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Specialized organizations and ambidextrous clusters in the open innovation paradigm

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KEYWORDS

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A&D;
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High-tech cluster;
Silicon Valley;
Venture capital firms

Summary By comparing Lucent Technologies and Cisco Systems over twenty years, one illustrates that a firm that outsources exploration through an Acquisition and Development (A&D) strategy of start-ups and exploitation specialization can be more innovative and competitive than an ambidextrous organization. The success of an A&D strategy depends on the embeddedness of the firm in the network of organizations comprised of an open innovation system and supported by an inter-organizational process of innovation. The embeddedness of Cisco Systems in the ambidextrous high-tech cluster of the Silicon Valley, especially its ties to venture capital firms and start-ups, explains the success of its A&D strategy. The spreading of A&D strategy among large firms reinforces the dynamics of the open innovation system and nurtures the cluster's ambidexterity by increasing incentives for other organizations and individuals of the network to explore new knowledge and create fresh start-ups.

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Introduction

In technology-intensive industries, innovation is a central issue for the competitiveness of the firm. The life cycle of innovation starts with exploration and ends with exploitation (March, 1991). Exploration generates new knowledge that supports disruptive innovations. Exploitation industrializes and commercializes them. Large firms in high-tech sectors invest in exploration to generate disruptive innovations that will sustain their competitiveness (Burgelman et al., 2004; Wheelwright & Clark, 1992). This justifies the important investments in R&D done by large companies (for example, in 2008, Microsoft invested \$6.4 billion in R&D;

Nokia, 5.3 billion; IBM, \$4.3 billion; Intel, \$4.1 billion and Motorola, \$2.9 billion).¹

The basic problem confronting an organization is to engage in sufficient exploitation to ensure its current revenues and, at the same time, to devote enough energy to exploration to ensure its future viability (March, 1991; Raisch & Birkinshaw, 2008). The design of an organizational structure that handles the two issues simultaneously is an important challenge for the management of innovation since the publication of Burns and Stalker's founding research (1961). As a consequence of this pivotal research organizational designs have been sophisticated to improve the coexistence of exploration and exploitation inside the

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¹ The 2009 EU Industrial R&D Investment Scoreboard.

firm. Lawrence and Lorsch (1967) pointed out the importance of organizational differentiation of the R&D unit from the production and commercialization units. Mintzberg (1982) proposed an adhocratic organization, while Burke (1992) suggested a project-oriented organization and O'Reilly and Tushman (1996) advocated for the ambidextrous organization. The latter argue that an ambidextrous firm that is capable of conducting simultaneously exploration and exploitation is more likely to achieve superior performance than firms emphasizing one at the expense of the other. Ambidextrous organizations are supposed to gain a sustainable competitive advantage by reaching an efficient equilibrium between exploration and exploitation (Andriopoulos & Lewis, 2009; Gupta, Smith, & Shalley, 2006) and by efficiently transferring to exploitation the disruptive innovations generated by exploration (Benner & Tushman, 2003; Gibson & Birkinshaw, 2004; McNamara & Baden-Fuller, 1999; O'Reilly & Tushman, 2004). In this configuration, the coordination of exploration and exploitation is conceptualized inside the organization and disruptive innovation results from an intra-organizational process.

Three recent findings related to organizational ambidexterity and management of innovation renew the debate on the efficiency of the coordination of exploration and exploitation by large firms. First, several scholars point out that handling ambidexterity inside the organization is so complex that it can fail (Andriopoulos & Lewis, 2009; Gupta et al., 2006; He & Wong, 2004). Due to differences in cultures and temporalities, coexistence and coordination of the two activities inside the same firm are difficult to implement (He & Wong, 2004; March & Levinthal, 1993). Even Tushman and O'Reilly (1996) suggest that, in practice, few firms may succeed at managing ambidexterity because exploration and exploitation are fundamentally different logics that require very different strategies and structures, and the resulting tensions between the two are difficult to reconcile. Recently, a special issue of *Organization Science* on this topic (Raisch, Birlinshaw, Probst, & Tushman, 2009) acknowledges that organizational ambidexterity faces several tensions that can hamper its efficiency.

Second, firms can efficiently and competitively outsource their innovation (Cohen & Levinthal, 1990; Powell et al., 1996) by sourcing new technologies outside the organization (Laursen & Salter, 2006). To accumulate the necessary knowledge, many organizations turn to external activities such as alliances, joint ventures, mergers and acquisitions, and corporate venture capital investments (Ahuja & Katila, 2001; Wadhwa & Kotha, 2006).

Third, recent studies point out that innovation is more of an open process than a closed process (Chesbrough, 2003). The term "open innovation" indicates that large companies combine externally and internally developed technologies in a flexible way to develop new businesses. In open innovation processes, organizational boundaries are porous and firms strongly interact with different actors in their environment (universities, research labs, customers, exhibitions, venture capital firms, etc.) in search of interesting ideas (Cooper, 2008). Several studies on industrial clusters (Becattini, 2002; Iansiti & Levien, 2004; Porter, 1998) have developed an inter-organizational understanding of innovation. Inside a cluster, there is a

labour division between heterogeneous and interdependent agents. Together they make complementary contributions to the innovation's life cycle. Open innovation is a kind of paradigmatic shift challenging well-established theories of management of innovation (Chesbrough & Appleyard, 2007).

In this article, one will first build on these theoretical findings to analyse how different forms of sourcing of exploration (insourcing or outsourcing) may influence the firm's performance and will revisit the question of ambidexterity in the open innovation perspective. One builds on a previous research on RD outsourcing through an acquisition strategy (Ferrary, 2008) to articulate this alternative way of innovation management with the new paradigm of open innovation in order to elaborate a more comprehensive framework of innovation. It has been advocated that in an open innovation system, the creation and the development of high-tech start-ups result from interactions between different actors of a complex network of innovation (Ferrary & Granovetter, 2009). In an open innovation system, ambidexterity takes place at a regional level through inter-organizational coordination. Some organizations are in charge of exploration while others focus on exploitation. In the inter-organizational process of open innovation, start-ups take care of exploration and large firms are dedicated to exploitation. Second, one will examine the consequences and the managerial issues of exploration outsourcing on the relationship of the firm within its business environment. Third, exploration outsourcing by large firms in an open innovation system also changes the behaviour of other actors within the industrial ecosystem (universities, entrepreneurs, Venture Capital firms, etc.). To support the findings of this analysis, a conceptual framework will be designed to present an inter-organizational process of innovation life cycle.

The analysis of intra and inter-organizational ambidexterity is based on a longitudinal comparative case study over fifteen years (1990–2006) of two of the main American telecommunication equipment makers: Lucent Technologies and Cisco Systems. Lucent Technologies is the archetype of an intra-organizational ambidextrous firm that invests important financial resources into exploration. The famous Bell Labs were the more visible part of this R&D strategy. Conversely, Cisco Systems is the archetype of exploitation outsourcing and specialization on exploitation. Cisco accesses disruptive technologies through a strategy of acquisition of high-tech start-ups. From 1993 to 2007, Cisco Systems bought 125 start-ups (Ferrary, 2008). This strategy of acquisition originated the new managerial concept of Acquisition & Development (A&D) to contrast with the more conventional concept of Research & Development (R&D) (Rifkin, 1997). In this case, acquisitions are considered as exploration in the search for new knowledge (Vermeulen & Barkema, 2001). The Cisco's success over Lucent Technologies justifies examining how the firm participates in an inter-organizational innovation process that locates ambidexterity in an open innovation system. Raisch and Birkinshaw (2008) and Andriopoulos and Lewis (2009) criticized the lack empirical tests of the ambidexterity-performance relationship. Empirical evidence that outsourced exploration

(inter-organizational ambidexterity) can be more efficient than insourced exploration (intra-organizational ambidexterity) will be presented.

Applying methods of comparative case study (Eisenhardt, 1989; Pettigrew, 1990; Yin, 1994), one has chosen theoretically relevant cases, collected case data, and conducted iterative and inductive analyses. One has also relied on a qualitative methodology of interviews² combined with archival or secondary data (Tschang, 2007). This research is based on the analysis of Lucent Technologies and Cisco Systems' financial reports (10-K documents declared to the *Security and Exchange Commission*) from 1992 to 2006. Measuring exploitation activities is an empirical issue. The relatively few empirical papers that have tested the ambidexterity assumption have relied upon questionnaires (He & Wong, 2004; Rothaermel & Alexandre, 2009). This study follows the methodological choice of Tsai and Wang (2008) to associate exploitation and innovative activities to internal R&D efforts and to measure the latter by the R&D budget. Ahuja and Katila (2001) also use R&D expenditures as innovative inputs. Following Gupta et al. (2006) who associate on one hand exploration and R&D, and on the other, exploitation and sales, this study also uses the R&D budget as a proxy for the exploration done by a firm and its revenues as a proxy for its activities of exploitation. Exploration can sometimes translate into revenues after two to five years. Only a longitudinal research can analyze this relationship. In this research, the nature of how exploitation (insourced or outsourced) generates revenues in the following years (2–5 years) will be analyzed. Revenue growth reflects the firm's capability to convert its exploration into exploitable disruptive innovations. Sustained sales growth has been found to be a reliable proxy indicator of other dimensions of superior firm performance, including long-term profitability and survival (He & Wong, 2004).

First, in order to understand how an A&D strategy as exploration outsourcing can be more competitive than an R&D strategy (as exploration insourcing), the Lucent Technologies' strategy of organizational ambidexterity is analyzed and contrasted with Cisco Systems' strategy of organizational specialization based exploitation combined with an A&D strategy. Second, the specific issues of an A&D strategy concerning the identification of innovations and the embeddedness of the firm in an ambidextrous cluster will be examined. The specific interactions of Cisco Systems with the open innovation system typified by the Silicon Valley, specifically with venture capital firms and start-ups, are part of the explanation of its successful A&D strategy. Last, one will analyze how Cisco Systems' outsourcing of exploration through acquisitions is spreading among large high-tech companies and thus changing the behaviour of the other agents of the ambidextrous high-tech clusters and reinforcing the dynamics of open innovation.

Organizational ambidexterity vs organizational specialization in the telecommunication equipment industry

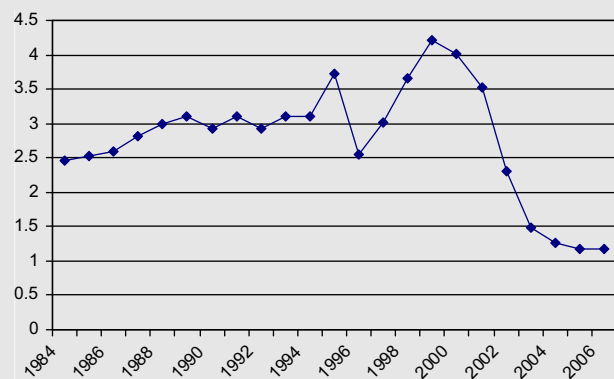
Lucent Technologies' organizational ambidexterity and R&D strategy

For a while, Lucent Technologies has represented the archetype of exploitation insourcing to innovate inside an ambidextrous organization. At the beginning of the 1980s, AT&T's telecommunication equipment division (which would become Lucent Technologies following a 1996 spin-off) was the dominant actor of this market and held a monopoly position in the US. This division was integrated into an industrial group with \$60 billion in annual revenue. The group also served as the division's main client. The telecommunication equipment division could rely on the R&D activities of Bell Labs (which became a part of Lucent Technologies after the spin-off), which invested more than \$2.5 billion in R&D every year. From 1984 to 2006, Lucent Technologies invested, \$63.8 billion in R&D (Table 1), partly through the Bell Labs. In 2000, Bell Labs employed around 25,000 researchers. Bell Labs are the internalized unit of exploration aimed to generate innovations to sustain the business growth of AT&T. In 1994, AT&T's Annual Report mentions on page 8 (10-K):

"AT&T Bell Laboratories provides support to all business units. It designs and develops new products, systems, software and services, and carries out a broad program of fundamental research, to provide the technology base for AT&T's future."

Moreover, this internalization has followed the principles of organizational differentiation of R&D activities (Lawrence & Lorsch, 1967). Since its founding in 1925, Bell Labs received significant research autonomy in its relationships with its parent company AT&T (Endlich, 2004). The results of Bell Labs' activities of exploration are impressive. From 1925 to 2006, Bell Labs registered more than 32,000 patents. An extensive array of awards has been bestowed upon Bell Labs and its researchers, including six Nobel prizes in

Table 1 Lucent Technologies' R&D investment from 1984 to 2006 (\$ billions).



² Six semi-directive interviews with two former researchers from Lucent Technologies, four current Cisco Managers and one of the venture capitalist who funded Cisco when the company was created were conducted.

physics, nine US Medals of Science, and seven US Medals of Technology. Bell Labs has originated several disruptive technological innovations that deeply transformed high-tech industries. The transistor, which sparked the creation of the semi-conductor industry, followed by the microprocessor industry were both invented by Bell Labs. Other significant innovations credited to Bell Labs are the charge-coupled device (CCD), which made digital imaging and portable video possible, the UNIX computer operating system, the C computer programming language, the laser, the communications satellite, cellular telephony and IMS (IP Multimedia Subsystem), the new architecture for converged communication networks and services.

On the exploitation side, in the 1990s, Lucent Technologies' revenues increased greatly from \$17.3 billion in 1992 to \$33.8 billion in 2000. However, despite its quasi-monopolistic position in the US at the beginning of 1980s and its historical relationships with its main clients (the local telephone companies created by the disassembling of AT&T) as well as its massive investments in R&D, the revenues of Lucent Technologies have sharply decreased since 2001, ending at \$8.7 billion in 2006 (Table 2). In 2006, Lucent Technologies almost went bankrupt and was subsequently acquired by Alcatel, a French telecommunication equipment maker. This sharp downturn in its fortunes is partly due to the crisis in the telecommunication sector that started in 2000. It is also due to Lucent's incapability to offer its clients innovative technological solutions specifically related to Internet Protocol communication.

The loss of competitiveness is even more significant if Lucent's revenues are compared with Cisco's revenues (Table 2). Since its founding in 1984, Cisco Systems has undergone tremendous business growth. In 2001–2002, during the recession of the telecommunication sector, Cisco's revenues decreased by only 15%. After 2003, Cisco went again through a period of increasing growth while Lucent's revenues continued to decline.

The comparison of the 2006 Consolidated Statements of Operations of the two companies points out the business advantage of Cisco Systems over Lucent Technologies (Table 3). In 2006, the Gross Margin of Lucent Technologies represented 42.46% of its Revenues (65.82% for Cisco Systems).

Table 2 Revenues of Lucent Technologies and Cisco Systems (\$ billions).

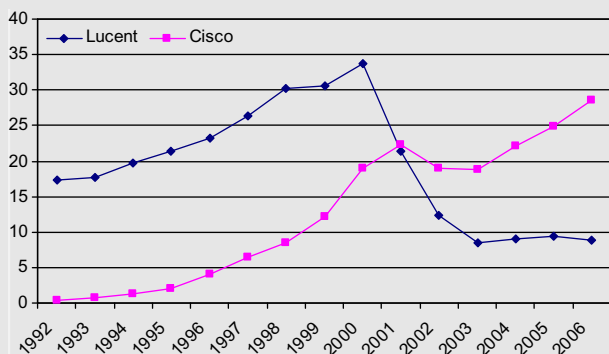


Table 3 (\$ billions).

	Cisco Systems	Lucent Technologies
2006		
Revenues	28,484	8796
Gross Margin	18,747	3735
GM/revenues	65.82%	42.46%
Net income	5580	527
NI/revenues	19.59%	5.99%
Market capitalisation	1,25,000	12,100

Its Net Income represented 5.99% of its Revenues (19.59% for Cisco Systems) and its market capitalisation was \$12.1 billion (\$125 billion for Cisco Systems).

Several hypotheses might be invoked to explain Lucent Technologies' business downturn in spite of massive R&D investments. The disruptive innovations produced by the activities of exploration did not match with the needs of the market or, Lucent Technologies has been unable to transfer disruptive innovations from the phase of exploration to the phase of exploitation (Ferrary, 2003b). Another explanation is that the organizational differentiation aimed to manage bounded rationality by ensuring focus on exploration engendered isolation that engrained a preferred technology, and impeded coordination between exploration and exploitation (Andriopoulos & Lewis, 2009). Researchers also argue that exploration insourcing induces myopic behaviour that leads to the development of competency traps (Levinthal & March, 1993; Levitt & March, 1988) and core rigidities (Leonard-Barton, 1992). A firm that sources all of its technology internally is unlikely to enhance its performance because of increased risks, including obsolescence (Eisenhardt & Martin, 2000). Often organizations do not possess the knowledge required to produce disruptive innovations and are thereby limited in their ability to produce knowledge purely through internal R&D investments (Hagedoorn, 1993). In high-technology industries like telecommunication equipment makers, where rapid technological change is the norm, few organizations are able to build capabilities without access to external knowledge (Leonard-Barton, 1995).

Lucent Technologies illustrates how insourced exploration can fail to generate revenues by transferring innovation from exploration to exploitation. The comparison with Cisco Systems highlights Lucent Technologies' failure but does not explain Cisco systems' success. The differences between the business performances of the two companies justify further investigation of Cisco's practices of management of innovation.

Cisco Systems' specialization and strategy of Acquisition and Development (A&D)

A longitudinal analysis (Pettigrew, 1990) of the foundation and the development of Cisco Systems highlights the singularity of its strategy concerning the management of technological innovations and the articulation between exploitation and exploration. Founded in 1984, Cisco Systems became the leader of the telecommunication equipment market by the 2000's. In 1984, Cisco Systems was founded by Sandra Lerner and Leonard Bosack, two

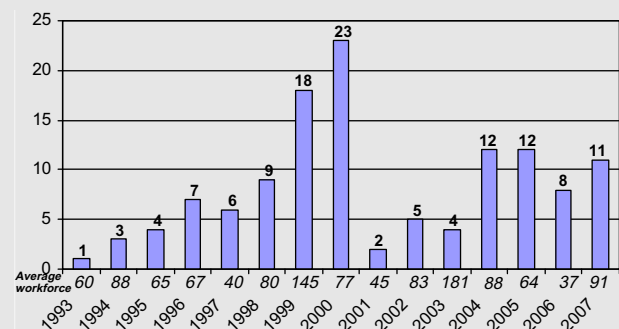
employees of the Information Technology (IT) department at Stanford University in California. Their first product was a multi-protocol router to interconnect the different IT networks of the university. At the beginning, the start-up was funded by Sequoia Capital, a venture capital firm that gave \$2.5 million for 29.1% of Cisco's shares. In 1990, the company made an IPO (Initial Public Offering) thus becoming a publically traded company. In 1990, Cisco's revenue was \$69 million and the company had 251 employees. In the following years, Cisco penetrated new segments of the telecommunication equipment market by commercializing disruptive technological innovations like Local Area Network (LAN) switchers, then equipment and software dedicated to Voice Over IP (VoIP), to Telephony Over IP (ToIP), video broadcasting over internet (IPTV), IT security solutions, storage networking, etc. The commercialization of these innovations has supported sustained growth and in 2007, Cisco Systems earned \$34.9 billion in revenue and employed over 63 thousand people.

The singularity of Cisco Systems' strategy results from the fact that the commercialization of disruptive innovations that has sustained its growth did not result from its internal activities of exploration but from an explicit strategy of start-up acquisition. In 1995, this so-called Acquisition Strategy officially became Cisco's way of commercializing new products. In 1996, Cisco Systems' Annual Report (10-K), included for the first time an "Acquisition Strategy" chapter introduced as follow: "*The Company has addressed, and expects to continue to address, the need to develop new products through the acquisition of other companies. . . The Company is continuously evaluating potential acquisition candidates as part of its growth strategy*".³ From 1993 to 2007, Cisco Systems acquired 125 companies (Table 4). The price for 113 of these acquisitions is public.⁴ Cumulatively, they are worth \$43.3 billion. That represents an average price by acquisition of \$383 million.

This strategy of acquisition does not square with the classic definition of diversification strategy which is typically aimed at acquiring mature products for mature markets in order to increase revenues. Nor does it try to improve the cost structure of the firm by realizing economies of scale. The purpose of this strategy is to acquire disruptive technological innovations at the end of their phase of exploration and at the beginning of their phase of exploitation (Byers & Dorf, 2005; Chesbrough, 2002). Acquisitions of start-ups can be conceptualized as an exploratory process whereby Cisco Systems employs these investments to search for new opportunities in their external environments.

Exploration for these disruptive innovations is done by start-ups. The life cycle of a disruptive innovation can be broken up between a pure exploration phase (research), a pure exploitation phase (production and commercialization) and a transition phase where exploration and exploitation overlap (development). An acquisition strategy consists in buying a start-up when its innovation is in the transition phase and the capabilities of exploitation of the large firm

Table 4 Number of start-ups per year acquired by Cisco Systems number of start-ups per year acquired by Cisco Systems (average workforce of acquired start-up).



are the most crucial for the start-up (Table 5). After their acquisition, these innovations are integrated into Cisco's activities of exploitation by being industrialized and commercialized. The example of Crescendo Communications, the first start-up acquired by Cisco Systems, highlights the process. Crescendo was founded in 1990 to develop high-performance workgroup solutions for desktops. In 1993, the start-up employed 52 people and its annual revenue was \$10 million. In September 1993, Cisco Systems acquired Crescendo for \$95 million. In 1994, Cisco Systems made \$500 million in sales by commercializing Crescendo's products (Paulson, 2001).

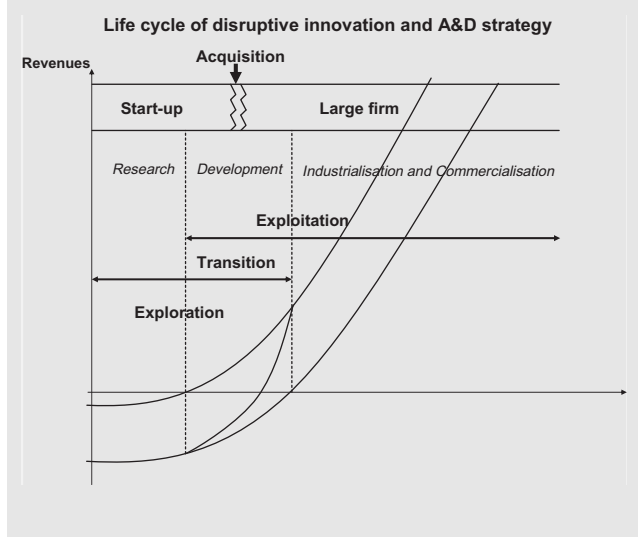
This acquisitive strategy is mainly focused on start-ups that are characterized by their newness and their size. First, on average, these start-ups are 4.5 years-old when they are acquired by Cisco. Second, these start-ups are very small companies. If the two largest acquisitions are excluded (Scientific-Atlanta employed 7500 people when it was acquired in 2005 and WebEx Communications which employed 2900 people when acquired in 2007), the average number of workers employed by these start-ups upon acquisition is 86 employees. This statistical mean has remained stable over the years (Table 4), showing a continuity in Cisco's strategy, which keeps focusing on small high-tech start-ups that support the transition phase of disruptive innovations.

Cisco Systems defines its strategic competence as its capability to accompany a technological innovation throughout the phases of industrialization and commercialization; not as its capability to generate disruptive technologies. Its competitive advantage is due to its ability to offer a large range of telecommunication equipment, to be a unique interlocutor for customers and to ensure the interoperability between types of equipment (Jennewein, Durand, & Gerybadze, 2007). Cisco's competitive advantage is linked to its specialization on exploitation of technological innovations. This is combined with exploration outsourcing through an A&D strategy. It is worth noting that both March (1991) and Benner and Tushman (2003) signaled the possibility that, under well-specified conditions, specialization rather than duality might be entirely viable. Implicitly, this firm delegates the exploration to other economic agents. On the demand side, the strategic issue for Cisco is to identify

³ In the 1995 Annual Report, acquisitions were mentioned: "*Beginning in fiscal year 1994, Cisco began entering new markets and broadening its product offerings through a series of acquisitions*", but the acquisition strategy was not explicit.

⁴ Information has not been disclosed for 12 of them.

Table 5 Life cycle of disruptive innovation and A&D strategy.



emerging new technological needs from its clients. On the supply side, the strategic issue is, first, to find and to buy start-ups that develop technological innovations that meet these needs; second, to industrialize, commercialize and integrate in the existing line of products the acquired technology. For example, the strategy of Cisco's marketing of OC-48 Sonet routers highlights its strategic capability to exploit innovations explored by start-ups. In 1999, Cisco Systems controlled only 1% of this emerging market and did not have a competitive product to face the growing demand. In 1999, Cisco Systems bought three start-ups that had developed OC-48 Sonet routers: StratumOne Communications (78 employees), Cerent Corporation (130 employees) and Monterey Networks (132 employees). In the year of their acquisition, these three companies made less than \$20 million in sales. In 2000, Cisco Systems made \$638 million in sales on the market of OC-48 Sonet routers and became the leader by controlling 29% of the market (Paulson, 2001).

Research on innovation and knowledge processes stresses the importance of the external acquisition of new knowledge for exploration. Studies on dynamics capabilities describe interrelations between internal and external knowledge processes that play an important role in corporate renewal. There is a need to explore the interplay between internal and external processes in the creation and preservation of organizational ambidexterity (Raisch et al., 2009). Cisco Systems is the archetype of outsourcing exploration implied in an intra-organizational process of innovation. This firm is specialized on exploitation and conceives ambidexterity at an interorganizational level instead of at an intra-organizational one. In the case of Cisco Systems, ambidexterity and open innovation can be articulated by stating that inbound open innovation refers to the acquisition of external technology in open exploration processes (Lichtenthaler, 2009). Inbound open innovation refers to inward technology transfer. It describes the practice of leveraging the discoveries of others (Chesbrough & Crowther, 2006). Cisco Systems illustrates that, under certain

conditions, the balance between exploration and exploitation could be achieved at the level of the broader high-tech cluster rather than at the level of the organization (Gupta et al., 2006). Jaffe, Trajtenberg, and Henderson (1993) argue that companies are becoming increasingly aware of their "mutual technological dependence". This awareness and this integration across organizational boundaries have the effect of moving the locus of innovation to the level of the community, rather than the firm. Then some organizations may specialize in exploration, some others in exploitation, while the balance between the two is achieved via a market (or a quasi-market) interface.

Rosenkopf and Nerkar (2001) found empirical evidence that exploration beyond organizational boundaries had more impact than exploration within organizations. Sustainable competitive advantage relies more heavily on the firm's ability to move beyond local search and to reconfigure its knowledge. Firms can decrease development time and risks by acquiring external technology (Ahuja & Katila, 2001; He & Wong, 2004; Rothaermel & Alexandre, 2009; Tsai & Wang, 2008). Acquisitions allow firms to acquire new knowledge and resources (Vermeulen & Barkema, 2001). Brown and Eisenhardt (1997) and Zahra (1996) found that firms that relied on external technology sourcing to probe and access cutting-edge knowledge held beyond the boundaries of the focal firm were more successful in their new product introductions than firms that focused on internal technology sourcing.

The longitudinal comparative case study between Lucent Technologies and Cisco Systems highlights, in the telecommunication equipment market, the superiority of exploration outsourcing by a firm specialized on exploitation over an ambidextrous firm. This analysis of the telecommunication equipment market points out that in a turbulent market the start-up structure is the most efficient organizational structure to explore disruptive innovation and to take advantage of business opportunities. This finding is consistent with Christensen and Overdorf's (2000) conclusion that start-ups are the most efficient structure to take advantage of industrial opportunities offered by disruptive technologies. Furthermore, for large firms, exploitation outsourcing can be a solution for resolving the paradoxical requirements of handling exploitation and exploration in the same organization. Externalization of one or another set of activities through outsourcing or by establishing alliances allows overcoming the limits of ambidextrous organization (Holmqvist, 2004). However, successful exploration outsourcing depends on specific conditions and the firm's embeddedness in its business environment, specially its ties with start-ups and venture capital firms.

The specific function of large firms in ambidextrous cluster sustaining open innovation

Embeddedness in ambidextrous cluster as a condition to outsource exploration

The ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends is critical to its innovative capabilities (Cohen & Levinthal,

1990). External cooperation is core to increase innovativeness and reduce time to market (Enkel, Gassmann, & Chesbrough, 2009). In an open innovation system, the life cycle of innovation is not understood as an intra-organizational process but as an inter-organizational one. An inter-organizational perspective presumes that innovation results from interactions between heterogeneous and interdependent actors that make up a network in which some of them handle exploration and others deal with exploitation. In this case, ambidexterity is not understood at the organizational level but at the level of a network of organizations. The strategic issue for large firms specialized on exploitation and implementing an A&D strategy is to be embedded in the network of organizations underlying the ambidexterity.

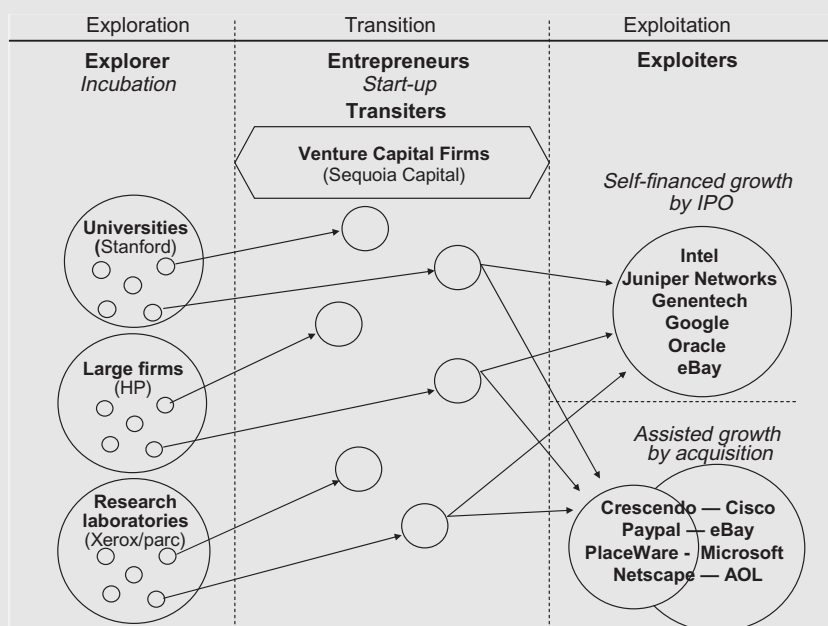
At the regional level of a high-tech cluster, innovative dynamics are based on social networks (Kenney, 2000; Lee, Miller, Hancock, & Rowen, 2000; Saxenian, 1994). The geographical proximity of agents involved in innovation is consistent with the small-world proposal that networks characterized by high clustering of individuals and low path length or social distance between the individuals in an inventor network should deliver a higher level of innovation than networks that possess different levels of these variables (Watts & Strogatz, 1998). Dense clusters of inventors are expected to spawn trust and collaboration. The relatively short path lengths between inventors are expected to enhance the ease and extent of information flow within the clusters (Gupta, Tesluk, & Taylor, 2007). In the Silicon Valley, connections across the inventor components within the region improve regional innovation by enhancing information flow and knowledge spillovers to inventors who would otherwise be relatively isolated from very useful information. The example of Cisco's interactions within the networks of organizations in the high-tech cluster of the Silicon Valley stresses the inter-organizational process of innovation supported by an ambidextrous network of organizations. In the Silicon Valley, the quality of embeddedness in a high-tech cluster, more specifically ties nurtured with venture capital firms, is an important condition to implement an acquisitive strategy. Cisco Systems is located in San Jose in the center of the Silicon Valley. Since the 1950s, as a region, the Silicon Valley has shown an impressive level of ambidexterity. At a regional level, exploration and exploitation coexist in specific entities and knowledge flows efficiently from explorative entities to exploitative entities to support an inter-organizational process of innovation. Important exploration activities are located in this region and they have originated numerous disruptive technological innovations such as semi-conductors, microprocessors, personal computers, telecommunication equipment, software and the internet. These activities of exploration coexist with activities of exploitation. The industrialization of some of these innovations gave birth to several large high-tech companies such as Hewlett-Packard, Intel, Apple, Sun Microsystems, Juniper Network, Yahoo! or Google, just to mention the most famous ones. In 2007, in the Silicon Valley, 1.4 million jobs were related to high-technologies and 22,000 companies were counted (Joint Venture, 2008). This region is characterized by a high start-up creation rate. From 1990 to 2000, an average number of 2940 new start-ups were created per year (Zhang, 2003).

The Silicon Valley is defined as a high-tech cluster because it is composed of a large diversity of heterogeneous and interdependent organizations that coordinate as a network to support the life cycle of disruptive innovations (Kenney, 2000; Lee, Miller, Hancock, & Rowen, 2000; Saxenian, 1994). In this region, large firms are mainly specialized in exploitation of innovations more than in their generation. The emergence and the conversion of a disruptive innovation into a new industrial sector results from a complex process in which a large diversity of interdependent economic actors make up an open innovation system in which such different organizations as universities, research laboratories, law firms, venture capital firms, consulting firms, investment banks and medias interact with large firms (Ferrary & Granovetter, 2009).

In Silicon Valley, some organizations handle exploration and, often involuntarily, nurture start-ups that will deal with the development of the disruptive technological innovations. The organizations that incubate "explorers" are the universities (Stanford, UC Berkeley, UC San Francisco, etc.), large firms (Hewlett-Packard, Intel, Sun Microsystems, etc.) and research laboratories (Xerox/Parc, Stanford Research Institute). Next, innovation transits to the exploitation phase from the exploration phase under the start-up structure managed by "entrepreneurs". However, entrepreneurs need resources in this transition phase. The venture capital firms play this role of "transiter" of innovation. By investing in start-ups, venture capital firms make them solvent to recruit employees and to use experts (lawyers, consulting groups, etc.) before they self-finance their growth. In Silicon Valley, a start-up that is unable to get venture capital funding will struggle to survive and develop its business. The venture capital firms perform a central function in the networks of organizations that sustain innovation (Ferrary & Granovetter, 2009). Considering that a start-up can hardly survive without venture capital funding, the VC firms also implicitly select the start-ups for the cluster by choosing among a large number of projects. Their investment is also a signal for the other actors on the quality of start-ups. Working with a start-up induces a risk due to its possible bankruptcy. The ability or the inability of a start-up to get funding from a prominent venture capital firm is understood by the members of the network as a signal that influences their decision to collaborate with the start-up. Venture capital firms embed the entrepreneurs that they fund by introducing them to potential clients, potential recruits, potential suppliers and, more importantly, potential acquirers. Finally, by investing over decades in start-ups, VC firms accumulate and spread knowledge on entrepreneurship to the entrepreneurs they backed.

The venture capital firms act as a "transiter" of innovation from the beginning of the transition phase by helping the "entrepreneur" to create his start-up to the end by connecting the start-up with a large firm that will acquire it to handle the exploitation phase or by introducing it to an investment bank that will underwrite an Initial Public Offering to finance the exploitation phase (Table 6).

In an informational perspective, venture capital firms are insiders that get private information on the start-ups they back (Hellman & Puri, 2002). The stake for large firms intending to set an acquisitive strategy is to access private information on the start-ups. They can nurture ties with

Table 6 The life cycle of a disruptive innovation in an ambidextrous cluster.

"explorers" by funding directly start-ups or, indirectly, by funding VC firms ("transiters") that invest in start-ups. Start-up firms represent an important opportunity for corporate investors to explore new ideas and knowledge (Wadhwa & Kotha, 2006). Large firms also can participate to syndication of start-ups funding organized by venture capital firms (Ferrary, 2010). Cisco Systems illustrate the capacity of a large firm to create ties in order to access private information. The competitive advantage of Cisco Systems related to its A&D strategy is enabled by the location of the firm in the Silicon Valley and by its embeddedness in regional networks. Strategic information on a start-up is private information as long as the start-up is privately owned. Little information on technologies, clients and employees owned by a start-up is available as long as the start-up is not a public company. A large firm that runs an A&D strategy has to be embedded in the informal social networks underlying the cluster to get access to private information. The circulation of this kind of information coincides with an imperfect market situation where social networks influence economic coordination (Ferrary, 2003a; Granovetter, 2005; Leamer & Storper, 2001). The quality of Cisco's embeddedness gives it privileged access to private information and explains some features of the start-ups that it has acquired. Out of 125 start-ups acquired by Cisco, 73 of them (58.4%) were located in the Silicon Valley. Furthermore, the start-ups acquired in this region have been bought faster than those from outside the region. A start-up from inside the Silicon Valley is acquired on average 3.69 years after its inception. A start-up from outside the Silicon Valley is acquired by Cisco on average 6.48 years after its inception. The geographical proximity and the embeddedness quality enable a better circulation of private

information. The more geographically distant a start-up is from Cisco, the longer the period of information diffusion and for Cisco to make a decision. The speed of acquisition due to geographical proximity also explains why the start-ups acquired in the Silicon Valley are smaller. On average, a start-up bought by Cisco employs 108 people when located in the Silicon Valley but employees 276 people (+155%) when the start-up is outside. Its better access to private information due to geographical proximity enables Cisco to acquire start-ups that are less involved in exploitation and, therefore, financially valued at a lower price. The average value of start-ups acquired inside the Silicon Valley is \$372 million versus \$494 million (+32%) for those acquired outside.

Embeddedness can take different forms. One of the more powerful embedding means is related to the relationships with the "transiters" of innovation, i.e. the venture capital firms. As primary investors, venture capital firms have privileged access to private information on the start-ups they have backed. At its inception, Cisco Systems was funded by Sequoia Capital, one of the most prominent VC firms in the Silicon Valley. Since then, the two organizations have stayed close. Until the beginning of the 2000s, Don Valentine, a partner at Sequoia Capital, was the vice-chairman of Cisco's board of directors. This close relationship explains why out of 125 firms acquired by Cisco, 14 of them have been funded by Sequoia Capital. Cisco also nurtures privileged relationships with other VC firms by investing in their funds (for example, KPCB in Silicon Valley). Cisco Systems maintains close ties with organizations specialized in exploration like Stanford University (for example, since 2002, the president of Stanford, John Hennessy, has been a member of the Cisco's Board of Directors and the firm funds several research programs at the university).

Spreading of AD strategy firm changes behaviours of cluster's actors

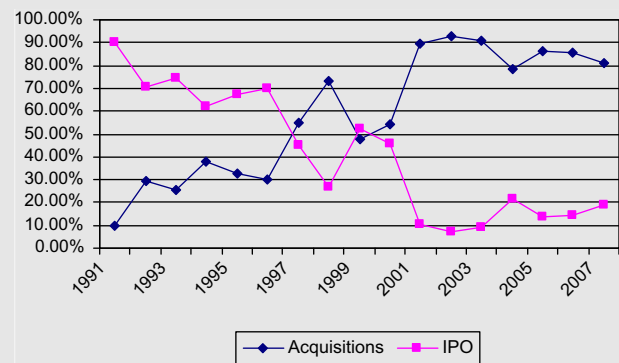
Exploration outsourcing through an A&D strategy is spreading among large high-tech companies, especially in Silicon Valley. For example, from 2001 and 2007, Google acquired 52 start-ups to enlarge its portfolio of technologies and products and, from 1998 to 2007, eBay bought 27 start-ups for the same purpose. Moreover, the fact that Microsoft, which has long been the archetype of a high-tech firm in search of organizational ambidexterity by investing heavily in R&D (\$7.1 billions in 2007), has acquired 87 start-ups from 1994 to 2007 also supports this idea. In the pharmaceutical industry, large firms also acquire biotech start-ups in order to industrialize and commercialize their innovations (Mitra, 2007).

Another evidence of the diffusion of the A&D strategy among large high-tech firms is the evolution of the number of start-ups backed by venture capital firms that has been acquired by large companies. This number rose to 363 in 2007 from 17 in 1991 (Table 7). This phenomenon became more marked after 1995. As this strategy spread, its evolution can be understood as the implicit recognition by the large high-tech firms of the competitiveness of the A&D strategy to source innovation.

By the end of the 1990s, the important development of acquisition strategies of high-tech start-ups by large firms had disrupted the venture capital industry. Historically, Initial Public Offerings (IPO) of start-ups were the financial exit strategy privileged by venture capital firms to sell their shareholding. The floating of a start-up's shares gives the opportunity to venture capital firms to sell their shares on financial markets. In 1991, 90.2% of exits by venture capital firms from start-ups capital ownership were carried out by IPO and 9.8% were due to an acquisition by a large firm. Since then, the situation has profoundly changed. In 2007, acquisitions of start-ups by large firms represented 80.9% of exits for VC firms (2002 has been a peak with 92.9%) and IPO only 9.1% (Table 8).

The success of some large high-tech firms of Silicon Valley emphasizes that the strategic issue is not to implement

Table 8 Exits of VC firms between Acquisition and Initial Public Offering.



an intra-organizational ambidexterity but to specialize on exploitation and at the same time to be part of an inter-organizational network that takes charge of exploration. The inter-organizational complementarities of the network in which large firms deal with exploitation are an incentive for "explorers" to invest in exploration. An "explorer" is more disposed to investigate a new field of knowledge if he can expect to sell his technological innovation to an economic agent specialized in exploitation and that looks for acquisitions.

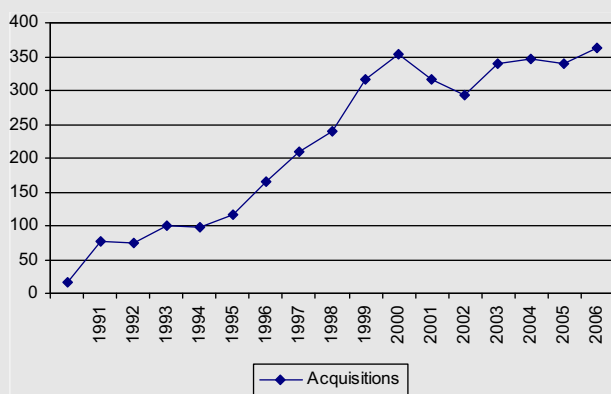
The spreading of A&D strategy amid large firms changes expectations and behaviours of potential entrepreneurs by increasing the incentive to explore new knowledge and to create start-ups. It also supports activities of "transiters" like venture capital firms. A venture capital firm gets an incentive to invest in start-ups if it knows that a large firm might potentially buy it. The spreading of A&D strategy supports the dynamics of open innovation system by motivating agents to participate more within the inter-organizational process of innovation.

Managerial implications

This study has a number of implications for managers in charge of innovation. The major implications of this study are as follows:

- In the open innovation paradigm, specialized organizations that outsource innovation and focus on exploitation can be more competitive than ambidextrous organizations.
- Innovation life cycle should be understood and managed as an inter-organizational process instead of as an intra-organizational one.
- The effectiveness of an acquisitive strategy depends partly on the firm's capability to nurture informal social ties with the network of organizations bearing innovations (universities, research labs, venture capital firms, ...).
- Implementation of an outsourcing strategy of innovation depends on the embeddedness of the firm in its business environment. Organizations should have an embedding strategy to access information on innovation.

Table 7 Number of VC backed start-ups acquired by large firms.



- Contracts, joint ventures and partnerships are devices that can be used by the firm to embed itself in social networks of an innovative cluster.

Conclusion

The longitudinal analysis of Lucent Technologies and Cisco Systems contribute to the debate on ambidextrous organization. In the extremely changing market of telecommunication equipment, in spite of its huge R&D investments, Lucent has also been unable to detect emerging new technologies that were radically different from its technological culture. Conversely, Cisco Systems did not try to implement an ambidextrous organization but specialized on exploitation and carried out an original A&D strategy by acquiring high-tech start-ups creating disruptive technologies.

Based on the analysis of these two large high-tech companies, it appears that the search for intra-organizational ambidexterity might lead to competitive disadvantage, especially in a changing environment. On the other hand, the specialization of the firm on exploitation and its embeddedness in an ambidextrous cluster in order to get access to exploration may give a sustainable competitive advantage. In this case, disruptive innovations result from an inter-organizational coordination of organizations; some specialized on exploration and other focused in exploitation. In this configuration, the start-up structure is the transitional organization of innovation between exploration and exploitation.

This article brings together recent theoretical findings on the limits of ambidextrous organizations (Raisch et al., 2009) and a new paradigm in management of innovation labelled "open innovation" (Chesbrough, 2003) to analyze A&D strategy. The ambidextrous cluster in which a specialized large firm is embedded is made up of a network of organizations that handle exploration at a regional level. The spreading of A&D strategy among large firms reinforces the dynamics of the open innovation system and nurtures cluster's ambidexterity by increasing incentives for the other organizations and individuals of the network to explore new knowledge and create start-ups.

This study has focused on the external conditions of the implementation of an A&D strategy. Although it is not central to the topic of this research, it should be mentioned that successful A&D strategy also depends on the absorptive capabilities of the acquiring firm (Kogut & Zander, 1992). Learning from acquisitions will only take place if knowledge, routines, skills, and people flow from the acquired firm to the acquiring company (Capron, 1999). Several scholars have analyzed the importance of absorptive capabilities in acquisitions (Tsai & Wang, 2008; Vermeulen & Barkema, 2001; Wadhwa & Kotha, 2006).

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