Innovation Strategies

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**Abstract**
A firm’s innovation strategy can be described as a vector of firm choices spanning the domains of technology development and commercialization. Within this area, we review the main research contributions concerning key choices such as the decision to conduct research, research intensity, the allocation of research dollars between basic research, applied research and development, the organizational locus of research activities, the geographical locus of research activities, the nature of technologies targeted, the breadth of technologies worked on, the knowledge management strategy employed, the value appropriation strategy pursued by the firm and the mode of technology commercialization. Many of the decisions entail trade-offs with each other or with other decisions of the firm, and the goal of innovation strategies in for-profit firms is to identify and execute the configurations of those choices that maximize firm value. Innovation serves as a key basis for value creation and competitive advantage, and innovation strategies represent significant investments for firms, especially in technology-intensive industries.

**Definition and Relevance**
A firm’s innovation strategy can be described through a vector of firm choices spanning the domains of technology development and commercialization. The choices faced by firms in these domains include the decision to conduct research (e.g., develop rather than imitate), research intensity, the allocation of research dollars between basic research, applied research and development, the organizational locus of research activities, the geographical locus of research activities, the nature of technologies targeted, the breadth of technologies worked on, the knowledge management strategy employed, the value appropriation strategy pursued by the firm and the mode of technology commercialization. Many of the decisions entail trade-offs with each other or with other decisions of the firm, and the goal of innovation strategies in for-profit firms is to identify and execute the configurations of those choices that maximize firm value. Innovation serves as a key basis for value creation and competitive advantage, and innovation strategies represent significant investments for firms, especially in technology-intensive industries.
The Dimensions of Innovation Strategies

The Decision to Conduct Research
Firms may choose not to engage in research, and instead simply imitate the innovations created by others to create saleable goods and services. However, the ease and profitability of imitation varies according to factors such as the modularity of the focal innovation, the complexity or tacitness of the underlying technology, specificity in a firm’s skills and causal ambiguity (Lippman and Rumelt 1982; Reed and Defillippi 1990). Pre-emption of scarce resources, development of brands, switching costs or accumulated expertise by innovators may make imitation not just less feasible but also less profitable (Lieberman and Montgomery 1988). Further, imitation may not be effective without some investments in research (Cohen and Levinthal 1990).

Research Intensity
Conducting research is costly; however, underinvesting in research may lead to insufficient innovation and loss of competitive position. Key antecedents of research intensity include the level of technological opportunity (Cohen and Levin 1989), liquidity (Grabowski 1968), the debt position of the firm (Smith and Warner 1979), industry concentration and organization size (Scherer 1980; Kamien and Schwartz 1982), the source of financing (Long and Ravenscraft 1993), the level of fragmentation of property rights (Clark and Konrad 2008), the composition of the top management team or board (Kor 2006) and the current performance of the firm (Greve 2003; Chen and Miller 2007).

The Allocation of Research Effort
Basic research, applied research and development represent alternative destinations for research investments and can be distinguished through (a) the ex ante clarity with which the goals of the project itself are defined (Nelson 1959), and (b) the ex ante uncertainty about the results of the research project. The outcomes of the research process may not be helpful in distinguishing between the two as applied research has on occasion led to fundamental and general scientific discovery (Nelson 1959; Rosenberg 1990). There is also a contradiction between the high social benefits of basic research and private profits (Nelson 1959; Pavitt 1990; Rosenberg 1990).

Development can be defined as the application of the scientific knowledge created in the first stage of R&D (Rosenberg and Steinmueller 1988), for example through products. Effective communication and sharing of internal and external knowledge within the organization (Clark and Fujimoto 1990; Iansiti and Clark 1994; Hoopes and Postrel 1999) and a consistency between the organizational structure, technical skills, problemsolving processes, culture and strategy (Clark and Fujimoto 1990; Brown and Eisenhardt 1995) are key to successful product development.

The Organizational Locus of Research Activities
Firms can vertically integrate R&D activities or use contractual arrangements such as licensing, strategic alliances or contracted research (Arora and Gambardella 1990; Pisano 1990; Ahuja 2000; Dushnitsky and Lenox 2005). Conducting R&D internally protects firms better against knowledge leakage (Pisano 1990), and potentially offers an ability to tightly target research to their strategic needs and their customers’ preferences (Helfat 1994); however, it may lead to higher expenditure and risk and constrain the firm to operate with a limited portfolio of knowledge, resources and capabilities (Argyres 1996; Ahuja and Katila 2001; Fleming 2001). The source of R&D also affects the use of the knowledge within the organization (Katz and Allen 1982; Menon and Pfeffer 2003). Research also suggests complementarity among external sources of R&D (Arora and Gambardella 1990) and between internal and external sources (Cohen and Levinthal 1990; Cassiman and Veugelers 2006).

The Geographical Locus of Research Activities
Knowledge often leaks from its source. Such spillovers are often localized and lead to the development of differentiated clusters of knowledge (Jaffe et al. 1993, vs. Thompson and Fox-Kean 2005; Thompson 2006). To benefit from such spillovers or to tailor products to target markets firms may
disperse their R&D locations. The spatial proximity effect on spillovers is moderated by factors such as social proximity (Audretsch and Stephan 1996; Agrawal et al. 2008), the interaction between spatial and social proximity (Gittelman 2007); individuals’ characteristics (Almeida and Kogut 1997; Zucker and Darby 1997), knowledge characteristics (Caballero and Jaffe 1993), firm characteristics (Feldman 1994) and network structure (Fleming et al. 2007). The geographical dispersion of a firm’s R&D activities (Singh 2005, 2008) as well as the location of these activities within the organizational structure (Van den Bulte and Moenaert 1998; Argyres and Silverman 2004; Alcacer 2006) can impact on firms’ innovation performance.

The Nature of Technologies Targeted
Innovation strategies may target the development of technologies that solve contextual techno-economic problems (i.e., specific technologies) versus technologies that solve broader classes of problems (i.e., general technologies), (Bresnahan and Trajtenberg 1995; Bresnahan and Gambardella 1998). More general technologies benefit firms in the context of high uncertainty by helping them to enter new product markets (Novelli 2010).

Targeted technologies may be simple or complex (Zander and Kogut 1995; Singh 1997), with the latter being more difficult to imitate (Macmillan et al. 1985) but involving higher failure rates, degradation in performance if even a few interdependences are ignored (Singh 1997), and leading to difficulties in subsequent innovation by the focal firm (Kogut and Zander 1992; Sanchez and Mahoney 1996; McEvily and Chakravarthy 2002). Firms can target incremental innovations, wherein they focus on making minor improvements in existing technologies, or they can target breakthrough innovations which lead to new technological trajectories and paradigms and replace existing technologies (Tushman and Anderson 1986; Henderson 1993; Ahuja and Lampert 2001).

Innovation strategies may also vary by targeting component versus architectural innovations (Henderson and Clark 1990), or targeting sustaining versus disruptive innovations (Christensen 1997). Architectural innovations preserve the usefulness of the knowledge about the products’ components but destroy the usefulness of the extant knowledge on how the components are related. Disruptive technologies are technologies that, despite their inferior performance on focal attributes and unsuitability for mainstream markets, eventually displace the mainstream technology from the mainstream market (Christensen 1997; Adner 2002).

The Breadth of Technologies Worked On
Firms may focus narrowly on a single technological domain or broadly on technologies in multiple areas. Technological diversification may help firms improve their ability to deal with suppliers, introduce special features into products (Argyres 1996; Granstrand et al. 1997; Gambardella and Torrisi 1998; Brusoni et al. 2001), expand their opportunities to tap into new product markets (Kim and Kogut 1996; Silverman 1999), and enable development of more general technologies by stimulating greater abstraction through induction (Novelli 2010). Although technological diversification requires superior R&D coordination (Argyres 1996), it can affect performance positively (Nesta and Saviotti 2005; Garcia-Vega 2006) under certain circumstances such as underlying coherence (Steinneman et al. 2007).

The Knowledge Management Strategy Employed
An effective knowledge management system allows firms to store, update and retrieve organizational knowledge, and deters its erosion through individual forgetting, misplaced manuals and personnel turnover (Argote et al. 1990; De Holan and Phillips 2004). Knowledge management strategies vary in that some rely on embedding knowledge in organizing principles and routines (Kogut and Zander 1992) while others lay out the fundamental tenets at the basis of the firm’s knowledge and articulate them through collective discussions, debriefing sessions and performance evaluation processes (Zollo and Winter 2002). Knowledge management practices can also be distinguished on the basis of whether they rely
on the creation of formal archives (e.g., electronic archives) and retrieval systems or whether they rely on people-centred practices of knowledge sharing and social interaction within the organization (Walsh and Ungson 1991).

The Value Appropriation Strategy Pursued by the Firm
Firms use strategies such as patents, secrecy, control of complementary assets, to protect their innovations from imitation, though the effectiveness of using these mechanisms is contingent upon environmental factors, such as the strength of the appropriability regime, the stage of the industry lifecycle and the characteristics of the industry (Teece 1986; Levin et al. 1987; Cohen et al. 2000).

The Mode of Technology Commercialization
To monetize their research investments firms can embody their technologies in products they manufacture and sell (Teece 1986), ally with a partner who provides access to the complementary assets required (Mitchell and Singh 1996) or they can commercialize the technology in disembodied form through licensing (Teece 1986; Arora et al. 2001). The appropriateness of a given mode is contingent on firm characteristics (e.g., the ability to continuously produce innovations, ownership of supporting assets) and on the characteristics of the environment in which the firm operates (e.g., the strength of the IP regime, level of transaction costs).

See Also
► Absorptive Capacity
► Basic Research
► Geography of Innovation
► Innovation
► Knowledge-Based Strategy
► Management of Technology
► Research and Development
► Technology Strategy

References


