than by the presence or absence of learning. As such, exploratory learning implies that the new learning occurs along an entirely different trajectory, including search, discovery, experimentation, risk taking and innovation, while exploitative learning implies that the learning occurs along the same trajectory as the old one, including refinement, choice, production, efficiency, implementation, and execution (Cheng & Van de Ven, 1996). To sum up, the above discussion highlights that both exploratory activities and exploitative activities include at least some amount of learning.

Recently, some researches have found that exploratory learning and exploitative learning affects new product introduction and NPD (e.g., Atuahene-Gima & Murray, 2007; Katila & Ahuja, 2002). In the context of the NPD team, exploratory learning activities refer to the learning from technological and market information, which are far beyond the current experiences of the firm, had an ill-defined solution space in problem solving and implementation of solutions. In contrast, exploitative learning activities refer to the learning from limited and well-defined technological and market solution space that relate to the firm's previous experience to ensure efficiency and implementation of solutions. To date, more importantly, few, if any, studies have discussed whether these two activities are viewed as competing or complementary aspects of organizational behavior in the context of a NPD project. In general, it is undoubted that a project team has the pressures of new product introduction; and ad interim, it has some restraints on limited resources, such as budget, time, and organizational routines and capabilities. For instance, NPD must be completed within pre-planned time. Sometimes, the time allowed is so short that exploitative learning is more available to the NPD team than the exploratory learning due to the complexity of adopting new techniques. In contrast, when the completion time is long enough for the NPD team, the exploratory learning can be adopted and increasingly executed. Given the above discussion, this study considers exploratory learning and exploitative learning at the single team level to be two ends of a continuum that compete for scarce resources (Gupta et al., 2006). In other words, more resources assigned to exploratory (exploitative) learning imply fewer resources left over for exploitative (exploratory) learning in the context of a single project.

2.2. Effect of exploratory and exploitative learning on NPD performance

A project team emphasizing exploratory learning activities may expand its ability to accommodate new variants of technological and market information into its product development process, and then, it may increase its distinct problem-solving competency (Levinthal & March, 1993). Moreover, exploratory learning also adds new variant elements to the project's repertoire, upgrading the probabilities for finding new useful combinations of problem-solving solutions. For instance, a team can use these new insights to generate emergent ideas and to form new and different alternatives for solving the problems of NPD and how these problems should be done. In other words, exploratory learning ensures that a new product team may contain emergent ideas that may differentiate the product or solutions from competitors' offerings and may challenge existing products (Katila & Ahuja, 2002), thereby resulting in radical and innovative products or problem-solving solutions.

However, extremely high levels of exploratory learning may possibly induce negative consequences, harming NPD performance. In general, most research recognizes that the exploratory learning associated with high new knowledge integration involves risks and costs (e.g., Bunderson & Sutcliffe, 2003; Edmondson, 1999; Levinthal & March, 1993), which results in plenty of unfamiliar insights along with project members being confronted with higher inefficiencies in problem solving. In addition, based on an evolutionary argument (Van de Ven & Poole, 1995), excessive exploratory learning may generate more variation that can not be effectively assimilated. For instance,

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