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Structural ambidexterity and competency traps: Insights from Xerox PARC☆

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ABSTRACT

We investigate the organizational dysfunctions that can interfere with the implementation of structural ambidexterity as a dynamic capability. We find that these dysfunctions give rise to competency traps characterized by interlinked cognitive, organizational and behavioral dimensions, that can severely compromise structural ambidexterity. Further, from the perspective of network ambidexterity, we also find that the inventions of the explorative unit can be treated as external to the focal organization, mirroring the dynamics of portfolio resources found in the context of strategic alliances. Our findings extend understanding of organizational ambidexterity as a dynamic capability, in particular how competency traps can severely compromise ambidexterity; and how network-like effects can adversely shape intra-firm dynamics.

1. Introduction

Innovation is seen as a key means of growth, differentiation and performance; but the challenges and tensions involved, particularly under efficiency pressures, have made it a challenging capability to accomplish (Crossan and Apaydin, 2010). Organizational ambidexterity has been proposed as a way for organizations to accommodate the tensions arising from simultaneous exploration and exploitation. One dominant approach involves structural ambidexterity, where exploratory units are separated from the broader organization to allow them to align their competencies toward accomplishing innovation (Tushman and O'Reilly, 1996). Through structural separation, flexible 'innovative units' explore new areas for growth whereas more formal 'operational units' ensure efficient operations in the existing business (Benner and Tushman, 2003; O'Reilly and Tushman, 2004; Turner et al., 2013). This organizational design is prevalent in companies that seek to develop and support a new business (Raisch, 2008), and has been associated with increased levels of innovation and positive financial returns (Simsek, 2009; Uotila et al., 2009).

While we have broad directions about how ambidexterity can be pursued, we do not have a clear idea of how organizations implement these suggestions. "While theoretical concepts have been presented for balanced structures, much less is known about how organizations deploy and execute these solutions" (Raisch, 2008: 483). Further, ambidexterity can be seen as a dynamic capability that is challenging to develop (O'Reilly and Tushman, 2008; O'Reilly and Tushman, 2013). Organizational dysfunctions such as inertia or politics can derail the development of particular capabilities. Since most studies have focused on firms that have successfully implemented ambidexterity (Lavie et al., 2010; Stadler et al., 2014), a focus on how ambidextrous capabilities can be disrupted becomes potentially fruitful.

Further, a more recent focus of ambidexterity research is how firms aim to develop innovative capabilities via engagement with a broader network of firms, through strategic alliances (Kauppila, 2010; Stadler et al., 2014). Often there are tensions when firms attempt to integrate innovations originating from the network, in their own operations (Srivastava and Gnyawali, 2011). Stadler et al. (2014: 183) suggest that network theory can help us understand how structural ambidexterity can be more effective, by suggesting the creation of social ties as bridging mechanisms between explorative and exploitative units. Such a suggestion assumes that tensions between the explorative subsidiary and the parent organization could be in some way analogous to tensions between the network and a focal firm. If so, this analogy can shed light on the difficulties of integrating inventions originating in explorative subsidiaries with the exploitative operations. The above considerations point to the following research focus that guided our work: What are the challenges that can be faced when implementing structural ambidexterity?

In order to investigate this question we explore the case of Xerox and PARC, an exemplary case of structural ambidexterity where PARC accomplished exceptional inventions, but Xerox engaged in poor or no

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commercialization because of various organizational impediments (Chesbrough, 2002; Hiltzik, 2000). We find that these impediments take the form of particular competency traps (Levitt and March, 1988) that have underlying cognitive, organizational and behavioral dimensions can severely compromise the actualization of structural ambidexterity as a dynamic capability. One way these competency traps compromise ambidexterity is by creating potent barriers to senior managers' recognizing the potential value of, and commercializing, breakthrough inventions. Further, we find that the dynamics involved between the emergent technological resources developed at PARC and the established, dominant technological resources of Xerox mirror in important ways the dynamics found in the context of strategic alliances and networks across organizations (Srivastava and Gnyawali, 2011). In our focal case, rather than PARC's inventions being treated as an internal, corporate Xerox resource, they were treated as a resource emerging from an organization's broader alliance network; with all the attendant tensions of integration. This is an unexpected finding that underlies the potency of an organization's dominant logic (Bettis and Prahalad, 1995; Prahalad and Bettis, 1986) to discount and filter out even inventions that come from within a corporation.

2. Structural ambidexterity, dynamic capabilities and network theory

Ambidextrous organizations are defined as those able to compete by both exploiting their current capabilities and exploring new ones (Cao et al., 2009). Ambidexterity has been considered particularly relevant in conditions of environmental volatility and uncertainty as it helps firms maintain their strategic agility by being both aligned to the existing environment and adaptive to possible turbulence. This balance of exploration and exploitation has been associated with organizational adaptation and superior organizational performance over the long term, especially in knowledge intensive industries (Junni et al., 2013). Such a balancing act is applicable to a variety of organizational dimensions, such as ambidextrous product selling, that is selling both existing as well as new products that can enhance overall sales performance (Van der Borgh et al., 2015).

The concept of organizational ambidexterity was initially proposed by Duncan (1976) who suggested that organizations can switch between alternative structures to support the development and then commercialization stages of the innovation cycle. Most recent studies on ambidexterity are conceptually driven by March (1991: 71) who described exploration and exploitation as two fundamentally different activities, with exploitation associated with "refinement, efficiency, selection and implementation" and exploration with "search, variation, experimentation and innovation". The two processes are regarded as incompatible, requiring different capabilities, and entailing organizational tensions as they compete for scarce resources. Yet, March (1991) highlighted the need for a balance between the two for superior organizational performance.

Later work suggested that firms overemphasizing either exploration or exploitation risk falling into failure traps or success traps respectively (Levinthal and March, 1993). Such vicious circles have been described as "unproductive schismogenesis," a process of self-reinforcement where "one action or attribute perpetuates itself until it becomes extreme and therefore dysfunctional" (Cameron and Quinn, 1988: 6). Based on March's initial view of exploration and exploitation as two ends of a single continuum, trade-offs between the two activities have been seen as endemic. Therefore, the metaphor of ambidexterity - the capability of being equally dexterous in both exploration and exploitation activities - has been proposed as a way for organizations to manage these trade-offs (Cao et al., 2009).

A key pathway to manage these tensions is known in the literature as structural or architectural ambidexterity where organizations can simultaneously manage short-term efficiency and long-term growth through the structural separation of exploration and exploitation activities in different business units; each with their own alignments and capabilities (Tushman and O'Reilly, 1996). Ambidexterity here is seen as the ability to "simultaneously pursue both incremental and discontinuous innovation … from hosting multiple contradictory structures, processes, and cultures within the same firm" (Tushman and O'Reilly, 1996: 24). The recommendation of dual structures as a means of achieving ambidexterity is underlied by early work in the organizational design literature, in particular the notion of maintaining an alignment between organizational design on the one hand, and the demands of the task as well as the environment on the other (Duncan, 1976; Lawrence and Lorsch, 1967).

It is assumed that holding two distinct alignments, each with their own management team, processes, cultures, and incentive systems (Benner and Tushman, 2003), can enable organizations to maintain the necessary competencies for addressing both existing and emerging business opportunities (Gilbert, 2005). Indeed, an inability of top management to conceptualize and commit to different business models simultaneously in traditional and emerging businesses (as in the case of Polaroid's failure to compete effectively in the digital space despite having invested in digital technology development), has been cited as a key reason for inertia (Tripsas and Gavetti, 2000). Structural separation allows units focusing on innovation to operate away from the pressures of immediate results and short-term efficiency imposed on the main organization (Benner and Tushman, 2003; O'Connor and Demartino, 2006). O'Reilly and Tushman (2004) emphasize the role of the top management team as the "corporate glue" that holds the organization together. The authors underline the need for a common strategic intent, an overarching set of values, and targeted linking mechanisms that ensure that competencies of both exploration and exploitation are being leveraged in a coordinated way (O'Reilly and Tushman, 2004; O'Reilly et al., 2009).

Responding to the need for integration mechanisms between structurally separate units, further research has focused on the role of social and behavioral integration of the top management team in ensuring strategic coherence and balanced resource allocation (Lubatkin et al., 2006). Shifting the focus of integration to middle management, Jansen et al. (2009) argue for the use of cross-functional interfaces (such as liaison personnel, task forces and teams) as a means of enabling knowledge exchange within organizational units that focus on exploration or exploitation. Fang et al. (2010) further argue that exploration and exploitation can be successfully managed through semi-autonomous subunits with a small fraction of cross-group links such as inter-team liaison roles, personnel rotation or interdivisional task forces. This mixture of structural differentiation and integration aims to allow for both preservation of different types of knowledge and capabilities, as well as identification and exploitation of valuable synergies. Further literature has confirmed the importance of these integrative mechanisms (Carmeli and Halevi, 2009; Jansen et al., 2009), suggesting that the pursuit of structural ambidexterity could be to a large extent a leadership issue than simply a structural one (Jansen et al., 2008; Nemanich and Vera, 2009; O'Reilly and Tushman, 2011; Smith and Tushman, 2005).

Further, O'Reilly and Tushman (2008: 190) argue that "dynamic capabilities are at the heart of the ability of a business to be ambidextrous – to compete simultaneously in both mature and emerging markets – to explore and exploit". Such capabilities, following Teece (2007), include sensing and seizing opportunities, and reconfiguring the organization so that it can take advantage of these opportunities. Dynamic capabilities are based on particular organizational and managerial processes, asset positions, and historical choices that create path dependence (Teece et al., 1997).

More recently O'Reilly and Tushman (2013: 332) reaffirmed the fruitfulness of this perspective: "the appropriate lens through which to view ambidexterity remains that of dynamic capabilities".

However, the flip side of dynamic capabilities is competency traps (Levinthal and March, 1993). According to Levitt and March (1988:

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322) "a competency trap can occur when favourable performance with an inferior procedure leads an organization to accumulate more experience with it, thus keeping experience with a superior procedure inadequate to make it rewarding to use". Leonard-Barton's (1992: 118) concept of "core rigidities" provides a complementary perspective: "values, skills, managerial systems, and technical systems that served the company well in the past and may still be wholly appropriate for some projects or parts of projects, are experienced by others as core rigidities – inappropriate sets of knowledge." Leonard-Barton (1992) thus highlights that the same capabilities that made the company successful can become dysfunctional when the environment changes, or when new product development is pursued. The potentially inertial nature or dynamic capabilities becomes clearer when we consider that such capabilities can be seen as types of routines that involve learned behavior, tacit knowledge and repetition over time (Winter, 2003). Competency traps can therefore be deeply embedded in organizations, being constituted of cognitive, organizational and behavioral dimensions (Srivastava and Gnyawali, 2011).

Moving beyond the individual firm, research has pointed to inter-organizational networks and strategic alliances as sources of ambidextrous capabilities (Hughes et al., 2007; Kauppila, 2010; Stadler et al., 2014). It has long been recognized that one of the key benefits of participating in networks is learning benefits, that accrue from the transfer of information that can be synthesized and integrated into more complex capabilities (Podolny and Page, 1998). As Gulati et al., (2000) note, a firm's network and partnerships can be instrumental in helping the firm generate inimitable resources and capabilities. Benefits can vary depending on the type of networks a firm participates in, since networks can be characterized by different degrees of organizational interdependence and network durability (Heracleous and Murray, 2001). Lin et al. (2013) for example found that firms that combine the three attributes of intra-organizational learning, inter-organizational partnering (strategic alliances), and an open culture that facilitates learning, are effective in fostering innovation ambidexterity (simultaneous accomplishment of both incremental and radical innovation). Kauppila (2010) found that a focal firm accomplished ambidexterity through a combination of both strong and weak ties to explorative partners, weak times to exploitative partners, and the development of absorptive capacity. As Stadler et al. (2014: 183) note, structural ambidexterity can function more effectively via the use of social ties as bridging mechanisms between explorative and exploitative units, as suggested by network theory. This suggests that insights from research on networks and strategic alliances can shed light on the implementation of structural ambidexterity.

We investigated Xerox and PARC as an exemplary case of structural ambidexterity that resulted in fruitful exploration but poor exploitation, in order to gain insights to the pursuit of structural ambidexterity in practice. In particular we explored inductively the reasons for which Xerox (the exploitative operations) failed to commercialize many of PARC's (the explorative subsidiary) inventions that subsequently proved to be ground-breaking and fundamental to the information technology industry. We extend current understanding by showing how competency traps (Levinthal and March, 1993; Levitt and March, 1988) with underlying cognitive, organizational and behavioral dimensions can severely compromise ambidexterity. Further, and within a network ambidexterity perspective, we show how a corporate dominant logic can treat inventions from within a corporation as if they were external, an approach consistent with the dynamics of portfolio resources in the context of strategic alliances (Srivastava and Gnyawali, 2011).

3. Method

We employ an in-depth case study design (Eisenhardt, 1989; Yin, 2014) to investigate how Xerox pursued radical innovation through structural separation in its Palo Alto Research Center, focusing on the period between 1970 and 1985. We selected this timeframe as it covers PARC's most significant events in its history: its foundation in 1970, the closure of PARC's Computer Science Lab in 1983, the launch of Macintosh in 1984 and Microsoft Windows 1.0 in 1985 (both of which incorporated technologies created at PARC); and finally the retirement of Peter McColough in 1985. McColough was Xerox's CEO (1968–1982) and Chairman (1971–1985), who founded PARC in 1970.

We selected this case through theoretical sampling (Breckenridge and Jones, 2009), as the research setting is an exemplar of the research question being explored (Yin, 2013). In particular, the foundation of PARC in 1970 and the subsequent events that followed, make PARC an apt case of how structural ambidexterity can operate in practice and the organizational challenges that can emerge in pursuing this capability.

3.1. Data gathering

We gathered historical data relating to Xerox PARC during 1970–1985; accounts and interviews of PARC executives, media reports, journal publications, book chapters, books and case studies about the organization. Our aim was to understand the organizational context, including information on relevant strategic decisions, corporate structure and culture. We began by interrogating the database EBSCO Business Source Premier to generate an initial pool of historical data that used Xerox or Xerox PARC in their title, abstract or key words. This database is commonly used in management research as it contains most data sources (both academic and popular) that can be instrumental for the analysis (Turner et al., 2013). This initial search generated 6244 results (6094 on Xerox and 150 on Xerox PARC). We continued by refining the data through a series of filters. Through filtering by type, timeframe and company, followed by manual selection and deletion, we ended up with a list of 65 relevant data sources. Further, we searched for additional publications using the filters by source type and company for 1986–1995 to ensure more comprehensive coverage and identify any later sources that referred to the focal period. Finally, we employed a last round of manually selecting relevant material and adding other data sources to our sample not included in the EBSCO database (such as video interviews, books, book chapters and case studies). Our criteria for manual selection of sources were first, that the document was primarily about Xerox and or PARC, rather than these being just one of several themes in the document. Secondly, the document focus was on strategy, organization or innovation issues rather than technical, operational or other narrowly focused issues.

We relied on published, historical information rather than the gathering of primary data via interviews. We chose historical data since the challenges of conducting interviews at this stage would have been significant in terms of locating key actors and the presence of memory distortions, given that over three decades have elapsed since the end of the case study period (1970–1985). However, our data gathering process also has limitations. Firstly, the flexibility of researchers in terms of navigating the data gathering process is more limited, since published information (as compared to real-time interview data) makes it harder for researchers to probe and question deeper and in a targeted way the emerging themes of interest. The second limitation relates to sample comprehensiveness. Historical documents that could be relevant to the case and could potentially exist in hard copy in company archives or other physical depositories, but that were not preserved in digital format, could not be employed in this research. A third limitation is that document interpretation is informed by the sociocultural context, where gathering documents produced in the present period rather than in prior decades offers a more proximate understanding of this context to researchers. Table A in the Appendix outlines our data gathering procedure, and Table B lists selected data sources.

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3.2. Analysis

Our analysis followed the principles of grounded theory (Corbin and Strauss, 2008; Gioia et al., 2012), whereby we coded archival data through an iterative process (e.g. Anand and Jones, 2008). The coding process started early in the investigation. The first round of analysis produced numerous codes that captured basic themes apparent in the data, relating to such issues as organizational structure, culture, incentives, key strategic decisions, leadership, organizational processes, innovation examples, management strategies, business model and core competencies. At this stage we wrote a detailed case narrative, describing the contextual factors that led to the creation of PARC, key events in Xerox's history and competitive environment that were occurring at the time, and other relevant factors such as Xerox's history, culture and competitive context, that informed subsequent analysis in terms of the implementation of structural ambidexterity.

Gradually we refined these categorizations into first-order categories, which then constituted second-order themes, in turn grouping into aggregate theoretical dimensions, as suggested by Gioia et al. (2012). In this process we continued to explore the dimensions and properties of emergent categories and concepts through axial coding which involved linking themes to contexts, consequences, patterns of interaction and causes, as reflected in the data (Corbin and Strauss, 2008). Through this process key tensions such as institutionalised hostility between the exploratory and exploitative units and differences in strategic orientation and values attendant to the pursuit of structural ambidexterity emerged.

At subsequent stages of the analysis we aimed to explore in more detail the tensions and barriers to executing this ambidextrous strategy through selective coding. We focused on interrelations between key themes by selecting core categories, systematically relating them to other concepts, validating those relationships through delving into the data, and filling in categories that needed further refinement and development (Corbin and Strauss, 2008). A process of constant reviewing and continuous collection of data till the point where new data no longer significantly illuminated the concepts led to theoretical saturation. The resulting data structure is outlined in Fig. 1 below. Representative quotations are then presented in the next section, in Tables 2, 3 and 4.

4. Challenges to structural ambidexterity at Xerox

4.1. Dominant logic and focus on the core business

Xerox was founded in 1906 as “The Haloid Company” in Rochester, NY. It was not until 1959 that the company came to prominence with the introduction of Xerox 914, the first automatic commercial plain-paper copier which was based on the new xerograph process that replaced the carbons and wet process duplication methods prevalent at

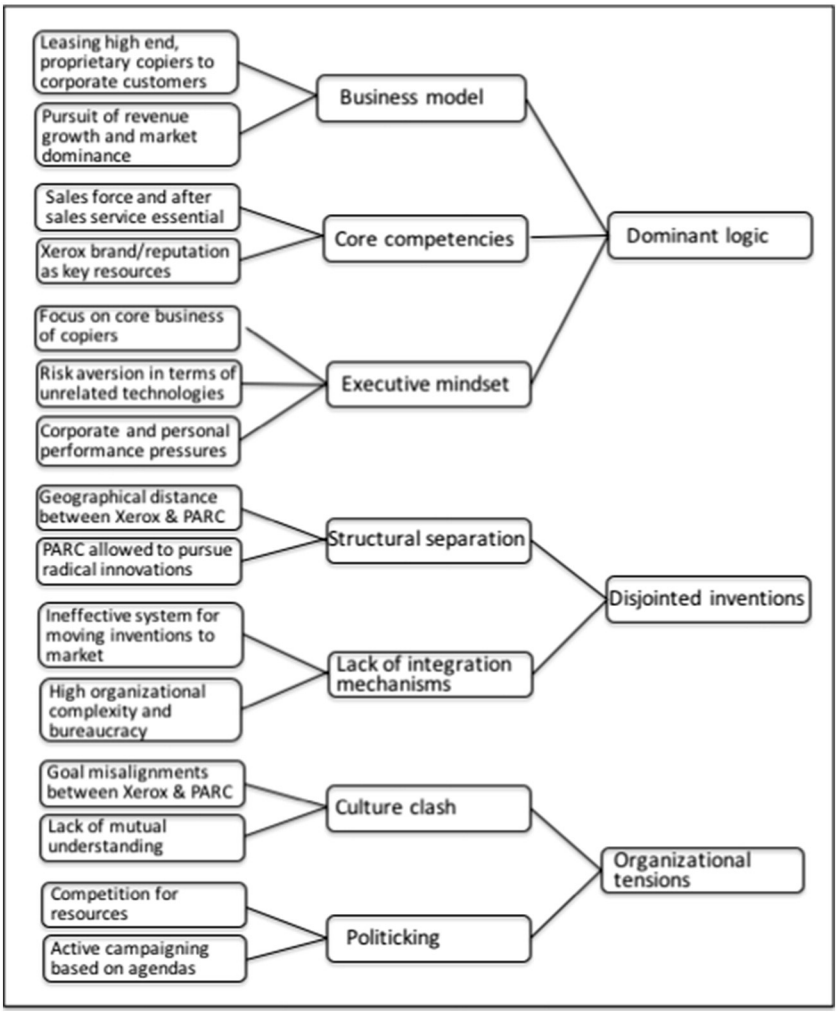

Fig. 1. Data structure: first order, second order and aggregate themes.

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Table 1
Main Xerox PARC inventions, 1970–1985.

Year	Xerox PARC inventions, 1970–1985
1971	Laser printer based on modified Xerographic process
1972	Object-oriented programming
1973	Alto personal workstation, featuring GUI with windows and icons
1974	Bravo word processing program, WYSIWYG editing protocol
1975	GUI with point-and-click interaction
1975	Ethernet developed by Bob Metcalfe, who later set up 3Com
1980	Non-erasable, magneto-optical storage devices
1982	Optical fiber-cable based local area network (LAN)

the time. After the launch of what is still considered as one of the most successful products of all time, the company was renamed Xerox in 1961 and had by the end of that year achieved $60 million in revenue from $32 million in 1959. Soon after, photocopying became known as "Xeroxing". By 1968, sales grew to $1.1 billion, and Xerox's headcount from 900 to 24,000 employees. By 1970 Xerox held a 95% market share in the global copier market with gross margins ranging from 70 to 80% (George and McLean, 2010; Heijden, 2002).

In 1970 Xerox founded PARC as an exploration subsidiary, purposefully located near Stanford University, with a mandate to create the technologies of the future and prepare Xerox for the "paperless" world of office computing (Fong, 2001). PARC's Computer Science Lab went on to develop revolutionary technologies during the 1970s and at the time was considered to be the mecca for top computer scientists, "like Disneyland for seven-year-olds" (Hiltzik, 2000: 153). Table 1 outlines key PARC inventions during the case study period (1970–1985).

Xerox continued growing fast, and by 1980 it recorded revenues of $8.2 billion. Only 3.7% of this amount however came from its office products division and the rest came from its copier business. Revenue projections at the time predicted that by 1985 Xerox's revenues would more than double, reaching $17 billion, with the office products division contributing only $1 billion of this amount (Uttal, 1981). Given the unprecedented success of the copier business and the fact that it accounted for the lion's share of revenues (over 94% in 1980), Xerox's dominant logic developed around the goal of focusing on, protecting and growing this business, where more copies by Xerox's corporate customers had a direct correlation with higher revenues and profits. Thus, "the company's chief aim has been to protect copier installations by strengthening its control of large, lucrative accounts" (Uttal, 1983: 673).

On the other hand, and excluding the invention of the laser printer at PARC, technologies created were often radically different to existing technologies, and had little explicit relevance to the copier business. PARC had been intentionally set up as a separate operation to shield it from the corporate paradigm and to enable ground-breaking inventions: "We didn't invent products; our game was to invent industries" (John Seely Brown as cited in Brown and Euchner, 2012: 19). Such inventions were inherently uncertain in terms of market potential, especially in the volatile technology industry and its incursions in other fields. For example, "no office equipment supplier, including IBM, foresaw that personal computers would compete with their wares". This was problematic for a large company like Xerox, where "every product must be a home run to justify the costs of marketing and development" (Uttal, 1983: 672–3). When Andrew Ludwick for example, a PARC researcher who worked on the AstraNET technology which linked several workstations with a single host cable wanted to commercialize the technology, Xerox rejected his proposal. "Since I thought that the market size of AstraNet was at most $100 million, no one at Xerox wanted to invest any time in the technology" (Ludwick as quoted in Chesbrough, 2002: 818).

Adverse estimations of potential market size, as well as politics, also led to the rejection of releasing a computer-based word processor known as the Notetaker, essentially an early portable computer, developed in 1976. At the time Xerox had set up a computer engineering facility in Dallas, headed by Robert Potter, which was competing rather than collaborating with PARC (Hiltzik, 2000: 263–4): "In addition to animosity, Dallas ignored PARC because Potter could not imagine a big market for advanced computer-based word processors" (Smith and Alexander, 1988: 170). When Larry Tesler (PARC principal scientist and first PARC scientist to be later employed by Apple) pushed for the commercialization of the Notetaker, he spent most of the year flying around the country trying to convince executives to back his product. He recalled, "Xerox executives made all kinds of promises, 'We'll buy 20,000 just talk to this executive in Virginia, then talk to this executive in Connecticut,' after a year I was ready to give up" (Hiltzik, 2000: 327).

The complex organization structure of Xerox led to high levels of bureaucracy, delays in decision-making and additional costs. A Xerox spokesperson later noted: "we had layered complexity into a structure that laid on costs, slowed decision making and masked responsibility" (Deutsch, 2000). Jacob Goldman (chief scientist at the founding of PARC) shared similar concerns about organizational complexity at Xerox; "there is, as a result, a loss of flexibility in the large organization and a compounding of overheads which translates itself into time delays in both the decision making process and the introduction to market" (Goldman, 1985: 4).

With a dominant market share and high levels of risk aversion, Xerox wasn't prepared to take a risk on technologies that were not fully ready for the market and that presented no clear route to profits (Chesbrough, 2002; Rao, 2011). Given that developing a new product was an expensive process and potential markets for new technologies were seen as small and uncertain, managers focused even more resources on the copier business (Pake, 1986; Uttal, 1983). As a result "the technologies closest to the company's core-business focus are the ones that receive attention and funding," ultimately preventing many PARC inventions from being commercialized (Holusha, 1998).

In the 1970s PARC's research was focusing on the domains of man-machine interface and other computing technologies that would later become building blocks of modern information technology. While PARC's research was considered important for corporate prestige, it had "little connection to the people who dealt with customers on a day to day basis" (George and McLean, 2010: 2). Apart from some of PARC's innovations at the time (for example a technology assisting users in identifying the source of a copier malfunction without calling a service technician, which reinforced Xerox's core business), most PARC technologies were seen as lacking any obvious link to increasing copying volume or quality. As a result, such "orphan" technologies were either terminated, or the scientists working on the projects got fed up with the internal delays, left PARC and commercialized them on their own (Chesbrough, 2010).

4.2. Culture clash and politicking leading to organizational tensions

Xerox's value proposition was "high quality copies in high volume at a low monthly lease rate" (Chesbrough and Rosenbloom, 2002: 538). The business model was based on developing machines that could manage a larger amount of copies, faster. As Xerox's CEO at the time observed later: "our profits came from how many copies were made on those machines. If a copier was slow in generating copies, that was money plucked out of our pocket" (Kearns and Nadler, 1992: 88). Xerox targeted the high end of the market; a Xerox 914 copier in 1966 for example cost $27,500. However, copiers "could be rented for twenty-five dollars monthly, plus at least forty-nine dollars' worth of copies at four cents each"; maintained by over a thousand repairmen who were "ready to answer a call on short notice to avoid losing

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money" (Brooks, 1969: 17). This business model reinforced the paradigm that "Xerox sees its business forte primarily as providing services and systems to the business office, and not as a component or subsystem supplier" (Pake, 1986: 25).

Another example of unsuccessful commercialization came from the launch in 1981 of Star, a system of interlinked computers for the corporate market, which could communicate with each other via Ethernet and were connected to a printer. Star was a completely closed system comprised exclusively of Xerox proprietary technology. This was the first commercially available set of workstations to feature a graphical user interface, icons and a mouse and offered ease of use that no other system at the time was able to offer (Heijden, 2002; Regani, 2005). However the Star system was expensive, "initially offered at $16,995; the network requisite facilities and shared printer raised the cost for a three-user system to over $100,000" (Chesbrough, 2002: 540) and was mainly sold to Fortune 100 companies via Xerox's enviable corporate relationships (Deutsch, 2000).

However, more cost-effective competitive offerings were about to enter the market. While PARC researchers were aware of this (Hiltzik, 2000: 263; Rao, 2011), Xerox managers did not appear to appreciate the implications of this prospect, maintaining both the uncompetitive price for the Star as well as targeting executive clients who likely were not the direct users (since at the time their secretaries would prepare the documents for them). Four months after the Star was introduced, IBM released the 5150, a personal computer available for as little as $1565 and aimed at a broader market, "designed for business, school and home" (IBM archives, 1981). Although the 5150 was not as technically advanced and did not have features such as icons, a graphical user interface or a mouse (Rao, 2011), its market entry contributed to the demise of the Star (Uttal, 1983: 674; Hiltzik, 2000).

PARC scientist Charles Simonyi helped create Bravo, the first WYSIWYG (what you see is what you get) text editor that was in use at PARC as early as 1974 and was so popular that relatives of PARC members would come in at night to use it (Hiltzik, 2000, p. 200; Channel 9, n.d.). However, Bravo was never commercialized. Simonyi expected an executive to stumble across it and realize its market potential, but also realised that "it was naïve to assume such an executive would come from Xerox" (Uttal, 1983: 674). Tenuous organizational links between PARC and the corporate center did not help. Charles Geschke, another PARC researcher remarked that "on the few occasions we'd have McCullough (Xerox's CEO between 1968 to 1982) come by it was like getting a state visit, you'd get fifteen minutes to pitch but there'd be no follow-through, no delegation to anyone who could understand what we were saying…" (Hiltzik, 2000: 266).

4.3. Separation leading to isolation and disjointed inventions

PARC was set up 3000 miles away from Xerox headquarters so that the research center would be able to operate and innovate with as little corporate interference as possible (Hiltzik, 2000; Uttal, 1983). At the same time, however, the large geographical distance between PARC and Xerox, as well as Xerox's organizational complexity, also engendered various cultural and organizational tensions.

While PARC, based on the West coast in Palo Alto, California, exhibited an informal culture and flat, organic design where employees enjoyed great autonomy, East-coast Xerox exhibited a formal culture and hierarchical, mechanistic design with stringent processes and rules. PARC "seemed more like a university department than a corporate research center" (Hiltzik, 2000: 58) where "members were notorious for long hair and beards and for working all hours – sometimes shoeless and shirtless" (Uttal, 1983: 671). Tensions between PARC employees and Xerox were rife. Computer scientist Adele Goldberg recalled being treated differently on corporate management training when other employees realised she was from PARC; "as soon as they found out I was from PARC, they weren't as nice anymore" (PARC, A Xerox Company, 2010). According to the Economist, "the people at PARC were treated like inmates of a zoo - admired and fed but rarely let loose" (Economist, 1993: 69).

The "knowledge that had flowed easily within PARC did not flow across its borders to the rest of the corporation" (Brown and Duguid, 2001), exacerbating PARC's isolation. As a result, structural separation hindered the "transfer of new technology to the operating groups and impedes the flow of market information to the technical people" (Chesbrough, 2002: 808). These tensions adversely impacted the commercialization of technologies: "One reason that is often cited for the company being unable to commercialize its innovations is the difference between cultures at Xerox and PARC. PARC, in its early years, was a free-wheeling place, populated by intellectual giants who had little knowledge of, and even less respect for business. The researchers looked on the suits from the headquarters with disdain, while the suits had little interest in even trying to understand what many of the scientists were talking about" (Regani, 2005: 8).

Meetings were designed to bridge the gap between PARC and Xerox: "At Xerox, for example, such formal exchanges took place in annual 'gap closure' meetings, when the two sides got together and contemplated the distance between them before returning to their separate spheres. Because these meetings were always struggles over power and turf conducted with varying amounts of passive-aggressive behavior, the gaps were almost impossible to close" (Brown, 1997: 100). The result was that very little technology moved from PARC to Xerox. Xero set up the Systems Development Division (SDD) in 1975 with the task of commercializing PARC technology: "Structurally speaking SDD, was a mess. The division had two headquarters, one in Palo Alto and the other in El Segundo, where it had taken over a block of manufacturing facilities vacated by SDS (Scientific Data Systems). This arrangement burdened Liddle (David Liddle, head of SDD after 1978, supervising development of the Star computer) and his cavalcade of immediate superiors with two mutually resentful semi-organizations located 500 miles apart" (Hiltzik, 2000: 249). As a result Xerox and PARC drifted further apart and decision processes were imbued with a substantial amount of politicking. As Robert Metcalfe (PARC researcher and main inventor of the Ethernet) remarked referring to PARC technologies that were already invented at the time he joined the organization, "The sad part was that after four years, those products were further away from market than when I joined" (PARC, A Xerox Company, 2010).

Rao (2011) describes the decision-making process as "not about new technologies and opportunities but about personalities, politics and short term decision making". A civil servant, Myron Tribus, who joined Xerox from serving in the Nixon administration, described how bad the politics at Xerox was: "I was used to the politics at Washington, but at Xerox it was way worse. In Washington, you knew your adversaries and accepted they would work against you. At Xerox, you only found out who was not on your side after you noticed the knife in your back" (Smith and Alexander, 1988: 156).

PARC's computing approach was based on a system of "distributed interactive computing", embodied in the ALTO office computer; a revolutionary product with real time responsiveness and user friendliness for individual users (Fong, 2001). The ALTO computer was the first to feature graphical user interfaces (GUI) with icons and overlapping windows, Bitmap displays and WYSIWYG (what you see is what you get) word processors. It was in use in PARC as early as 1973, a time when IBM was still making electric typewriters. Despite its revolutionary technology however, ALTO failed to become a market success. It cost over $16,000 to build, being uncompetitive from a cost perspective and therefore unlikely to enjoy mass-market demand.

John Ellenby, PARC researcher and the person responsible for the Futures Day presentation in 1977 in which PARC technologies were presented to Xerox's senior management, pushed for the commercialization of an affordable ALTO computer (a groundbreaking market offering at the time, but too expensive for most customers). Management ultimately decided to release a typewriter made by the Dallas based office systems division instead, which would have cost roughly

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Table 2
Aggregate theme 1 - dominant logic.

Second order themes	Representative data
Business model	"Xerox's prosperity was founded not on the number of machines sold, but basically on the number of pieces of paper that cycled through the machines. In that way, we are like razor-blade companies, producing razors, but making money on the blades. We do something similar with paper, toner, and service, and we're very good at it" (Brown, 1997: 101) "Our profits came from how many copies were made on those machines. If a copier was slow in generating copies, that was money plucked out of our pocket" (Peter McColough, Xerox CEO 1968–1982, as cited in Chesbrough, 2010: 355) "Xerox initially offered the Star workstation for purchase at $16,995; the requisite facilities and shared printer raised the cost for a three-user system to over $100,000. These systems were sold primarily to Fortune 100 companies through a direct sales force" (Chesbrough and Rosenbloom, 2002: 540) "Xerox sees its business forte primarily as providing services and systems to the business office, and not as a component or subsystem supplier" (Pake, 1986: 25) "In a large company every product must be a home run to justify the costs of marketing and development" (Jacob Goldman as cited in Uttal, 1983: 673) "Xerox's high-speed copier business model worked beautifully with the new printer technology (laser printer), creating a new, large and profitable business" (Chesbrough and Rosenbloom, 2002: 540)
Core competencies	"Xerox's direct sales force, once its greatest strength, has, meanwhile, become its albatross. Xerox sales representatives had enviable relationships with the corporate purchasing agents who bought analog copiers" (Deutsch, 2000) "Xerox had become a pioneer in providing a service dimension to its product sales. … The company had stationed its own employees at customer sites around the world to provide a comprehensive range of device management services which it called Managed Print Services" (Chandrasekhar, 2014: 1) "… consistent Xerox preference for exploiting unique proprietary technologies through a direct sales system to a group of known customers" (Chesbrough and Rosenbloom, 2002: 543) "… the sales force was trained on copiers and typewriters, not new office technology" (Rao, 2011) "This is a problem for Xerox, still overwhelmingly a one product company whose copiers accounted for three-quarters of last year's $8.5 billion in revenues and almost all the 1$ billion in operating profits" (Uttal, 1983: 671) "Sustaining growth on the basis of a single product – which was by then so ingrained into its DNA that Xerox had become a synonym for copying – was becoming difficult, notwithstanding the company's deeply rooted sales-driven ethos" (Chandrasekhar, 2014: 4)
Executive mindset	"Xerox managers did simply not understand how to think about a technology as different from copiers as digital computers" (Smith and Alexander, 1988: 176). "If Xerox had one single management weakness, it was that none of the powerful players from Peter (McColough, Xerox CEO) down, and that includes me, had a technical background or the technical support to permit them to challenge the hard judgments of the engineering group" (Jack Crowley, Executive Vice President at Xerox, quoted in Smith and Alexander, 1988: 160) "New ventures had to be led by people running established divisions, people who hated risk-taking" (Rao, 2011) "Xerox headquarters had a hard time understanding anything that wouldn't be a $100 million business" (Technical engineer as cited in Hiltzik, 2000: 247) "Xerox may have fumbled the dawn of the personal computer era because top management was preoccupied with defending its core copier business from a Japanese invasion" (Holusha, 1998) "They had to sandbag the Alto III, because they wouldn't make the numbers and therefore wouldn't get their bonuses" (John Ellenby as cited in Hiltzik, 2000: 265) "O'Neill saw the importance of using the existing corporation. To him, a product at all costs was not the answer. A product that made a lot of money was the answer" (Bob Potter as cited in Smith and Alexander, 1988: 159) "Generally, the technologies closest to the company's core business focus are the ones that receive attention and funding, the company has conceded" (Holusha, 1998) "There was no room for the unexpected especially where the corporate image was concerned" (Hiltzik, 2000: 159)

the same amount to produce (Hiltzik, 2000; Smith and Alexander, 1988). According to Ellenby, part of the reason the Dallas division resisted so strongly to the release of a cheaper Alto was that "they

Table 3
Aggregate theme 2 - disjointed inventions.

Second order themes	Representative data
Structural separation	"…PARC was also, for all practical purposes, outside the grasp of the corporate headquarters and its attendant bureaucracy and politics" (Regani, 2005: 8) "PARC had weak ties to the rest of Xerox" (Uttal, 1983: 671) "It impedes the transfer of new technology to the operating groups and impedes the flow of market information to the technical people" (Chesbrough, 2002: 808, referring to the separation of research laboratories) "Without a clear understanding of corporate Strategy and pressure from a hungry marketing group, even the best technologists can get out of hand" (Uttal, 1983: 673) "On the few occasions we'd have McColough come by it was like getting a state visit, you'd get 15 min to pitch but there'd be no follow-through no delegation to anyone who could understand what we were saying…" (PARC scientist Charles Geschke referring to Xerox CEO's visits, as cited in Hiltzik, 2000: 266) "Structurally speaking SDD [Systems Development Division, tasked with commercializing PARC inventions] was a mess. The division had two headquarters, one in Palo Alto and The other in El Segundo, where it had taken over a block of manufacturing facilities vacated by SDS. This arrangement burdened Liddle and his cavalcade of immediate superiors with 50 two mutually resentful semi-organizations located 500 miles apart" (Hiltzik, 2000: 249)
Lack of integration mechanisms	"PARC's main shortcoming has been lack of management attention" (William Spencer as cited in Uttal, 1983: 674) "There was a complete mismatch between Xerox's sales channels and many of the individual technologies that we were creating inside Xerox PARC." (Brown and Euchner, 2012: 19) "Xerox literally did not know what to do with these technologies, which became 'orphans' within the company." (Chesbrough, 2010: 356) "At Xerox, for example, such formal exchanges took place in annual 'gap closure' meetings, when the two sides got together and contemplated the distance between them before returning to their separate spheres. Because these meetings were always struggles over power and turf conducted with varying amounts of passive-aggressive behavior, the gaps were almost impossible to close. The result was that very little technology came out, and the serious money seemed to go to those who wrote books about our failure to make money from our own technology" (John Seely Brown – as cited in Brown, 1997: 100) "… The knowledge that had flowed easily within PARC did not flow across its borders to the rest of the corporation." (Brown and Duguid, 2001: 94) "… the scientists working on the projects got fed up with the internal delays, and took the project to the outside world on their own." (Chesbrough, 2010: 357) "You could see that Microsoft do things one hundred times faster, literally" (Charles Simonyi, cited in Rao, 2011)

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Table 4
Aggregate theme 3 - organizational tensions.

Second order themes	Representative data
Culture clash	"One reason that is often cited for the company being unable to commercialize its innovations is the difference between cultures at Xerox and PARC. PARC, in its early years, was a freewheeling place, populated by intellectual giants who had little knowledge of, and even less respect for business. The researchers looked on the suits from the headquarters with disdain, while the suits had little interest in even trying to understand what many of the scientists were talking about." (Regani, 2005:8) "At Xerox, for example, when managers tried to extend the knowledge created at PARC to the rest of the company, what had been intuitive among scientists working on the GUI proved almost unintelligible to the engineers who had to turn the ideas into marketable products. Insurmountable barriers of misunderstanding and then distrust developed between the communities. The scientists dismissed the engineers as copier obsessed 'toner heads,' whereas the engineers found the scientists arrogant and unrealistic" (Brown and Duguid, 2001: 93) "The researchers worked on commercially relevant (if premature) ideas. Xerox saw itself solely as a copier company when rivals were transforming themselves into purveyors of information handling systems. Worse, the people at PARC were treated like inmates of a zoo - admired and fed but rarely let loose" (Economist, 1993: 69) "Members were notorious for long hair and beards – sometimes shoeless and shirtless" (Uttal, 1983: 672, referring to PARC scientists) "I am fond of saying, 'We didn't invent products; our game was to invent industries'" (John Seely Brown in Brown and Euchner, 2012: 19) "They [PARC] questioned the pace at which Xerox was pursuing commercialization of their inventions, or disagreed with the company's commitment to proprietary standards and 'systems only' marketing" (Chesbrough and Rosenbloom, 2002: 540–541) "There were also fundamental differences in objectives of the scientists and the managers, and time-frames to which they worked" (Regani, 2005: 8)
Politicking	On management training with the rest of the Xerox corporation "as soon as they found out I was from PARC, they weren't as nice anymore" (Adele Goldberg quoted in PARC, A Xerox Company, 2010) "One reason is that the company's decision-making on dozens of occasions was not about new technologies and opportunities, but about personalities, politics, and short-term incentives." (Rao, 2011) "I was used to the politics at Washington, but at Xerox it was way worse. In Washington, you knew your adversaries and accepted they would work against you. At Xerox, you only found out who was not on your side after you noticed the knife in your back." (Myron Tribus as cited in Smith and Alexander, 1988: 156) On Myron Tribus leaving the company, "Instead of finding a way to work with the guy to take advantage of his brilliant talents, Sparacino played politics day and night to get rid of him." (Goldman as cited in Smith and Alexander, 1988: 155) "A bunch of horses asses who didn't know anything about technology were making the decision" (Goldman as cited in Hiltzik, 2000: 143, referring to a committee of corporate staff planners who were stalling the introduction of the laser printer and were going to recommend the introduction of a much inferior technology based on cathode ray tubes) "At Xerox headquarters the contretemps had earned themselves a reputation for insolence it would never entirely shake" (Hiltzik, 2000: 121) "But as (John) Ellenby gradually realised, the numbers were merely cannon fodder in a battle that was political to the core" (Hiltzik, 2000: 265)

wouldn't make their numbers and therefore wouldn't get their bonuses" (Hiltzik, 2000: 265). Hiltzik notes that "as Ellenby gradually realised, the numbers were merely cannon fodder in a battle that was political to the core" (Hiltzik, 2000: 265).

According to PARC engineer Bob Metcalfe who later founded 3Com, PARC had a conducive environment of creative freedom for its engineers: "There wasn't any hierarchy. We built out our own tools. When we needed to publish papers, we built a printer. When we needed to edit the papers, we built a computer. When we needed to connect computers, we figured out how to connect them. We had big budgets. Unlike many of our brethren, we didn't have to teach. We could just research. It was heaven … We built a computer and it was a beautiful thing … We developed our computer language, our own display, our own language. It was a gold-plated product. But it cost $16,000, and it needed to cost $3,000" (quoted in Gladwell, 2011).

Other influential PARC inventions included the computer mouse, Ethernet protocol, the laser printer, bit mapping, advances in information theory, object oriented computing languages and the idea of "windowing" computer applications (George and McLean, 2010). Although laser printing alone went on to repay Xerox's investment in PARC many times over, the company was unable to appreciate the potential market value of other technologies invented there and to successfully exploit them (Chesbrough, 2002). Spin-off companies from PARC such as 3Com and Adobe, as well as unrelated companies such as Microsoft and Apple, capitalized on many of PARC's inventions. George Pake, who was instrumental in setting up PARC said of that period: "my friends tease me by calling PARC a national resource" (Uttal, 1983: 617). Steve Jobs, who was inspired after seeing PARC's ALTO computer and subsequently incorporated many of its features in the first Apple computer, believed that "Xerox could have owned the entire computer industry, could have been the IBM of the nineties, could have been the Microsoft of the nineties" (Hiltzik, 2000: 389).

Tables 2, 3 and 4 below present raw data clustered in terms of second order themes, which in turn constitute aggregate themes.

5. Discussion: competency traps and dynamics of portfolio resources at Xerox

5.1. Competency traps

Within the perspective of organizational ambidexterity as a dynamic capability, we shed light on the organizational dysfunctions that can compromise structural ambidexterity. We do so via the concepts of competency traps (Levitt & March, 1988), dominant logic (Prahalad and Bettis, 1986) and portfolio resources (Srivastava and Gnyawali, 2011). We also draw from the concept of dynamic capabilities, particularly the idea that an organization's processes, asset positions and historical paths can both enable but also constrain its ability to sense opportunities, seize them and reconfigure itself (Teece, 2007; Teece et al., 1997). When opportunities are seen to be consistent with existing organizational capabilities and configurations, top managers are likely to pursue them. If opportunities are seen to be outside the organizational core business, then the dynamic capabilities act as competency traps, constraining the pursuit of commercialization of technologies and ultimately strategic renewal. We find that dominant logic is related to the cognitive dimension of competency traps, disjointed inventions to the behavioral dimension, and inter-unit organizational tensions to the organizational dimension of competency traps.

5.1.1. Cognitive dimension of competency traps: dominant logic at Xerox

Xerox executives operated via a dominant logic that emphasized the business model of leasing high-end, whole copier systems using proprietary technology to large corporate customers. Xerox's brand and reputation were seen as key resources, accompanied by an extensive sales force and after sales service that were seen as Xerox's core competencies. Executives focused on the core business of copiers to meet demanding organizational and personal performance expectations, and exhibiting risk aversion manifested in unwillingness to pursue new and uncertain businesses outside this core focus.

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The concept of dominant logic, the "mental maps developed through experience in the core business" (Prahalad and Bettis, 1986: 485), can be seen as an apt way of understanding how Xerox executives' view of their business constrained strategic scope and led to failure to exploit new opportunities offered by PARC's inventions. Given that the dominant logic of Xerox at the time focused on how to accelerate printing by providing more reliable and efficient printers, most of PARC's inventions did not fit this logic (Chesbrough, 2010). The idea of senior executives' dominant logic constraining the commercialization of inventions and therefore posing barriers to structural ambidexterity supports O'Reilly and Tushman (2013: 328) assertion that "the key to ambidexterity is the ability of the organization to sense and seize new opportunities … this is, at heart, a leadership issue more than a structural one". Path dependencies in terms of organizational and managerial processes and asset positions adopted historically, constrained Xerox's future path: "a firm's past experience conditions the alternatives management is able to perceive" particularly with respect to technological choices (Teece and Pisano, 1994: 548).

As Tripsas and Gavetti (2000) found in their study of Polaroid's inertia with respect to digital photography, managerial cognition shapes how executives interpret emerging opportunities and whether they are willing to pursue new business models to take advantage of these opportunities. In Polaroid's case, the company's dominant logic was associated with a business model of razor/blade, where Polaroid was making the vast majority of its profits on the film (the blade) rather than the cameras (the razor); on the software rather than the hardware. The emergence of digital photography on the other hand required a business model focused on the cameras themselves (the razors), an entry into consumer electronics and manufacturing of digital cameras rather than film; a focus on the hardware rather than the software. Polaroid was unable to make this strategic shift swiftly and effectively enough in terms of implementing a new business model, despite having invested in the development of digital technologies. Along similar lines, most PARC inventions were not consistent with the tried and tested business model of Xerox, and with top management's dominant logic, and therefore did not receive enough attention or commitment from the organization. Similarly to Polaroid, Xerox's business model was that of razors/blade, where the copiers were the razors and the number of copies made along with the after-sales and maintenance services Xerox provided were the blades. Xerox made its profits mainly on the blades. Xerox management's dominant logic was focused on maintaining and refining that model rather than taking what they saw as uncertain and risky bets on new technologies.

Smith and Tushman (2005) describe the tendency of organizations toward homogeneity, when firms rest most comfortably on mindsets and routines that support one preferable way of operating, constraining innovation and change that challenges this mindset. In order to overcome myopic visions senior teams are urged to develop processes for developing both forward looking cognitive models and backward-looking experiential learning (Gavetti and Levinthal, 2000; Louis and Sutton, 1989). Our analysis suggests that lack of such an ambidextrous, dual mode of cognitive thinking, combined with Xerox's dominant logic, severely compromised structural ambidexterity.

5.1.2. Organizational dimension of competency traps: disjointed inventions

Despite structural separation being a key prescription of the ambidexterity literature for encouraging innovation in established corporations, such separation can also engender organizational dysfunctions that could derail successful commercialization of new technologies; thereby severely compromising structural ambidexterity. PARC's structural separation was underlined by the vast geographical distance between its location and Xerox's headquarters, and by a lack of integration mechanisms. Xerox had no effective system for moving PARC's inventions to market, a situation compounded by Xerox's high levels of organizational complexity. In setting up PARC, Xerox overcame resource rigidity (the failure to reallocate resources to new capabilities or tasks), but not routine rigidity (the failure to change organizational processes) as a source of organizational inertia (Gilbert, 2005). The absence of credible challenges to the dominant logic that would foster the necessary unlearning to enable new learning to take place (Bettis and Prahalad, 1995) contributed to the persistence of routine rigidity. The lack of a structured model of discovery, incubation and acceleration to identify, nurture and successfully commercialize new technologies (O'Connor and Demartino, 2006) compounded Xerox's inertial tendencies. These inertial tendencies arose from the routinized, learned, tacit nature of Xerox's established capabilities (Winter, 2003); particularly as these had led Xerox to competitive success in prior years.

5.1.3. Behavioral dimension of competency traps: organizational tensions

The culture clash between Xerox and PARC was characterized by goal misalignments, lack of mutual understanding, and a lack of willingness to experiment by Xerox executives. Rampant politicking took place via competition for resources and active campaigning based on individual and group agendas, with PARC often losing out in such political battles. Culture clash and politicking led to a high level of organizational tensions.

A force-field logic can shed some light in explaining lack of effectiveness of structural ambidexterity at Xerox. Kurt Lewin (1947) argued that change processes occur within a social field, and any change is faced with forces working for and against it. By removing the forces against, the change would proceed effectively. On the other hand, by increasing the forces for change, the forces against would strengthen to impede it. At Xerox, the exploratory unit represented the forces for change, which were impeded by the established dominant logic and other barriers to ambidexterity we identified. In the absence of integrating mechanisms, which would have helped to mitigate the inertial effects of the dominant logic, the innovations coming from PARC were met with increased resistance from the dominant logic, as predicted by Lewin (1947).

After an initial period of uncoordinated response, Xerox developed a spin-off process where technologies not deemed to fit were spun off. Some of those were successful, but most failed. The successful ones used a very different business model than the one employed by Xerox (Chesbrough, 2010). Eisenhartdt and Martin (2000) note that dynamic capabilities take the form of specific processes such as product development or decision making. Such a spin-off process, had it been developed at an earlier stage, and functioning effectively, would represent a specific dynamic capability that could have enabled strategic renewal at Xerox by extending its corporate portfolio and reach to new markets.

The above interlinked cognitive, organizational and behavioral dimensions collectively led Xerox into a competency trap. Xerox's core capabilities became core rigidities (Leonard-Barton, 1992) in the face of inventions whose market potential was not recognized because of already established organizational values, skills, technical and managerial systems. The copier business was successful and without disconfirming evidence or other potent challenges to the dominant logic, Xerox executives persisted in honing the competencies that supported the copier business and undervalued other technologies developed by PARC scientists.

5.2. Dynamics of portfolio resources and Xerox

In the context of strategic alliances, where firms have the option to access and build on portfolio resources, "stronger firms will avoid going out of their 'comfort zones' and eschew risky opportunities to leverage portfolio resources. Also, stronger firms will have a dismissive attitude toward external resources as they have become inwardly focused … and prefer to stay on their own established technological trajectories" (Srivastava and Gnyawali, 2011: 800). The resource dynamics found in

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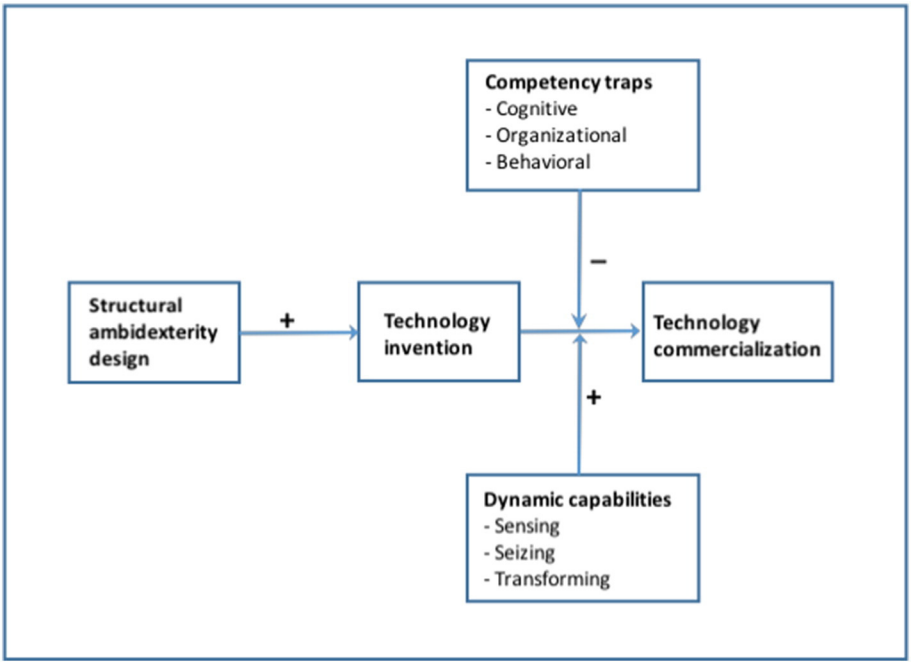

Fig. 1. Structural ambidexterity, technology invention and competency traps.

the context of strategic alliances and inter-organizational networks, where portfolio resources are located both within and outside the firm, can shed light on the challenges to accomplishing ambidexterity (Stadler et al., 2014). This is particularly relevant to structural ambidexterity, since the separation of the explorative subsidiary, engenders the danger of this subsidiary being seen as somehow "outside" the main organization, particularly if the dominant logic of the main organization is pervasive and not challenged. This rationale can shed light on the challenges to structural ambidexterity at Xerox. In the context of Xerox's success based on the copier business, executives over-valued the competencies associated with this business and undervalued several PARC technologies perceived as unrelated, that nevertheless subsequently went on to shape the information technology industry. These technologies were seen as external to the core business of copiers and marginal to Xerox's future competitive success despite the fact that they originated from within Xerox.

The dynamic capabilities perspective (Teece and Pisano, 1994; Teece et al., 1997) offers a further interpretation of the challenges that incumbents have in introducing new offerings. Given the particular configurations of organizational and managerial processes, asset positions and historical paths that are geared to an existing technology or product, incumbents find it very difficult if not impossible to alter these organizational configurations in the ways that would be demanded by new offerings. Our analysis shows that Xerox as a corporation lacked *dynamic* capabilities as defined by Teece (2007); the ability of a corporation to sense opportunities and threats, seize opportunities, and reconfigure its operations as needed to accomplish sustainable competitive advantage. The lack of dynamic capabilities led to what Lieberman and Montgomery (1988) refer to as "incumbent inertia", organizational inflexibility arising from such conditions as asset lock-in, organizational routines and political dynamics.

Our findings therefore offer insights on how cognitive, organizational and behavioral aspects of competency traps form a potent set of barriers to recognizing the potential of, and commercializing, breakthrough inventions. From a theoretical perspective, we bring together the concepts of competency traps and structural ambidexterity, within an overall view of ambidexterity as a dynamic capability, to enrich our understanding of this mode of accomplishing ambidexterity, and its attendant risks. From a managerial perspective, once these competency traps set in, technologies with substantial promise can be treated as external to the organization, even though they originate from within, mirroring the approach often taken by strong firms within alliance networks; an ultimately self-defeating strategy. Recognizing such organizational dysfunctions can enable a firm to purposefully pose challenges to its dominant logic, pay more attention to the potential of new technologies, and enhance its strategic options via active market experimentation with these technologies.

Fig. 2 emerges from our findings. Other things being equal, a structural ambidexterity design is conducive to technology invention. Whether managers then commit to and pursue the commercialization of this invention however is shaped by whether they see it as falling within the organization's existing capabilities and offerings. In that case, dynamic capabilities of sensing, seizing and performing may be put into action (to the extent that they are indeed present in an organization). However, if managers see technology inventions as unrelated to current capabilities and offerings, then the cognitive, organizational and behavioral dimensions of competency traps come into play and divert attention away from these inventions and the prospects of commercialization.

Further research can focus on the challenges that arise with the implementation of structural ambidexterity, in particular whether such competency traps with cognitive, behavioral and organizational dimensions are prevalent, and what specific form they take in other organizations. Further, we need to know more about how executives interpret and deal with these challenges, a fundamental issue in organizational ambidexterity and one about which we have scarce knowledge (O'Reilly and Tushman, 2013). Future research can also extend the networks and alliances perspectives as they apply to structural ambidexterity. In particular, can the resource dynamics observed at Xerox, that are analogous to how inventions are interpreted if they originate from outside a focal organization (Srivastava and Gnyawali, 2011), with the resulting tensions in integration, also be observed in other cases of structural ambidexterity? If so, how can structural ambidexterity be implemented in ways that minimise these risks?

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Appendix A

Table A
Identifying relevant literature: criteria and rationale.

Criteria	Rationale	Business source premier data	
		Xerox	Xerox PARC
1. Search of key terms (Xerox OR Xerox PARC) in title, keyword and abstract	Umbrella terms that would cover relevant publications and contextual information	6094	150
2. Limit by source types	We selected academic journals (Business and Management), newspapers, magazines. We filtered by all journals included in the Association of Business Schools list, quality levels 1 to 4	3121	100
3. Limit by company	We selected academic journals, newspapers, magazines where substantial reference was made to Xerox or Xerox PARC	1441	41
4. Limit by timeframe • Publications between 1970 and 1995 • Publications referring to the period 1970–1985	Our analysis focused on the period 1970–1985, which marked the launch of Xerox PARC and encompassed key events that followed. In order to ensure no important contextual information on that period was missed, we extended the search timeframe to 1995 and included any further publication that was referring back to the period 1970–1985	55	25
5. Manual selection and deletion of duplicates	We deleted duplicates & manually selected additional material such as books, video interviews and published case studies focusing especially on Xerox and/or Xerox PARC	65	

Table B
Selected sources of data on Xerox and PARC.

Books	Hiltzik, M. 2000. *Dealers of lightning*. Xerox PARC and the Dawn of the Computer Age. 1st ed. New York: HarperCollins. Smith, D. and Alexander, R. 1988. *Fumbling the future*. 1st ed. New York: W. Morrow. Heijden, K. 2002. *Sixth sense*. 1st ed. Chichester: Wiley. Kearns D. T. and D. A. Nadler. 1992. *Prophets in the Dark: How Xerox Reinvented Itself and Beat Back the Japanese*, Harper Business, New York.
Book chapters	Brown, J. 1997. Changing the game of corporate research: learning to thrive in the fog of uncertainty. In: *Technological innovation oversights and foresight*, ed. J. March, R. Garud and P. Nayer, New York: Cambridge University Press. Goldman, J. E. 1985. Innovation in Large firms. In: *Research on technological innovation, management and policy*, ed. R. S. Rosenbloom, Greenwich, CT: JAI Press. Pake, G. 1986. From Research to Innovation at Xerox: A Manager's Principles and Some Examples. In: *Research on Technological Innovation, Management and Policy*, ed. R. Rosenbloom, Greenwich: Cambridge University Press. Rao, A. 2011. Lab Inventors: Xerox PARC and the Innovation Machine (1969–83). In: *A History of Silicon Valley*, ed. A. Rao and P. Scaruffi, Omniware Group.
Journal publications	Brown, J. and Duguid, P. 2001. Creativity versus structure: a useful tension. *Sloan Management Review*, 42(4): 93–94. Brown, J. and Euchner, J. 2012. Conversations: The Evolution of Innovation: An Interview with John Seely Brown. *Research-Technology Management*, 55(5): 18–23. Chesbrough, H. 2010. Business model innovation: opportunities and barriers. *Long Range Planning*, 43(2): 354—363. Chesbrough, H. and Rosenbloom, R. 2002. The role of the business model in capturing value from innovation: evidence from Xerox Corporation's technology spin-off companies. *Industrial and Corporate Change*, 11(3): 529–555. Fong, G. R. 2001. ARPA Does Windows: the defense underpinning of the PC revolution. *Business and Politics*, 3(3): 213–237.
Case studies	George, B. and McLean, A. 2010. *Anne Mulcahy: Leading Xerox through the Perfect Storm Harvard Business Publishing*, Case Reference no: 9-405-050. Regani, S. 2005. *Xerox PARC – Innovation without Profit?* ICMR Center for Management Research, Case Reference no: 305-053-1.
Media reports	Deutsch, C. 2000. The Fading Copier King; Xerox Has Failed to Capitalize on Its Own Innovations. [online] *New York Times*. Economist, 1993. Barefoot into PARC, 328(7819): 68–9. Gladwell, M. 2011. Creation Myth: Xerox PARC, Apple, and the truth about innovation, *The New Yorker*. Available at: http://www.newyorker.com/magazine/2011/05/16/creation-myth Holusha, J. 1998. Putting Ideas to Work: The Case of Xerox PARC. *Strategy and Business*, 10. Available at: http://www.strategy-business.com/article/9854?gko=3a579 Uttal, B. 1981. Xerox xooms towards the office of the future. *Fortune*, May 18. Uttal, B. 1983. A lab that ran away from Xerox. *Fortune*, September 5.
Video interviews	PARC, A Xerox Company, 2010. *PARC 40: Alumni perspectives*. [video], Available at: http://www.slideshare.net/PARCInc/40th-alumni-panel-parc Channel 9, n.d. *The History of Microsoft with Charles Simonyi*. [video] Available at: http://channel9.msdn.com/Shows/TheOfficeBlog/The-History-of-Microsoft-with-Charles-Simonyi-The-Pioneer-Behind-Microsoft-Word-Part-One

References

Anand, N., Jones, B., 2008. Tournament rituals, category dynamics, and field configuration: the case of the Booker Prize. J. Manag. Stud. 45, 1036–1060.
Benner, M.J., Tushman, M.L., 2003. Exploitation, exploration, and process management: the productivity dilemma revisited. Acad. Manag. Rev. 28, 238–256.
Bettis, R.A., Prahalad, C.K., 1995. The dominant logic: retrospective and extension. Strateg. Manag. J. 16, 5–14.
Breckenridge, J., Jones, D., 2009. Demystifying theoretical sampling in grounded theory research. Grounded Theory Rev. 8 (2), 113–126.
Brooks, J., 1969. Business Adventures. first ed. Weybright and Talley, New York.
Brown, J., 1997. Changing the game of corporate research: learning to thrive in the fog of uncertainty. In: March, J., Garud, R., Nayer, P. (Eds.), Technological Innovation Oversights and Foresight. Cambridge University Press, New York, pp. 95–110.
Brown, J., Duguid, P., 2001. Creativity versus structure: a useful tension. Sloan Manag. Rev. 42, 93–94.
Brown, J., Euchner, J., 2012. Conversations: the evolution of innovation: an interview with John Seely Brown. Res. Tech. Manag. 55, 18–23.
Cameron, K.S., Quinn, R.E., 1988. Organizational paradox and transformation. In: Quinn, R., Camberon, K. (Eds.), Paradox and Transformation: Toward a Theory of Change in Organization and Management. Ballinger, Cambridge.
Cao, Q., Gedajlovic, E., Zhang, H., 2009. Unpacking organizational ambidexterity: dimensions, contingencies, and synergistic effects. Organ. Sci. 20, 781–796.
Carmeli, A., Halevi, M.Y., 2009. How top management team behavioral integration and behavioral complexity enable organizational ambidexterity: the moderating role of contextual ambidexterity. Leadersh. Q. 20, 207–218.
Chandrasekhar, R., 2014. Xerox Innovation Group – From Products to Services. Ivey Publishing (Case number 2014-03-25).
Channel 9, n.d. The History of Microsoft With Charles Simonyi. [video] Available at: http://channel9.msdn.com/Shows/TheOfficeBlog/The-History-of-Microsoft-with-Charles-Simonyi-The-Pioneer-Behind-Microsoft-Word-Part-One
Chesbrough, H., 2002. Graceful exits and missed opportunities: Xerox's management of its technology spin-off organizations. Bus. Hist. Rev. 76, 803–837.

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Chesbrough, H., 2010. Business model innovation: opportunities and barriers. Long Range Plan. 43, 354–363.
Chesbrough, H., Rosenbloom, R., 2002. The role of the business model in capturing value from innovation: evidence from Xerox Corporation's technology spin-off companies. Ind. Corp. Chang. 11, 529–555.
Corbin, J., Strauss, A., 2008. Basics of Qualitative Research. third ed. Sage, Los Angeles, CA.
Crossan, M.M., Apaydin, M., 2010. A multi-dimesional framework of organizational innovation: a systematic review of the literature. J. Manag. Stud. 47, 1154–1191.
Deutsch, C., 2000. The Fading Copier King; Xerox Has Failed to Capitalize on Its Own Innovations. ([online] New York times. Available at: http://www.nytimes.com/2000/10/19/business/the-fading-copier-kingXerox-has-failed-to-capitalize-on-its-own-innovations.html).
Duncan, R.B., 1976. The ambidextrous organization: designing dual structures for innovation. In: Kilmann, R.H., Slevin, D. (Eds.), The Management of Organization Design: Strategies and Implementation. North Holland, New York.
Economist, 1993. Barefoot into PARC, 328(7819). pp. 68–69.
Eisenhardt, K.M., 1989. Building theories from case study research. Acad. Manag. Rev. 14, 532–550.
Eisenhartdt, K.M., Martin, J.A., 2000. Dynamic capabilities: what are they? Strateg. Manag. J. 21, 1105–1121.
Fang, C., Lee, J., Schilling, M.A., 2010. Balancing exploration and exploitation through structural design: the isolation of subgroups and organizational learning. Organ. Sci. 21, 625–642.
Fong, G.R., 2001. ARPA does windows: the defense underpinning of the PC revolution. Bus. Polit. 3, 213–237.
Gavetti, G., Levinthal, D., 2000. Looking forward and looking backward: cognitive and experiential search. Adm. Sci. Q. 45, 113–137.
George, B., McLean, A., 2010. Anne Mulcahy: Leading Xerox Through the Perfect Storm. Harvard Business Publishing (Case Reference no. 9-405-050).
Gilbert, C., 2005. Unbundling the structure of inertia: resource versus routine rigidity. Acad. Manag. J. 48, 741–763.
Gioia, D.A., Corley, K.G., Hamilton, A.L., 2012. Seeking qualitative rigor in inductive research: notes on the Gioia methodology. Organ. Res. Methods 16, 15–31.
Gladwell, M., 2011. Creation Myth: Xerox PARC, Apple, and the Truth About Innovation. (The New Yorker. Available at: http://www.newyorker.com/magazine/2011/05/16/creation-myth).
Goldman, J.E., 1985. Innovation in large firms. In: Rosenbloom, R.S. (Ed.), Research on Technological Innovation, Management and Policy. JAI Press, Greenwich, CT, pp. 1–10.
Gulati, R., Nohria, N., Zaheer, A., 2000. Strategic networks. Strateg. Manag. J. 21, 203–215.
Heijden, K., 2002. Sixth Sense. first ed. Wiley, Chichester.
Heracleous, L., Murray, J., 2001. Networks, interlocking directors and strategy: toward a theoretical framework. Asia Pac. J. Manag. 18, 137–160.
Hiltzik, M., 2000. Dealers of Lightning. Xerox PARC and the Dawn of the Computer Age. first ed. HarperCollins, New York.
Holusha, J., 1998. Putting Ideas to Work: The Case of Xerox PARC. Strategy + Business 10 Available at:. http://www.strategy-business.com/article/9854?gko=3a579.
Hughes, M., Hughes, P., Morgan, R.E., 2007. Exploitative learning and entrepreneurial orientation alignment in emerging young firms: implications for market and response performance. Brit. J. Manag. 18, 359–375.
IBM Archives, 1981. The Birth of the IBM PC. ([online] Available at: http://www-03.ibm.com/ibm/history/exhibits/pc25/pc25_birth.html).
Jansen, J.J.P., George, G., Van Den Bosch, F.S.J., Volberda, H.W., 2008. Senior team attributes and organizational ambidexterity: the moderating role of transformational leadership. J. Manag. Stud. 45, 982–1007.
Jansen, J.J.P., Tempelaar, M.P., Van Den Bosch, F.A.J., Volberda, H.W., 2009. Structural differentiation and ambidexterity: the mediating role of integration mechanisms. Organ. Sci. 20, 797–811.
Junni, P., Sarala, R.M., Taras, V.A.S., Tarba, S.Y., 2013. Organizational ambidexterity and performance: a meta-analysis. Acad. Manag. Perspect. 27, 299–312.
Kauppila, O.P., 2010. Creating ambidexterity by integrating and balancing separate interorganizational partnerships. Strateg. Organ. 8, 283–312.
Kearns, D.T., Nadler, D.A., 1992. Prophets in the Dark: How Xerox Reinvented Itself and Beat Back the Japanese. Harper Business, New York.
Lavie, D., Stettner, U., Tushman, M.L., 2010. Exploration and exploitation within and across organizations. Acad. Manag. Ann. 4, 109–155.
Lawrence, P.R., Lorsch, J.W., 1967. Differentiation and integration in complex organizations. Adm. Sci. Q. 12, 1–47.
Leonard-Barton, D., 1992. Core capabilities and core rigidities: a paradox in managing new product development. Strateg. Manag. J. 13, 111–125.
Levinthal, D.A., March, J.G., 1993. The myopia of learning. Strateg. Manag. J. 14 (S2), 95–112.
Levitt, B., March, J.G., 1988. Organizational learning. Annu. Rev. Sociol. 14, 319–340.
Lewin, K., 1947. Frontiers in group dynamics. Concept, method and reality in social science; social equilibria and social change. Hum. Rel. 1, 5–40.
Lieberman, M.B., Montgomery, D.B., 1988. Fist-mover advantages. Strateg. Manag. J. 9, 41–58.
Lin, H.-E., McDonough, E.F., Lin, S.-J., Lin, C.Y.-Y., 2013. Managing the exploitation-exploration paradox: the role of a learning capability and innovation ambidexterity. J. Prod. Innov. Manag. 30, 262–278.
Louis, M., Sutton, R., 1989. Switching cognitive gears: from habits of mind to active thinking. Hum. Rel. 44, 55–76.
Lubatkin, M.H., Simsek, Z., Yan, L., Veiga, J.F., 2006. Ambidexterity and performance in small- to medium-sized firms: the pivotal role of top management team behavioral integration. J. Manag. 32, 646–672.
March, J.G., 1991. Exploration and exploitation in organizational learning. Organ. Sci. 2, 71–87.
Nemanich, L.A., Vera, D., 2009. Transformational leadership and ambidexterity in the context of an acquisition. Leadersh. Q. 20, 19–33.
O'Connor, G.C., Demartino, R., 2006. Organizing for radical innovation: an exploratory study of the structural aspects of RI management systems in large established firms. J. Prod. Innov. Manag. 23, 475–497.
O'Reilly, C.A., Tushman, M.L., 2004. The ambidextrous organization. Harv. Bus. Rev. 82, 74–81.
O'Reilly, C.A., Tushman, M.L., 2008. Ambidexterity as a dynamic capability: resolving the innovator's dilemma. Res. Organ. Behav. 28, 185–206.
O'Reilly, C.A., Tushman, M.L., 2011. Organizational ambidexterity in action: how managers explore and exploit. Calif. Manag. Rev. 53 (4), 5–22.
O'Reilly, C., Tushman, M.L., 2013. Organizational ambidexterity: past, present and future. Acad. Manag. Perspect. 27, 324–338.
O'Reilly, C.A., Harreld, J.B., Tushman, M.L., 2009. Organizational ambidexterity: IBM and emerging business opportunities. Calif. Manag. Rev. 51 (4), 75–99.
Pake, G., 1986. From research to innovation at Xerox: a manager's principles and some examples. In: Rosenbloom, R. (Ed.), Research on Technological Innovation, Management and Policy. Cambridge university Press, Greenwich, pp. 1–32.
PARC, A Xerox Company, 2010. PARC 40: Alumni Perspectives. ([video], Available at: http://www.slideshare.net/PARCInc/40th-alumni-panel-parc).
Podolny, J.M., Page, K.L., 1998. Network forms of organization. Annu. Rev. Sociol. 24, 57–76.
Prahalad, C.K., Bettis, R.A., 1986. Dominant logic: a new linkage between diversity and performance. Strateg. Manag. J. 7, 485–501.
Raisch, S., 2008. Balanced structures: designing organizations for profitable growth. Long Range Plan. 41, 483–508.
Rao, A., 2011. Lab inventors: Xerox PARC and the innovation machine (1969–83). In: Rao, A., Scaruffi, P. (Eds.), A History of Silicon Valley, first ed. Omniware Group (Excerpts available at http://www.scaruffi.com/svhistory/sv/chap84.html).
Regani, S., 2005. Xerox PARC – Innovation without Profit? ICMR Center for Management Research (Case 305-053-1)
Simsek, Z., 2009. Organizational ambidexterity: towards a multilevel understanding. J. Manag. Stud. 46, 597–624.
Smith, D., Alexander, R., 1988. Fumbling the Future. first ed. W. Morrow, New York.
Smith, W.K., Tushman, M.L., 2005. Managing strategic contradictions: a top management model for managing innovation streams. Organ. Sci. 16, 522–536.
Srivastava, M.K., Gnyawali, D.R., 2011. When do relational resources matter? Leveraging portfolio technological resources for breakthrough innovation. Acad. Manag. J. 54, 797–810.
Stadler, C., Rajwani, T., Karaba, F., 2014. Solutions to the exploration/exploitation dilemma: networks as a new level of analysis. Int. J. Manag. Rev. 16, 172–193.
Teece, D.J., 2007. Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. Strateg. Manag. J. 28, 1319–1350.
Teece, D.J., Pisano, G., 1994. The dynamic capabilities of firms: an introduction. Ind. Corp. Chang. 3, 537–556.
Teece, D.J., Pisano, G., Shuen, A., 1997. Dynamic capabilities and strategic management. Strateg. Manag. J. 18, 509–533.
Tripsas, M., Gavetti, G., 2000. Capabilities, cognition, and inertia: evidence from digital imaging. Strateg. Manag. J. 21, 1147–1161.
Turner, N., Swart, J., Maylor, H., 2013. Mechanisms for managing ambidexterity: a review and research agenda. Int. J. Manag. Rev. 15, 317–332.
Tushman, M.L., O'Reilly, C.A., 1996. Ambidextrous organizations: managing evolutionary and revolutionary change. Calif. Manag. Rev. 38 (4), 8–30.
Uotila, J., Maula, M., Keil, T., Zahra, S.A., 2009. Exploration, exploitation, and financial performance: analysis of S&P 500 corporations. Strateg. Manag. J. 30, 221–231.
Uttal, B., 1981. Xerox xooms towards the office of the future. Fortune :pp. 44–52 (online). http://www.guidebookgallery.org/articles/Xeroxxoomstowardtheofficeofthefuture.
Uttal, B., 1983. A lab that ran away from Xerox. Fortune, (September). In: Burgelman, R., Maidique, M. (Eds.), Strategic Management of Technology and Innovation, fourth ed. Irwin, Homewood, Ill, pp. 671–674.
Van der Borgh, M., de Jong, A., Nijssen, E.J., 2015. Alternative mechanisms guiding salespersons' ambidextrous product selling. Brit. J. Manag. http://dx.doi.org/10.1111/1467-8551.12148.
Winter, S., 2003. Understanding dynamic capabilities. Strateg. Manag. J. 24, 991–995.
Yin, R.K., 2014. Case study research: Design and methods. Sage, CA.

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