Effectively enacting disruptive technological change: Insights from an incumbent firm engaged in developing the ADSL architecture.

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Extended Abstract of Paper Submitted to HTSF Conference

University of Twente,
Enschede June 2010

Introduction

Disruptive technological change remains a challenge for incumbent firms. The conflicting demands stemming from focus and commitment on the one hand and experimentation and flexibility on the other hand remain difficult to reconcile.

Different solutions have been advanced to address this 'innovative dilemma', including the creation of separate entrepreneurial ventures (Bower & Christensen, 1995; Burgelman, 1983; Christensen & Overdorf, 2000) or the adoption of organizational structures of an ambidextrous nature (O'Reilly & Tushman, 2004, O'Reilly & Tushman, 2008).

At the same time, questions remain to what extent current theorizing provides a satisfactory account on how to deal with disruptive technological change effectively within the boundaries of an incumbent firm. Like outlined by Van Looy et al. (2005), sustainability of ambidexterity requires spillovers between different activities; how to reconcile such requirements with a strict separation between exploration and exploitation oriented activities – as advanced by O'Reilly and Tushman (2004, 2008) - remains unclear.

Within this contribution we want to add to our understanding of how and when large established firms can be effective when confronted with disruptive technological change by examining the trajectory of an incumbent firm (Alcatel) in the telecommunication industry that has been successful in exploring and exploiting the promises of broadband access technology.

Methodology

We engaged in an analysis of the events leading to the successful development[1] (and deployment) of the ADSL architecture within a large multinational telecommunication firm by adopting a longitudinal case study design (Pentland, 1999; Pettigrew, 1990). Data have been collected by means of semi-structured interviews (n=+/- 25) and document analysis for the time period 1986-1996. Document analysis included both internal documents (e.g. minutes of relevant meetings, strategy documents (n> 1500) and external documents (press releases, technology and industry reports, patent documents and scientific publications). Figure 1 and 2 provide an overview of major evolutions. Figure 1 depicts the amount of patent activity and major events related to the development of ISDN and ADSL technology based on patent data and technical and industrial reports. Figure 2 provides an overview of strategic themes pursued by the incumbent firm as identified by means of a content analysis of internal documents (annual corporate reports)

Findings

In the first period of the time frame under study (1986-1990), the incumbent firm focused on the development and commercialization of an ISDN oriented infrastructure (ISDN: Integrated Services Digital Network) which allows data transmission within the existing telecom infrastructure designed for the transmission of voice (the plain old telephone system or POTS).

[1] Above 50% market share figures in 2000 demonstrate the success of the firm (M2Presswire, 2000).

Within that time period, new technological platforms (including coax and optical fiber) emerged which promised superior data transmission capacity and by doing so, would enable totally new market applications, e.g. the delivery of video on demand (VOD). VOD was perceived to be the killer application, requiring more capacity than could be provided by ISDN. As a result the emerging technological platforms (coax and optical fiber) started to introduce a disruptive 'threat' for the existing telephone systems[2]. Confronted with these developments in the early 1990s, the incumbent firm did not opt for a separate, entrepreneurial venture that would focus on exploring these new developments. Rather, a multitude of competing technological platforms were explored and developed within one and the same research unit (including fiber, coax, and copper based product architectures).

Amongst these competing technologies, fiber was initially perceived as superior, as it enabled the fastest data transmission. ADSL on the other hand turned out to be more cost effective as it allows for the simultaneous transmission of digital data and voice over the existing twisted copper pair (Reusens, et al., 2001). The initial idea of ADSL dates back to 1979 (see figure 1) when Cioffi first introduced computations that suggest more capacity by using copper wire, and the early 1980s when Lechleider advanced asymmetry as an additional way to increase capacity (of copper based digital subscriber lines). Only in the early nineties, this possibility was taken seriously by the incumbent firm when several people within the central research department become knowledgeable of the outcomes of experiments undertaken by Bellcore (US) that confirmed the growth potential of copper wires combined with DSL technology[3].

Figure 2 further clarifies these dynamics by mapping the strategic themes within the incumbent firm (based on a content analysis of the incumbent's annual accounts in which future strategic directions are being discussed, time period 1986-1996). The figure shows the initial focus on ISDN, which eventually turned out to be insufficient for the perceived killer application VOD. As a result, the incumbent shifts attention towards fiber, coax and ADSL; these technologies however only become an explicit strategic theme from 1993 onwards.

As explained, ADSL turned out to be the most cost-effective and gradually emerged as the most promising technological platform within the incumbent. The initial perceived killer application VOD fades rather quickly (due to various technical reasons while also content players turned out to be reluctant to engage in cost effective license agreements) to become replaced by the subsequent growth of internet traffic which emerges as the new engine behind market demand.

These developments result in the creation of a dedicated 'virtual unit' geared towards the exploitation of ADSL situated within the boundaries of the existing firm in February 1996. The entrepreneurial team steering these developments, opted from the start to design ADSL in a modular way. Rather than integrating ADSL functionality within the existing switching products, a modular technological architecture was perceived as instrumental to speed up market development. The modular design implied that ADSL functionality could be offered independent of customer's historical choices or (current) preferences with respect to switching equipment.

Furthermore, within this 'virtual' unit, autonomous decision making authority- on the level of the product architecture, pursued business model and market development initiatives – was combined with a redeployment of resources and capabilities stemming from other parts of the

[2] Which relied heavily on copper wires and focused on voice transmission (for an overview of different technological platforms, see Ginsburg, 1999; Goralski, 2002; Reusens, et al., 2001; Van der Plas, Smets, Suard, & Verbiest, 1995)

[3] Alcatel engaged in a formal R&D collaboration with Bellcore in 1989.

organization, including the integration of ATM technology and the mobilization of hardware development capabilities. Stated otherwise, spillovers and complementarities - beyond the boundaries of the 'virtual unit'- are actively being pursued and result from the interplay between bottom-up entrepreneurial initiatives and supportive senior management decision making processes. This combination of entrepreneurial dynamics and the effective mobilization of corporate resources allowed the firm to create an integrated and scalable product architecture that outperformed competing offers and paved the way for effective market exploitation.[4] As a result, the incumbent firm was able to attain a contract with four Regional Bell Operating Companies (RBOCs) in the United States in 1996, enabling a breakthrough on the US market, followed by commercial success on a global scale.

Discussion – Preliminary conclusions

Analyzing the chronological case reveals several key findings that inform the current debate on how to organize 'radical' innovation within incumbent firms effectively.

First, Alcatel systematically invested in researching a broad variety of – at least partly competing – technological platforms notwithstanding the presence of a strategic focus favoring one (or a limited number of) technology platforms only. The portfolio of research projects addressing this variety of technological platforms was situated within one and the same central research unit; besides relying on internal R&D efforts, Alcatel systematically scouted its environment and engaged in R&D alliances with a variety of partners. While research ideas usually are being transferred to business units upon entering the development phase (after proof of concept or a first prototype has been delivered), a deliberate choice was made to create a separate, virtual, venture structure in order to develop the ADSL architecture ('virtual company'). This structure was considered more adequate in terms of ensuring sufficient levels of entrepreneurial dynamics. Such dynamics were considered critical as one is competing in a newly emerging field populated not only by larger incumbent firms, but also with smaller technology based entrepreneurial firms. Recent experiences on the market development efforts pertaining to ATM – undertaken by the Switching BU – reinforced this viewpoint.

While this virtual structure guaranteed considerable degrees of freedom (autonomy) on the level of business model choices, product design and marketing strategy, sourcing of critical resources/capabilities within the broader organization turned out to be as characteristic for the VC. As such the boundaries between the virtual company and the established organizations are of a semi-permeable nature. The entrepreneurial dynamics that unfold within this virtual company do resemble the ICV processes documented by Burgelman (1983), both in terms of combining bottom up, entrepreneurial dynamics with senior management support. In addition, technological design choices engrain organizational (entrepreneurial) practices and vice versa. This interplay between technological design and organizational dynamics manifests itself twofold: a) the choice for a modular ('stand alone') architecture results from and enables entrepreneurial activity at the same time; b) arriving at an effective technological architecture - which merges existing technologies with novel developments - only has been achieved by adopting an organizational design which combines entrepreneurial dynamics with corporate sourcing. Hence, neither complete separation, nor an organizational design of an ambidextrous

[4] A joint procurement consortium (JPC) formed by four regional bell operating companies (RBOCs) in the United States selected the multinational telecommunication firm as the supplier for ADSL equipment (BusinessWire, 1996).

nature accounts for the observed dynamics in a satisfactory manner. Rather, our findings substantiate the ingredients of hybrid or quasi-structures characterized by the simultaneous presence of entrepreneurial autonomy and the enactment of complementarities (Brown & Eisenhardt, 1997; O'Connor & DeMartino, 2006; Schoonhoven & Jellinek, 1990). Choices with respect to the technological architecture seem to be crucial in terms of constituting organizational and entrepreneurial dynamics within the boundaries of an existing firm.

Figure 1: Overview of major events and patent activity within the field of ISDN & ADSL

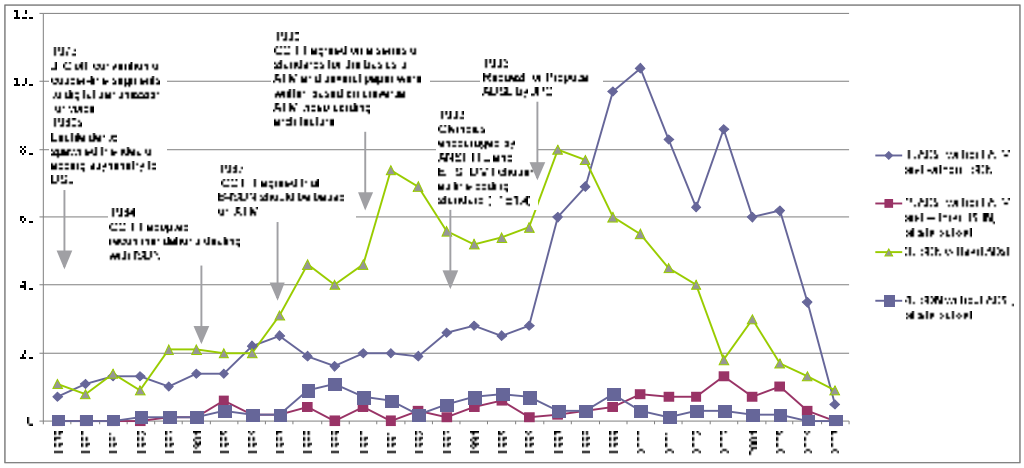
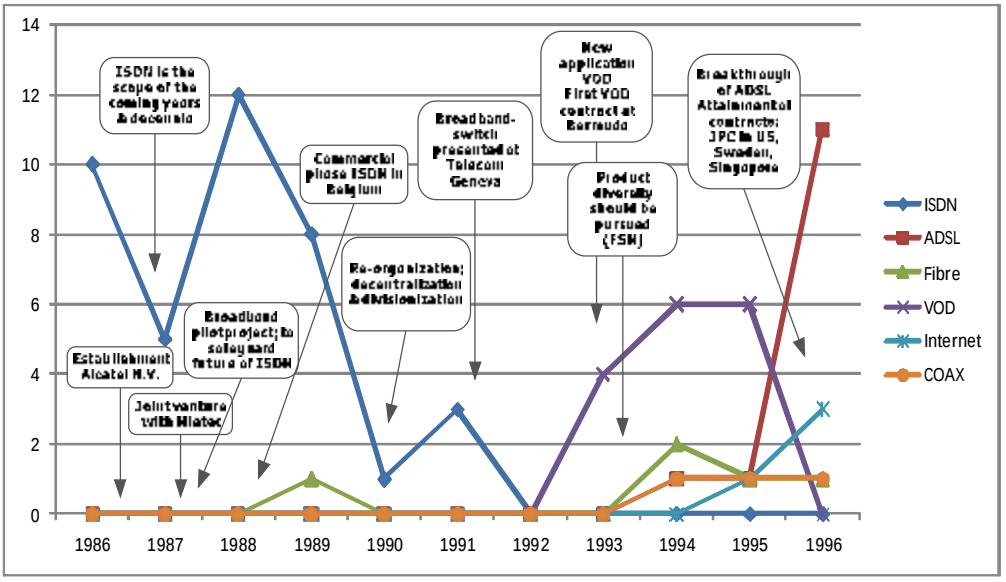


Figure 2: Strategic themes pursued over time by the incumbent firm: 'Technologies' and 'Market Applications'



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