



The business model dilemma of technology shifts



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ABSTRACT

Technology shifts are lethal to many manufacturing companies. Previous research indicates that this is not purely a problem of technological innovation, but is also closely related to the inertia of business models and business model innovation. This paper inquires into the dynamics of this intersection between technology and business models. Anchored in a case study in the automotive industry, it reveals how a potential technology shift constitutes a business model dilemma for firms leading in the existing technology. The paper illustrates why technology shifts are so difficult to master and contributes to theory by suggesting that managing technology shifts does not require either technology or service innovation in order to create a viable business model, but instead a compound of both. Furthermore, the paper applies a business model perspective to illustrate the explanatory power of analyzing the challenges of technology shifts faced by incumbent firms.

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1. Introduction

Technology shifts are among the most lethal threats to any successful business. Many historical accounts tell of companies for which the technology that once constituted their competitive advantage eventually became their primary drawback. There are several ex post explanations of the causes of such failures (Arthur, 1989; Foster, 1986; Utterback, 1994). Although some firms have overcome these Schumpeterian winds of creative destruction, it seems profoundly difficult for a mature company facing a potential technology shift to identify the causes of failure and the strategies for success in advance (Abernathy and Clark, 1985). From a managerial point of view, the fundamental question still remains unsolved: Why are these shifts so difficult to manage?

Innovation research generally suggests two alternative strategies: either investing in R&D to radically transform the firm's technological core competence (Cusumano and Rosenbloom, 1987), or transforming the firm's value proposition embedding the product in functional sales and product service systems (Vandermerwe and Rada, 1988). The first strategy entails investing in R&D to gain competitive advantage through a stronger technological position, but with a different technology creating the value (Adler, 1989). The second strategy entails forward integration and expanding the value proposition to include a broader scope than a specific core technology (Baines et al., 2009; Mont, 2004).

However, for a company facing a technology shift, both these strategies suffer from inherent uncertainties. The technological innovation strategy enhances successful technological change, but risks creating an obsolete value proposition due to new, emerging customer demands. The “servitization” strategy enhances the company's ability to match the value proposition with customer demands, but creates the risk that the company may lose its technological competitive edge.

This paper examines the *business model dilemma* of mature manufacturing companies facing a potential technology shift. Several empirical studies have demonstrated that it is profoundly difficult to exchange one core technology for another (Dosi, 1982; Leonard-Barton, 1992; Utterback, 1994), and awareness is growing that the fundamental challenge of this process is “a business model problem, not a technology problem” (Christensen, 2006: 48). Anchored in a case study of a potential technology shift in the automotive industry, this paper takes this line of reasoning one step further. Using the case as an illustrative example, the paper inquires into the dynamics of the intersection between technology and business models. It reveals why technology shifts are so difficult to master and suggests that discontinuous innovation is not about *either* technological innovation *or* service innovation in order to gain a viable business model, but is instead a compound of both. The critical challenge for a company facing a technology shift is overcoming the technology shift as such, while simultaneously crafting a business model matching the unknown competitive context after the shift.

The paper is structured as follows. The next section outlines the paper's theoretical foundations in the literature on technology shifts, servitization, and business models. We then describe the

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methodological approach taken and how the data were gathered and analyzed. The following sections outline and analyze the case of two incumbent premium truck manufacturers facing a probable technology shift to electric road systems (ERS), a technology that might make the current technological regime of the internal combustion engine obsolete. The paper concludes by discussing the business model dilemma of today's truck manufacturers and suggests business model analysis as a useful way to further explore the dynamics of technology shifts. Finally, implications for research and practice are suggested.

2. Theoretical foundations

In theory, there is a classical distinction between incremental and radical innovation (Schumpeter, 1939). Incremental innovation is competence enhancing and aligned with the progress of the current technological paradigm, while radical innovation tends to destroy competence and lead to a paradigm shift (Abernathy and Clark, 1985; Dosi, 1982). Technological discontinuities are innovations that dramatically advance an industry's price or performance frontier (Anderson and Tushman, 1990). A discontinuous technological change might make the existing technology obsolete and significantly affect the "firm's existing investments in technical skills and knowledge, designs, production technique, plant, and equipment" (Utterback, 1994: 200).

Throughout history, successful firms have often experimented with new technologies to forestall their replacement by new firms (Tushman and O'Reilly, 1996). While some firms in mature industries have successfully managed this transformation (cf. Bergek et al., 2013), research has demonstrated many examples of how incumbent firms encounter severe difficulties when facing radical technology change (Foster, 1986; Utterback, 1994; Tushman and O'Reilly, 1996). Established firms tend to focus too much on their existing customers, and consequently do not allocate resources to develop new technologies perceived as less profitable or under-performing (Christensen and Bower, 1996; Sandström, 2010). However, if these new technologies develop, new entrants tend to outcompete established firms, which often fail to respond in time to the threat from such disruptive innovations (Christensen, 1997). In such a situation, the established firms' core competencies become their core rigidities (Leonard-Barton, 1992).

There are several possible responses to discontinuous innovation, for example, focusing on and increasing investments in the established business, ignoring the innovation, or disrupting the discontinuity by counterattacking (Charitou and Markides, 2003). Firms can also be ambidextrous, developing both radical and incremental innovation at the same time (Gibson and Birkinshaw, 2004; Tushman and O'Reilly, 1996), or search for radical technologies exogenous to the focal industry (Datta and Jessup, 2013). According to the innovation literature, the classical approach is to invest in technological R&D to gain competitive advantage through establishing a leading position in the new technology. However, few empirical studies explore such R&D strategies among incumbent companies facing disruptive technological change (Yu and Hang, 2010, 2011).

Servitization is an alternative strategy, recently discussed in innovation theory. Instead of investing in technological R&D, targeting innovation in the value-creating technology, this strategy emphasizes innovation in the value proposition offered the customer (Barnett et al., 2013; Ng et al., 2012). An emerging research discourse examines servitization, but most servitization research has so far not considered discontinuous innovation. The following sections will describe technological innovation strategy, servitization strategy, and then business models as analytical tools for

understanding the strategic challenge of firms facing technology shifts.

2.1. Technological innovation strategy and servitization strategy

A company can benefit from a technological innovation strategy in several ways, by creating barriers and controlling premium market segments (Porter, 1985), pioneering new markets (Lieberman and Montgomery, 1998), establishing industry standards and dominant designs (Abernathy and Utterback, 1978), and building favorable market reputations (Zahra, 1996). The underlying message is to gain competitive advantage through investing in R&D, technology, and product development (Utterback, 1994), implying a competitive strategy with technology leadership as the main driver (Porter, 1985).

The technological innovation literature usually assumes that the value-creating technology constitutes the firm's core competence (Prahalad and Hamel, 1990). Despite having been heavily questioned (e.g., Cantisani, 2006; Chesbrough, 2003; Kline and Rosenberg, 1986), the general notion is that new technologies are initially developed internally and then brought to a market in which demand already exists or will be created (Brem and Voigt, 2009). The objective is to make commercial use of new knowledge; if successful, this entails an application push on the market, created by a technical capability of the firm; if unsuccessful, this entails developing new technological attributes unwanted by customers or already invented by somebody else (Brem and Voigt, 2009). Hence, the spheres of potential new technologies and of customer demand factors need to be adjusted into mutual alignment. In practice, this is more easily said than done. One suggested management approach is a technology portfolio planning process enabling decisions on how to allocate strategic resources to different technological alternatives based on different future scenarios (Chen et al., 2009; Yu, 2006).

An alternative strategy to technological innovation is to transform the firm's value proposition by climbing the value chain, embedding the technology in a value proposition of functional sales and product-service systems (Baines et al., 2009; Mont, 2002). Following the increasing significance of services, such manufacturing firm servitization (Vandermerwe and Rada, 1988) has attracted increasing research attention (Santamaría et al., 2012). Attention has shifted from the role of the product itself to the function it provides for its users (Giarini and Stahel, 1993), addressing the need to sell systems encompassing combined products and services (Mont, 2002; Tukker and Tischner, 2006). By aligning technology with the service offering, this servitization strategy presents a way for traditional manufacturing firms to differentiate themselves and achieve competitive advantage. Consequently, by adhering to the functionality of the value proposition for the customer, the company can—at least in theory—liberate itself from the specifics of the product's technology (cf. Oliva and Kallenberg, 2003).

The servitization literature has focused primarily on the value proposition of firms based on an underlying core technology (Gebauer et al., 2005; Ng et al., 2012). However, although some studies indicate that disruptive innovation may present opportunities to generate new services (Godlevskaja et al., 2011), this has not been validated by empirical research. Instead, the empirical cases often cited, for example, that of Rolls-Royce (Ng et al., 2012), are based on the premise of a permanent and stable core technology around which the services are created (Baines et al., 2009). Few empirical studies address the servitization of manufacturing companies in the context of a technology shift, in which the role of the core technology is diminished (e.g., the empirical ERS case examined here).

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