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Investigation and validation of technological learning versus market performance

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Abstract

This paper details a journey of discovery for conceptualizing, identifying, documenting and validating instances of higher-order learning, its nature, as well as its content, process, context and impact. The authors are engaged in a multi-industry, longitudinal, empirical study to investigate the relationship between technological learning activities and firm market performance. This relationship is postulated to vary under specific firm, market and industry conditions, so that the effects of learning can enhance or limit market performance, emerge over different periods of time, and require varying levels of investment.

For this paper, we conduct a pilot study using a preliminary sample of 19 firms from four industries over a period of twelve years as a pilot study for a broader analysis of approximately 100 firms in these industries covering 25 years. The empirical analysis in this pilot study shows little evidence of a relationship between technological learning and market performance; however, the lack of evidence is due to the crude nature of the measures used and the limitations of available data. A more comprehensive research design is proposed which will provide a better test of the relationship. © 2000 Elsevier Science Ltd. All rights reserved.

Keywords: Strategic technology management; Higher order technological learning; Firm performance; Competitive advantage

1. Introduction

Existing work on a theory of the firm, especially for understanding the strategic implications of the nature of the firm, tends to be constrained along two dimensions. First, theories tend to be static, analyzing the nature of a firm and its competitive position at a given point in time. Second, these theories tend to emphasize homogeneity, meaning that firms are treated as generally functioning in the same way, with variations in performance attributed to subtle differences in conceptual constructs not readily apparent (such as organizational culture, managerial talent, “core competences”, and knowledge).

Further extensions to the theory of the firm need to challenge the static, homogeneous approach, and move towards the creation of a theory of the firm that accommodates the dynamic and heterogeneous nature of firms.

Some recent works include a greater focus on dynamism and differences in firms as key determinants of competitive advantage (Porter, 1991); examples include the development of the “dynamic capabilities” theory (Teece et al. 1992, 1997), attempts to identify the differences among firms with greatest strategic significance (Nelson, 1991), and how the particular nature and environment of firms, especially in high-technology fields, leads to a new basis of competition and competitive advantage in those firms (Granstand, 1998). Competitive advantage in these industries is not based simply on the construction of barriers to entry or the establishment of market dominance, as the hypercompetitive environment of high-technology industry renders such advantages only temporary (D’Aveni, 1994). Instead, competitive advantage is derived from the ability to develop and commercialize new technologies more rapidly than other firms, by promoting and facilitating the creation and dissemination of technological and organizational innovations. In this environment, strategy becomes “a series of quests for the next technological winner” (Arthur, 1996).

A promising path towards the evolution of this new

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theory of the firm is to focus on the role of organizational learning in competitive advantage (Edmondson and Moingeon, 1996). This choice of research focus is supported by the more recent examination of the nature of knowledge, and how the acquisition and integration of knowledge leads to the development of new competences through organizational transformation (Nonaka and Takeuchi, 1995; Spender, 1996). These processes of knowledge-based transformation are organizational learning activities. The result of improved organizational learning is enhanced “strategic flexibility” (Sanchez, 1993), meaning that the firm faces a greater range of potential options for action which can then be leveraged to achieve a better fit to its competitive environment. Such a view of organizational learning is analogous to the general concept of learning advanced by Huber (1991): “An entity learns if, through its processing of information, the range of its potential behaviors is increased” (p. 89). Thus, a learning-based theory of the firm would advance our understanding of the dynamic construction of competitive advantage by

...focusing on the ways that organizations and the people therein generate, process, and alter their explicit knowledge and tacit skills, as well as the paths of change that such styles of organizational cognition can follow...and [thereby] create questions and motives for further research on the dynamics of the creation and evolution of firm core competencies. (Carayannis, 1994b).

In this paper, we address a specific broad area of organizational learning, which we term **technological learning**. Technological learning (TL) is defined as the process by which a technology-driven firm creates, renews, and upgrades its latent and enacted capabilities based on its stock of explicit and tacit resources (Aaker, 1989; Amit and Shoemaker, 1993; Bahrami and Evans, 1989; Barney, 1991; Carayannis, 1993, 1994a,b; Morone, 1989). It combines both technical and administrative learning processes.

2. Literature review and conceptual foundations

This research integrates three streams of literature relating to organizational learning, strategic management, and technology management, to create an empirical model for detecting and measuring organizational learning activities and connecting them to changes in firm performance. This model should suggest how learning can lead to new insight about a theory of the technology-based firm (Granstand, 1998).

2.1. Organizational learning literature and strategic advantage

The field of organizational development now includes an emphasis on the need to create a “learning organization” to increase the efficiency and effectiveness of a company (Senge, 1990). Preliminary efforts have been made to delimit and explore the intersection of the microeconomic understanding of the organizational dynamics of learning contributed by the organizational development perspective and the macroeconomic analysis by strategy researchers on how learning enables firms to develop the basic elements of competitive advantage (Edmondson and Moingeon, 1996).

Early research on organizational learning focused most substantially on attempting to describe learning processes in organizational settings, without necessarily assigning a normative value to learning (cf. March and Simon, 1958; Cyert and March, 1963; Nelson and Winter, 1982; Levitt and March, 1988). Learning as an organizational activity is perceived as an integration of individual efforts and group interactions. Thus, organizational learning becomes a process embedded in relationships among individuals; some authors argue that organizational culture is the outcome of shared learning experiences. More recent research applies the findings of descriptive analyses of organizational learning to identify the improvement of organizational learning (Senge, 1990; Ciborra and Schneider, 1992), under the presumption that firms which are better at organizational learning will perform better than others in the market.

Learning on its own may not qualify as a source of competitive advantage, as there are varying degrees to which learning contributes to firm performance. As noted by Huber (1991), “Entities can incorrectly learn, and they can correctly learn that which is incorrect”. Ineffective or inappropriate learning processes can erode firm competitive advantage if they lead to “competency traps” or “superstitious learning” in the language of Levitt and March (1988). Even effective learning processes can be undermined by changes in market and environmental conditions which render them irrelevant, or worse, damaging to firm performance. Thus, learning activities can change from core competencies to core rigidities (Leonard-Barton, 1992). This again emphasizes the need for organizations to be able to identify learning which enhances strategic advantages versus those which destroy advantages.

2.2. Strategic management literature and learning-based advantages

The field of strategic management is dedicated to the explanation of differences in firm performance, and further to the understanding of how to replicate conditions which lead to improvements in performance. As

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