



Inhibitors of disruptive innovation capability: a conceptual model

A conceptual model

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Abstract

Purpose – The purpose of this paper is to examine why large firms often fail to develop disruptive innovations. This study identifies several key inhibitors or barriers that hinder those developments. A conceptual model is presented that examines the interrelationship and interdependence of these inhibiting factors, in an effort to provide a better understanding of how companies can improve their disruptive innovation capabilities.

Design/methodology/approach – This paper focuses on disruptive innovation rather than incremental innovation and is limited to research findings on large corporations. Recently published works (1990-2004) have examined *success factors* as the determinants of disruptive innovation capability. A complementary approach is to examine the *inhibitors* of disruptive innovation and investigate their interrelationship and interdependence. The study is based on an extensive review of literature available, and examines both internal and external inhibiting factors to develop a conceptual model of disruptive innovation capabilities.

Findings – Many large corporations fail to develop disruptive innovations. It is argued that the basic constraints to creating successful disruptive innovation stem in large part from several inhibiting factors, and we have identified different clusters of interrelated and partly-interdependent inhibitors: the inability to unlearn obsolete mental models, a successful dominant design or business concept, a risk-averse corporate climate, innovation process mismanagement, lack of adequate follow-through competencies and the inability to develop mandatory internal or external infrastructure. The conceptual disruptive innovation capability model provides a better understanding of the interrelationship among these limiting factors. There is still a vast gap between intention and actual disruptive innovation capability. Developing distinctive capabilities to bridge this gap should be an integral part of a company's strategy for growth.

Research limitations/implications – This paper is based on an extensive review of literature on disruptive innovation barriers. In it is proposed a conceptual interrelationship model of innovation inhibitors as a basis for determining and improving a company's disruptive innovation capability. It is suggested that, in addition to the theory presented in this paper, further empirical research studies be carried out to validate the key inhibitors of our conceptual model, their interrelationship and interdependence, and the impact on disruptive innovation development.

Originality/value – The study is intended to provide practical insight into clusters of inhibiting factors that prevent large organisations from improving their disruptive innovation capability. The conceptual model facilitates the development of distinctive competencies and mindsets to improve these capabilities.

Keywords Innovation, Corporate strategy, Large enterprises

Paper type Conceptual paper



Introduction

In recent years, the speed of new product development has drastically increased; product lifecycles have been reduced by half or more, and this trend will clearly continue. Yet only 7 per cent of the Dutch SME organisations introduce new products

to the market (De Volkskrant, 2003). A research study by the NIPO Research Institute (2002) revealed that 20 per cent of Dutch employers suffer structural losses due to a lack of innovation capability. According to the EU innovation index, the Dutch economy lacks a driving force for innovation (EIM, 2002), and its R&D spending is one of the lowest in the EU, with only 0.6 per cent of GNP going to R&D compared to an EU average of 2.4 per cent (EIM, 2003).

The need to innovate is revolutionary rather than evolutionary, and it is a necessity for survival in dynamic and complex markets and in uncertain economic circumstances. But the development and implementation of disruptive innovation are not well understood (Leifer, 2001), and only a small number of companies manage to leverage and maximise their disruptive innovation capability. Yet, future success has much to do with a company's innovation capability. Without radical innovation, decline is inevitable (Hamel, 2002). A Deloitte Research (2004) study revealed that there is a vast gap between intention and actual disruptive innovation capability of firms. Developing distinct capabilities to bridge this gap should be an integral part of a company's strategy for growth.

Recently published works (1990-2004) have mainly examined the success factors as key determinants of disruptive innovation. However, organisational learning over-samples success and under-samples failure. Any learning process tends to eliminate failure, and this tendency is accentuated by the way learning produces confidence and confidence in turn produces favourable expectations and favourable interpretations of outcomes, known as failure myopia (Levinthal and March, 1993).

A complementary approach is to examine inhibitors or barriers of disruptive innovation, their interrelationship and interdependence, as major factors that limit a firm's disruptive innovation capability. In this paper we examine the inhibiting determiners of large corporations. This review is based on an extensive study of literature on disruptive innovation in companies in the USA and Europe. The identified clusters of inhibitors provide a basis for further study to validate these limiting factors and develop ways to transform them into drivers of disruptive innovation performance.

Innovation

"The most important business issue of our time is finding a way to build companies where innovation is both radical and systemic" (Hamel, 2002). Innovation is a key factor for a company to survive and grow on the long run (Tidd, 2001). Despite the successful implementation of innovations, only a few companies have come to understand what is necessary for successful innovation (Christensen, 2003).

The "innovation" phenomenon has a connotation of newness: "Innovation is the generation, development, and adaptation of an idea or behaviour, new to the adopting organization" (Damanpour, 1996; Higgins, 1995); of success: "The first successful application of a product or process" (Cumming, 1998), and of change: "Innovation is conceived as a means of changing an organization, either as a response to changes in the external environment, or as a pre-emptive action to influence the environment" (Damanpour, 1996). Technical innovation does not create value directly; all it does is create change in processes, functionality or utility. It is the extent to which internal operations or external customers value a change, that leverage is created (Paap and

Katz, 2004). In this paper we interpret innovation as: “The process of successfully creating something new that has significant value to the relevant unit of adoption.”

The object of innovation can be classified as things (products and services), or as changes in the way we create and deliver products and services (processes). Johne (1999) distinguishes product and process innovation from market innovation. Other objects of innovation are the organisation, transactions, management style and business model (Slappendel, 1996; Higgins, 1995; Paap and Katz, 2004). These types of innovation relate mainly to process innovation. Innovation can also be distinguished by aggregation level. Innovation can take place at an individual level (improvement), at functional level (process improvement or adaptation), at company level as an entire value chain (radical product and service innovation, new business models), and at industry level (technology breakthroughs) as systems of innovation (Edquist, 1997).

Innovation covers the continuum from incremental or sustainable innovation (remodelling functionality) to radical or disruptive innovation (breakthrough, paradigm shift). Incremental innovation development remains within the boundaries of the existing market and technology or processes of an organisation (Figure 1: lower left) and carries lower financial and market-acceptance risks.

Disruptive innovation

In a quickly changing and uncertain world, innovation is the key to competitive advantage. Yet innovation also increases uncertainty and market pressure (Lettice and Thomond, 2002; van Ex, 1999). The more radical the innovation, the more difficult it is to estimate its market acceptance and potential. The increasing complexity and market dynamics create a substantial knowledge gap between theory and practice. Many companies are not organised to give new ideas a chance, to recognise trend breaking points in the market, to adapt quickly to changing market circumstances, or to cause market changes in the first place (Markides, 1999).

Disruptive innovations “change the game”. They attack an existing business, and offer great opportunities for new profit growth. Only radical innovations lead to

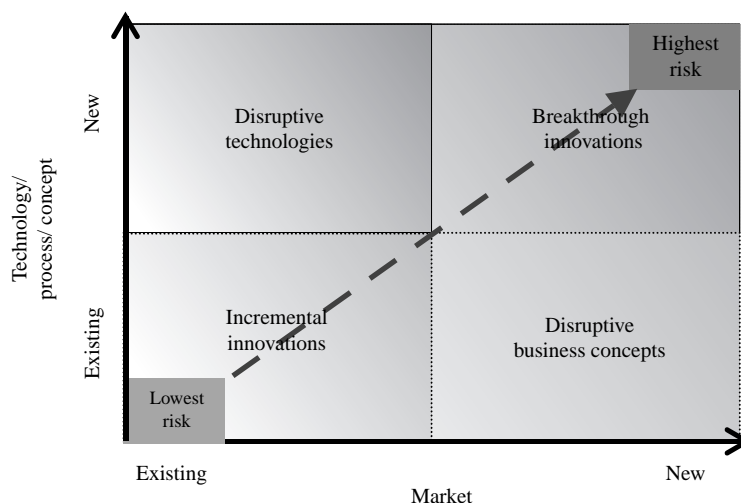


Figure 1.
Innovation application space

growth (Hamel, 2003). Lettice and Thomond (2002) define disruptive innovation as: “A successfully exploited product, service or business model that significantly transforms the demand and needs of an existing market and disrupts its former key players”. Damanpour (1996) defines it as “... those that produce fundamental changes in the activities of an organization and represent a large departure from existing practices”, and Leifer (2001):

A radical innovation is a product, process or service with either unprecedented performance features or familiar features that offers significant improvements in performance or cost that transform existing markets or create new ones (Figure 1: top left and bottom right).

Brown (2003) considers disruptive innovation as something that changes social practices, the way we live, work and learn. It requires breaking conceptual frameworks, reframing the problem and going to the very roots of it. In this paper we define disruptive innovation as:

A successfully exploited radical new product, process, or concept that significantly transforms the demand and needs of an existing market or industry, disrupts its former key players and creates whole new business practices or markets with significant societal impact.

Breakthrough innovations are based on inventions that serve as a source of many subsequent inventions (Figure 1: top right) (Ahuja and Lampert, 2001). Ambiguous, extremely turbulent and uncertain times, combined with a long development time, make breakthrough innovations a highly risky matter.

Veryzer (in: Lettice and Thomond, 2002) distinguishes three types of disruptive innovation: technological discontinuity (e.g. PC, flat TV monitor, internet, MP3, nanotechnology), commercial discontinuity (e.g. Sony Walkman, E-commerce, business models) and a combination of both (e.g. compact disk, cellular mobile telecommunications).

Disruptive innovation frequently results from a combination of the emergent qualities of several smaller ideas based on observing the world differently, challenging presuppositions, expanding boundaries, spotting the “white space”, discovering the as yet unrealised needs of customers, setting challenging targets, thinking the unthinkable and challenging our underlying mental models (Coulson-Thomas, 2001; Wind and Crook, 2005). Innovation patterns appear as fractals, with small decision cycles imbedded in larger decision cycles (Leonard and Sensiper, 1998), in which the basic development steps (identify – develop – plan – implement) are the guiding principle (Figure 2). Within this basic outline, the process of disruptive innovation is a rhythm of searching and selecting, exploring and experimenting, of learning and unlearning, and cycles of divergent and convergent thinking. It is a complex and interactive process of probing and learning or feedback (Figure 2). Contrary to linear, incremental innovation processes, such as the stage-gate concepts (Cooper *et al.*, 2002a, b), disruptive innovation is more like a spiral or circular development process of continuous fast feed-forward and feed-back loops (Figure 2). This disruptive innovation development process is an interdependent system, based on the concepts of system thinking and of dynamic strategic thinking with learning as a central aspect (Brown and Eisenhardt, 1995; Senge, 1994; Dickson, 2001). This process is affected by exogenous determinants such as economic, social and political factors, competition and infrastructure, and endogenous determinants such as resources, corporate structure and corporate culture.

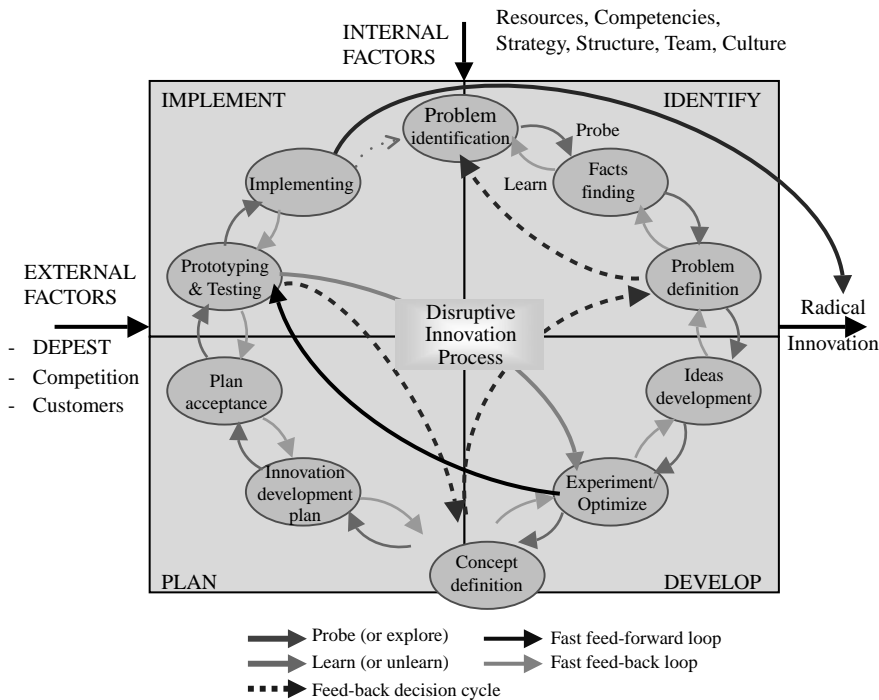


Figure 2.
Dynamic disruptive innovation process

Disruptive innovation capability

Disruptive innovation is a very hard concept to grasp and hardly a one-time effort; rather, it is an all-absorbing activity requiring continuous improvement in the overall capability of firms (Cohen and Leventhal, 1990). Based on her research, Henderson (1993) suggests that incumbents invest more in incremental innovation than in radical innovation and are significantly less effective than entrants in their efforts to introduce radical innovations successfully, such that it makes their existing capabilities obsolete. The term “capabilities” emphasises the key role of strategic management in appropriately adapting, integrating and reconfiguring organisational skills, resources and functional competencies to match the requirements of a changing environment. In high-velocity markets, the ability to renew competencies to accommodate the changing business environment is very important, referred to as dynamic capabilities (Teece *et al.*, 1997). Most often, disruptive growth opportunities lie outside a company’s current technology base and markets. We therefore define disruptive innovation capability as:

The internal driving energy to generate and explore radical new ideas and concepts, to experiment with solutions for potential opportunity patterns detected in the market’s white space and to develop them into marketable and effective innovations, leveraging internal and external resources and competencies.

Inhibitors of disruptive innovation

Many companies encounter internal and external barriers or inhibitors that get in the way of developing the right capabilities to support innovation. While internal

and external forces of change stimulate innovative exploration, internal resistance to change often prevents it. How much impact the removal of inhibitors has on a company's disruptive innovation capability and how much of a challenge their removal presents depends on the nature of these barriers. In our research, we identified several key inhibitors that negatively affect a company's disruptive innovation capability.

The "Adoption Barrier" (cluster 1)

Dominant design, path dependency and successful concepts. Many winners often become losers, losing their innovative edge (Paap and Katz, 2004). Many enterprises limit themselves for too long to incremental innovation, such as improvements of existing designs and technologies, the so-called dominant design. They run the risk of being overtaken by entrepreneurial companies that introduce a disruptive innovation that totally disrupts the market (Christensen, 2003). The Swiss watch industry is a striking example. In 1970, 90,000 employees worked in 1,600 companies in the Swiss watch industry, which owned 90 per cent of the world watch market. Within 10 years, over 800 companies went bankrupt and 50,000 employees lost their jobs. The watch industry changed radically, but the Swiss industry did not adopt the change, even though they themselves had developed the disruptive quartz technology. In 1990, a new Swiss company (SMH) developed the Swatch watch based on quartz technology and became the world's number-one watch producer within the shortest possible time (Tushman, 1997; Paap and Katz, 2004).

Existing successful products, designs or technologies limit the will to take risky initiatives and increase the risk of falling into the familiarity trap, the tyranny of success (Ahuja and Lampert, 2001; Christensen, 2003). Many companies have become prisoners of their own successful business model, such as McDonald's, Coca Cola, Xerox and Siemens, unable to unlearn (Hamel, 2002; Paap and Katz, 2004).

Especially with a dominant design, technology innovation is path-dependent, with roots in the past that the company has continued ever since (van Ex, 1999; Christensen, 2003). There were much better alternatives to the QWERTY keyboard, such as the Velotype, DVORAK and anti RSI-variations, but none of them survived.

Organisational dualism

Paap and Katz (2004) argue that patterns of success may cause a conflict between functioning efficiently to sustain the current successful business model and incorporating disruptive innovations that will enable a company to be competitive in the future. Brown (1998) terms this one of the trickiest issues we face in achieving the right balance between centralisation and decentralisation. The hierarchical structure, although an effective structure for routine-based processes, activities and continuous improvements (doing what we do best), is less appropriate and flexible for radical innovation development (Moorman and Miner, 1997). Large corporations often lack a clear two-fold structure, combining consistency for incremental innovation, and flexibility and experimenting capabilities for radical innovation (Cosier and Hughes, 2001; Tushman, 1997; Sharma, 1999). Xerox Corporation addressed this dichotomy by creating small spin-offs like Xerox New Enterprises to better exploit its innovative research capability (Loutfy and Belkhir, 2001).

Excessive bureaucracy

Excessive bureaucracy is often synonymous with large organisations that demand allegiance to rules and procedures that ultimately frustrate creativity, and as a result are slower to react and less willing to take risks (Quinn, 1985). Existing successful products, a dominant design and a risk-averse attitude create a status quo preference that limits the willingness to stimulate disruptive innovation and to accept cannibalisation of its own investments (Chandy and Tellis, 1998). According to Stringer (2000), generic conservatism and learning deficiency are the main reasons why large companies find it so hard to successfully embrace radical innovation and then commercialise on it. Stinger argues that most large companies are genetically programmed to preserve the status quo; they have invested too much in it to embrace radical innovation.

When companies grow (e.g. through merger) they often lose the capability to penetrate smaller, emergent markets as it usually does not serve their growth needs (Loutfy and Belkhir, 2001; Christensen, 2001, 2003). Product sales margins can be perceived as adequate by smaller companies, whereas large organisations may consider them inadequate, often due to the higher cost structure. Digital Equipment Corporation (DEC) was used to the high sales margins of its minicomputers, but considered the margin structure of PC's to be inadequate.

Stifling of the status quo

Deviations from the standard are often not appreciated, as variety is perceived as negative in many large corporations. Yet standards, such as dominant design, are often barriers to innovation. Because many companies prefer the stable, efficient environment to fulfil market requirements, the status quo is reinforced; and the familiar, stable and close-to-home situation is maintained at the expense of new opportunities, "That's the way we've always done things around here" (Lettice and Thomond, 2002; Stringer, 2000; Sharma, 1999). This invocation of a dominant and familiar paradigm to address problems reduces the probability of experimentation and of radically different approaches, hence falling into the familiarity trap (Ahula and Lampert, 2001).

The "Mindset Barrier" (cluster 2)

Inability to unlearn. Unlearning is defined as the process by which people and firms eliminate old logic (test the validity of their beliefs and discard the present way of doing something) and substitute it with something fundamentally new (Sinkula, 2002; Baker and Sinkula, 2002). The ability to unlearn is one of the most critical competencies people require to overcome pre-judgement and obsolete mental models, key barriers to disruptive innovation. Unlearning is central to higher order learning: the capability and application of generative and meta-learning and challenging assumptions (Argyris, 2000; Baker and Sinkula, 2002; Senge, 1994). It must take place both at the individual and at the organisational level.

Most (organisational) unlearning is problem-driven, and is set in motion by some external shock to the organisation (Sinkula, 2002). The ability to sense when unlearning efforts should be initiated seems critical. Inability to unlearn, to break through the barriers of conventional thinking, and to discard outdated beliefs hinders the shedding of obsolete mental models. This influences, for instance, the way market

information is collected, interpreted and acted upon. If core assumptions are not examined, correct interpretation and unlearning are inhibited. Apple Computer's outsider status in the music industry gave it an independence of thought and action that allowed it to do what the music industry itself apparently could not do – sell single songs rather than CD albums (Wind and Crook, 2005).

Lack of distinctive competencies

Core competencies, although very useful in the past, can become “core rigidities” or “capability-rigidity paradoxes” for future effective radical innovation (Leonard-Barton, 1992; Johannessen *et al.*, 2001). Knowledge about, and use of, old competencies inhibits efforts to change capabilities (Leventhal and March, 1993). In general, most large corporations lack the management ability to adapt the necessary skills to engage in and profit from new technology and to manage the challenges that will reap the business opportunities that lie in disruptive technology. Exploiting disruptive innovations is feasible through initiating new business development (NBD) processes and through corporate “venturing”, joint ventures, alliances, acquisitions and the like. However, many of these collaborations fail to generate breakthrough innovations because they focus on acquiring new products rather than new capabilities. They lack the ability to absorb knowledge (Powell, 1998). NBD is, in the first place, an experiment in maximising learning (Lynn *et al.*, 1996).

When aiming at radical innovation, a company is faced with radical uncertainty. This implies that a company lacks knowledge and does not even know which knowledge it lacks (Vanhaverbeke *et al.*, 2003). Lack of adequate technical and managerial knowledge often limits the capability of double loop, meta-learning and unlearning (Baker and Sinkula, 2002). Francis *et al.* (2003) identified several “pre-action barriers” of companies facing a “we are in the wrong place” strategic dilemma of how to approach the issue: avoidance (seek to avoid the reality), indecision (strategic direction dilemma), poverty (need to take action when financial results are poor), insularity (need to destroy what was created successfully before), and inability (lacking skills to lead transformational change). In addition, the lack of adequate numbers of highly-educated individuals is another cause for concern (Sirilli and Evangelista, in: de Jong, 2003).

Obsolete mental models and theory-in-use

Mental models, individual and organisation-wide beliefs about the world and how to make sense out of it (why are things done the way they are done), that no longer fit the changing environment or competitive situation, mould the development of theory-in-use, the tacit knowledge system of the organisation (knowing how, but not necessarily why, things are done the way they are done). It forms barriers on the way to developing disruptive innovations (Baker and Sinkula, 2002). When redefining the driving force of the business, previously helpful routines become rigidities and stumbling blocks, since they are often, in part, tacit (Francis *et al.*, 2003).

Deeply-seated personal mental models are not given up peacefully. Brown (1998) argues that changing the mental models of the corporation and its underlying business models are amongst the hardest things to change. Previous business successes and success formulas often retard rather than enhance the capacity to unlearn (Baker and Sinkula, 2002). The dominant players are trapped by their own success. It is no

surprise that pioneering technologies, breakthrough business models and disruptive innovations are usually brought about by outsiders and from unrelated contexts, not by the dominant players. The music industry clung to a mindset from the old order and paid a high price for holding back the tide of the new online music business led by Apple's iTunes, Music Store and iPod (Wind and Crook, 2005). Enterprise software (ERP) was developed by SAP, not by IBM or Microsoft; mobile phones with cameras were invented by Ericsson and Sony, not by market leader Nokia.

The power structure of the organisation generally determines which mental models are adopted. Kenneth Olsen used a brilliant model for minicomputers to build DEC into a powerhouse, but became so attached to this successful model that he was blindsided by the rise of the personal computer.

The "Risk Barrier" (cluster 3)

The learning trap. Inward-focus, which often reinforces the "not invented here" syndrome and groupthink, is one of the traditional barriers to innovation. Most of the companies looking for a stable environment fall into the learning trap, a tendency to keep on doing the same thing even in situations where it is no longer effective. Experience, routines, procedures and familiar knowledge that were relevant in the past, may prove to be inadequate in a new situation. Learning traps embody the conflict between efficient routines and processes to continue successful businesses and the need to challenge these capabilities to bring about future disruptive innovation (Levinthal and March, 1993). This retards the development and exploration of disruptive ideas and proactive approaches (Moorman and Miner, 1997; Unsworth, 2001; Ahuja and Lampert, 2001; Sandberg, 2002). In particular, it applies to large and mature companies (Christensen, 2002). Organisation members often create their identities based on what they know how to do well. Deviating from existing knowledge domains poses a threat to the identity of an organisation.

Lack of realistic revenue and ROI expectation

Pressure to predict a monetary return on investments in disruptive innovations poses a barrier to innovation (Harper and Becker, 2004). Aggressive revenue expectations and targets of disruptive innovations can keep venture managers from choosing to target emerging markets, places where disruptive technologies are likely to find their initial success, or including features that may please customers in existing markets, but will make the product too expensive (Gilbert, 2003).

Based on research, Neely and Hill (1999) have identified several innovation inhibitors, such as high and difficult to manage innovation costs, fear of imitation, long pay-back time, lack of adequate financial resources and high-risk expectation.

High risks and uncertainty

Companies are faced with radical uncertainty or second-order ignorance: They do not, and cannot, know in advance what they need to know. No single mind can specify in advance what kind of practical knowledge is going to be relevant, when and where (Tsoukas, 1996). Especially with technological innovation, radical innovation explores areas that are novel; the technological feasibility is usually a major problem and forecasting sales is nothing more than a reasonable guess (Vanhaverbeke *et al.*, 2003). In the early phases of a disruptive innovation, anticipating and influencing market

potential and market demand is very insecure, but essential to influence it pro-actively in order to avoid the “chasm-pitfall” and reduce uncertainty (Wieffers, 2002; Sandberg, 2002). According to Brown (2003), it is not technology as such that matters, but technology-in-use, something that is hard to predict ahead of time. Unpredictability makes it hard to obtain long-term internal support and resources (Sandberg, 2002; Christensen, 2003; CBS, 2003).

Risk averse climate

Even when a radical idea is accepted, it does not mean it will lead to a radical new development. It requires a climate that is receptive to uncertainty, to unusual ideas, to a probe-and-learn approach. It is hard to obtain continuous management support when risks and uncertainty are high (Rice *et al.*, 2000). The failure rate of products of innovation projects is rather high (Shilling and Hill, 1998; Lynn and Reilly, 2002). The high cost associated with product development, combined with the low success rate of new products, scares senior management away from investing in “wild new ideas” (Hamel, 2002). If innovations are successful, it often happens in spite of the system and in the absence of senior management support, such as, for example, the PlayStation idea within Sony (Hamel, 2002). This is possible when disruptive innovation projects are driven by highly-motivated, project champions. The barrier to disruptive innovation frequently turns out to be senior management’s lack of courage and a climate that supports a management approach of control rather than trust (Stringer, 2000; Perel, 2002). A Fortune 500 survey by McKinsey and Company showed that fear of risk-taking was the number-one barrier to innovation (Foster and Kaplan, 2001). An inward focus, the legitimate benefits of proven technologies and a dominant market position further stimulate the risk-averse attitude (learning trap).

Unwilling to cannibalise

Cravens *et al.* (2002) and Chandy and Tellis (1998) argue that firms that dominate markets are often reluctant to foster radical innovation because they are unwilling to cannibalise their own investments and assets until it is too late. Although substitution of existing products and markets mainly applies in a later phase of the process, due to the initial sub-optimal state of the disruptive innovation for existing markets, it may affect early management decisions (Christensen, 2003). Brown (1998) argues that the greatest difficulty a company encounters is the challenge to the architecture of a company’s revenues when it attempts to introduce a technology change. This kind of change is the hardest for corporations to accept and act on. According to Chandy and Tellis (1998), especially in the case of successful and dominant products, processes and business models, people remain committed to their earlier decisions and tend to justify their prior decisions to themselves (self-justification) and others (save face). According to an extensive research study by Deloitte Research (2004), established companies are focused on short to medium term growth and so try to protect their current products. In digital photography, senior management of Kodak, AGFA and Ilford hesitated too long in cannibalising their chemical film processes with innovative but initially higher cost per print digital printing technology. Just because its current business model had been so successful, Motorola continued building analogue wireless phones at a time when the industry had turned to global digital standards (Wind and Cook, 2005).

The “Nascent Barrier” (cluster 4)

Lack of creativity. Large corporations lack the motivational capacity of small companies to “nurture” or motivate innovative people who have new, creative and “break-the-rules” ideas (Stringer, 2000). According to Ahuja and Lampert (2001), in ambiguous and uncertain environments reliance upon historical experience and the search for solutions in the area of existing solutions are often the norm. Standard business routines stifle the creative thought process and feed intolerance of differences by denying diversity (Unsworth, 2001; Quinn, 1985). Nayan and Ketteringham (in: Roffe, 1999) stated that curiosity within the originating person is a driving factor in innovative breakthroughs. Feurer *et al.* (1996) argue that future radical improvements in organisations hinge on creativity. Often, creativity has not been systematically incorporated within the teams’ and individuals’ thinking patterns (Feurer *et al.*, 1996; Al-Mashiri and Zairi, 1999). Thus, from a corporate innovation champion’s perspective, an effort based on known antecedents is less risky than exploring novice roots.

Lack of market sensing and foresight

In general, market research works well for incremental innovations in existing markets. However, conventional market research in the case of radical innovation can have a devastating effect on the development of radical ideas, or can even be misleading (Trott, 2001; Lynn, 1996). Market research tests for the first video recorder, fax, microwave, mobile telephone, FedEx and Sony’s Walkman were all negative. Akiro Morita, former Sony CEO appears to have said: “Our plan is to lead the public with new products rather than ask them what kind of products they want. The public does not know what is possible, but we do.” Markets that do not exist cannot be analysed. Who would have asked for a subscription to an internet provider 15 years ago, or asked for a TV 75 years ago? Owing to the long development time of disruptive innovation, chances are high that customer needs will have changed anyway in the meantime along with technology and competition (Mullins, 2000). Empirical research by Gatingnon and Xuereb (1997) validates the assertion that strong customer orientation leads to less radical innovation among firms. Christensen (2003) provides evidence that dominant firms in the high-tech sector have lost their market position by staying too close to their customers. In contrast, disruptive innovation searches for the unexploited white spaces between disciplines, and probes latent needs (Brown, 1998). Innovators imagine the future, then invent it. Entrepreneurs need an incredibly good ear for making sense of the backtalk from the marketplace, and a great sense of timing.

Disruptive innovations are often sub-optimal in their early phases. Trying to please customers in established markets, where performance expectations are high, will often lead to failure. Initially, focusing on emergent markets or low-cost applications where requirements satisfy the lowest common denominator is a more secure way to leverage the breakthrough in design and manufacturing (Gilbert, 2003). While many technologists monitor the technology landscape for clues that their technology is about to become obsolete, they often fail to see the signs in time, according to Paap and Katz (2004). Radical innovation is often hampered because technical insights are not recognised as opportunities (O’ Connor and Rice, 2001). The importance of challenging and unlearning misguided beliefs and assumptions is a vital aspect in this learning process (Slater and Narver, 1995; Ross in: Senge, 1994).

Senior management turnover

Executive turnover during the long period of innovation projects – a period often lasting 10 to 15 years – creates substantial challenges for disruptive innovation teams and corporate venture capital organisations. The consequences of these personnel changes affect commitment continuity severely (Rice *et al.*, 2000).

Innovation process mismanagement

In a study, Oke (2004) identified the lack of an effective innovation development process as a barrier to innovation management. Stringer (2000) refers to a recent study that concluded that the single biggest growth inhibitor for large companies was mismanagement of the innovation process. According to Stevens and Burley (2003), the personality of the individuals involved in the initial phases of the innovation process is as important as the innovation process itself. Only when the team “chemistry” is optimal, can the team be truly innovative and create “flow” (Levine, 1994).

Ashmos and Nathan (2002) argue that the deeper underlying cause of the problems with team performance is to be found in the command-and-control mental model that has prevailed in managerial thought for years. This model continues to persist despite the fact that today’s business environment is staggeringly complex, rapidly changing and unpredictable. Yet challenging, questioning, and provoking are activities teams should be engaging in, in highly turbulent environments.

The “Infrastructural Barrier” (cluster 5)

Lack of mandatory infrastructure. Decades can separate breakthrough inventions from their exploitation for commercial application, a gap which the innovation community refers to as the “Valley of Death”. Disruptive innovations often lack the necessary infrastructure, or may be too underdeveloped to be easily integrated. According to Walsh and Linton (2000), infrastructure can be divided into an “upstream” and “down-stream” component. The upstream component has to do with the technical newness of the radical innovation such as missing standards and processes, and the lack of production equipment. The downstream component refers to the market side, things such as market acceptance, available distribution channels, alliances, and external infrastructure. When electrification became possible, the whole external infrastructure was lacking for in-house use. Computer file transfer remained mainly a local activity until internet and WAN networks were introduced (Paap and Katz, 2004). Infrastructure factors such as the lack of regional support and insufficient state aid may also limit radical innovation progress (CBS, 2003).

Lack of adequate follow-through

Apart from possibly lacking “upstream” and “downstream” components in the infrastructure, a “midstream” component may be lacking, too. Florida and Kennedy (in: Lynn, 1996) indicate that the USA is good at developing “breakthroughs” but lacks the “follow-through” on which competitive advantage is based. Brown and Duguid (2002) regard the step from innovation to sustainable growth as one of the greatest challenges that innovative companies face. It requires close co-operation between, and management of, a practice-driven structure (R&D) and a process-driven structure (value chain). A successful disruptive innovation often demands an innovative business model that is enabled by technological innovation. Rapid business model

prototyping is as critically important as is technological innovation (Brown, 1998, 2003). Profitability of a new product can erode rapidly if it is not designed to be updated quickly, and if it cannot be marketed and serviced cost-effectively (Deloitte Research, 2004). Sandberg (2002) pleads for a close and pro-active co-operation between the marketing and development teams of radical new products. There is a great need to educate the market about radical new products to create timely awareness of the new concept or vision, even in the pre-introduction phase.

Conclusion

Disruptive innovation development is not a one-time effort; it requires a continuously developing absorptive capacity to improve the overall innovation capability of firms. As we have seen, large corporations in particular face several barriers or inhibitors on their way to developing and commercialising on disruptive innovations. These inhibitors are interrelated and partly interdependent. The conceptual model shown in Figure 3 demonstrates these interrelationships in a systemic way.

For large corporations, this conceptual model clearly emphasises two main inhibiting clusters (Figure 3: cluster 1 and 2), combined with three associated clusters (Figure 3: cluster 3-5).

The first cluster of interrelated disruptive innovation inhibitors is based on organisational rigidity and the existence of a dominant design carried on through successful concepts from the past. These inhibiting determinants reinforce the status quo within the organisation and limit the corporation's interest in taking on risky innovative initiatives (cluster 4) or cannibalising its past investments (cluster 3). It is the massive inertia produced by the previous technology's long-present base, the adoption barrier (Herbig and Kramer, 1993).

The second cluster comprises the inability to unlearn, lack of distinctive competencies and maintaining mental models that are out of sync. This positively interrelated and interdependent cluster largely affects the other inhibiting clusters and has a major influence on a company's ability to successfully develop and implement disruptive innovation. At both the individual and organisational level it reflects the inability to discard outdated beliefs and mental models, and lacks the appropriate competencies to challenge the rigidities in skills, knowledge, mentality and mindsets to face strategic dilemmas. This cluster comprises the "mindset barrier" as a potential inhibitor to disruptive innovation practices. It is related to management, for instance, in its lack of courage in taking business risks or in cannibalising existing products and markets in a timely manner (cluster 3). It hampers the ability to reengineer business strategies, to sense new opportunities, or to explore and experiment with radical ideas (cluster 4), such as those reflected in the dynamic disruptive innovation process (Figure 2).

The third cluster of associated inhibitors is related to the corporate attitude towards taking business risk, fed by a risk-averse climate and the lack of courage of senior management to distinguish between the fine line of meaningless risk and meaningful risk, the "risk barrier".

The fourth cluster of associated inhibitors is related to sub-optimal innovation process management. Inadequate team "chemistry" and motivation, commitment discontinuities, lack of sensitivity to weak signals, and lack of "out-of-the-box" creativity lead to an ineffective disruptive innovation process rather than a dynamic

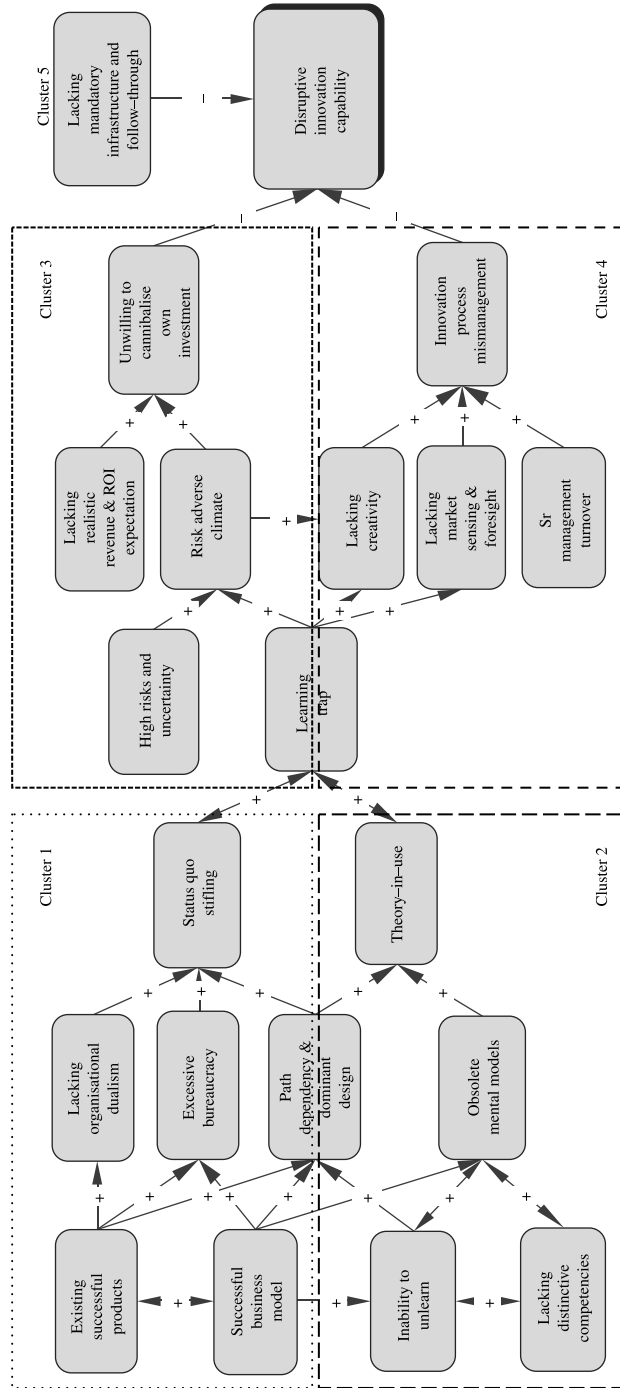


Figure 3.
Conceptual model of
disruptive innovation
inhibitors

process (Figure 2), the “nascent barrier”. The still-common command-and-control approach to the use of teams can lead to disappointing outcomes, particularly for navigating uncharted territories.

The fifth cluster represents an infrastructural barrier, based on exogenous and endogenous infrastructural inhibitors. These factors can delay the redeployment of radical innovations over a long period during which the market or demand may change substantially. The chances of implementing disruptive innovations successfully are further limited when a company’s value chain lacks the necessary and adequate follow-through capabilities.

There is still a vast gap between intention and actual disruptive innovation capability. Developing distinctive capabilities to overcome this gap should be an integral part of a company’s strategy for growth. How much impact the removal of inhibitors have on a company’s disruptive innovation capability and how much of a challenge their removal presents depends on the nature of these barriers. Removing a single inhibitor will, in general, not significantly improve a company’s disruptive innovation capability. However, transforming, reshaping and reconfiguring clusters of interrelated inhibitors have the potential to substantially improve a company’s disruptive innovation capability.

This paper is intended as a contribution towards the examination of managerial practices, in particular the examination of the inhibitors of disruptive innovation, which is of significant importance to large corporations given the economic stakes associated with such activities. The conceptual model of interdependent and interrelated inhibiting factors offers a better understanding of and a systemic approach to enhancing a company’s disruptive innovation capability. Companies should examine their corporate DNA to see whether they are able to respond effectively and proactively to future “white space” opportunities and develop a challenging internal climate in which open mindedness and entrepreneurial spirit are stimulated. Further research is needed, however, to validate the results of this literature study.

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