# Managing Exploratory Innovation: Towards an Analytical Framework

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## ABSTRACT

The literature on innovation has introduced different terms to characterize innovation that break with existing knowledge: radical, breakthrough, architectural, disruptive innovation. Beyond the profusion of notions and the confusion induced, each type is defined by the results of the innovation process and not the activities needed to achieve them.
The concept of exploratory innovation put emphasis on processes and refers to the literature on organizational learning and to the competence-based view (Greve 2007, Danneels 2002). However, it is conceptualized as opposed to exploitation processes, in particularly in the work on organizational ambidexterity (Tushman and O'Reilly 1996), and rarely on the basis of its own characteristics. Yet such innovation requires to conduct specific activities and companies develop many initiatives in this direction.
The objective of this paper is to propose a conceptual framework for the notion of exploratory innovation and the activities that underlie this process.
Our communication will be based on a synthesis of the literature and on empirical works previously published. In comparing and contrasting more specifically two cases studied we will illustrate the proposed model.
We will define exploratory innovation as combining three dimensions: a technological dimension, a market dimension and a strategic dimension. Indeed, radical innovation (Utterback 1994) refers to innovations that are based on radically new technological knowledge. Disruptive innovation (Christensen 1998) emphasizes innovation leading to a completely renewed analysis of the market. Architectural innovation (Hendersen and Clark 1990), value innovation (Kim and Mauborgne 1999) and business model innovation lead to insist on the strategic change that can be associated to such innovations.
We propose a conceptual framework for the management of exploratory innovation that differentiates two levels:

- a strategic level, the "strategic domain of innovation "
- an operational level, "creative experimentation"

Research works on organizational ambidexterity emphasize the importance of establishing a unit dedicated to exploratory innovation, the exploration unit. Studies on radical innovation management focus on innovation programs (O'Connor and De Martino 2006) which

encompass multiple projects. Le Masson, Weil and Hatchuel (2010), introduce the concept of design space and stress the iterative generation of new concepts and new knowledge. Elaborating on these works we will introduce the concept of “strategic domain of innovation” and explain how its scope is defined. We will highlight the managerial issues to be tackled at this level that are related to the relationships between the innovations considered and their implications for the strategic positioning of the company.
We will insist on a second level of management: the "creative experimentation". Exploratory innovation is associated to medium and long term returns. However, the literature has outlined that early interactions with potential customers are decisive in its success. Lynn, Morone and Paulson (1996) stressed the importance of "low cost probe" to guide the development of radical innovation, Von Hippel (2005) highlighted the role of lead users and user communities. Chesbrough (2010) call for business model experimentation. We will underline that these creative experiments are intended to identify new value propositions, novel uses as well as scenarios for organizing the value chain and revenue streams. They are generative and unlike the experimentation characterized in the new product development literature (Thomke 2003), they are not intended to validate the earlier stages of the design process.
This framework we hope could contribute to foster further research on exploratory innovation.

**Key words**: exploration, strategic renewal, value innovation

## Introduction

The literature on innovation has introduced different terms to characterize innovations that are "really new" and break with the existing knowledge of the firm: radical, breakthrough, architectural, disruptive innovations. Beyond the profusion of notions and sometimes the ambiguity induced, each term defines a type of innovation rather than a process, and management principles needed to achieve them. It appears therefore necessary to better characterize innovation processes that are based on knowledge that is not familiar to a particular firm. We argue that the concept of exploratory innovation can, to a certain extent, encompass the different terms characterizing "really new" innovations mentioned above. It places emphasis on processes (i.e. the processes of exploring) rather than on results, and can therefore be associated with management principles.

The concept of exploratory innovation has been used in reference to the literature on organizational learning and to the competence-based view (Greve 2007, Danneels 2002). In this research stream, exploratory innovation is considered as based on new knowledge regarding technologies and/or markets. In line with the distinction introduced by March between exploitation and exploration, exploratory innovation is often studied as opposed to exploitative innovation. Thus the literature on organizational ambidexterity (Tushman and O'Reilly 1996, Gibson and Birkinshaw 2004, Raisch, Birkinshaw, Probst and Tushman 2009) discusses the balance between exploitation and exploration but exploratory innovation is rarely studied on the basis of its own characteristics and there are few contributions highlighting how to manage exploratory innovation processes.

Yet such innovation requires the conduct specific activities. Established companies develop many initiatives to foster exploratory innovation besides their usual business. But how should they proceed? Are exploratory innovation management principles somehow specific?

In addition, research on exploratory innovation refers to rather different definitions of these processes (Li et al. 2008). Considering the lack of operational definitions of exploratory innovation and of actionable knowledge about the management of such processes, our objective is to propose a conceptual framework for the notion of exploratory innovation and the activities to be developed to foster this process.

In a first part we will propose a definition of exploratory innovation, contrast this notion to various types of innovation previously underlined in the literature, and stress characteristics that require specific management of such processes. This part will be more theoretical and based on a literature synthesis and modeling.

In a second part we will propose a conceptual framework for the management of exploratory innovation. This part will be based on empirical case studies on the management of exploratory innovation, that we, the authors, carried out in our previous work and which have led to publications. The share of our research field experiences led us to identify two levels in the management of exploratory innovation: the first one is a strategic level and consists in managing strategic domains of innovation, the second one is more operational and is concerned with the conduct of creative experimentation, here referred to creative experimentation. We illustrate these two levels by different management principles based on our field studies and provide theoretical arguments to support this model. Finally, we argue that the suggested model of the management of exploratory innovation may both inspire future research on exploratory innovation and help managers to better manage these processes.

## 1. Characterizing the phenomenon of exploratory innovation

With reference to the literature on so-called radical or breakthrough innovations, it should here be recalled that the notion of exploration borrows from the properties of types of innovation as well as from the management processes of the innovation activity. In addition to this first stream of literature, which first and foremost sought to qualify the types of breakthrough innovation, another one can be found on the management of exploration, which focuses on renewing knowledge and skills, and on the ways of extracting "dominant design" from exploitation.

### 1.1. A genealogy of "really new" innovation concepts

Use of the term "exploration" has boomed in the last ten years or so in management literature. According to Danneels (2002), exploration is defined as "a corporate learning activity that leads to the addition of new resources or skills." Danneels defines "pure exploration" as situations in which the company must at once renew its technical and market-related knowledge base. In this vein, exploration helps to further boost the variety of knowledge bases that the company commands. A company that explores is one that distances itself from the knowledge sets that it applies to its usual processes, breaking with its usual knowledge sets. The notion of exploration thus falls within a genealogy of innovation management literature concepts that for a long time have drawn distinctions between various forms of "breakthroughs."

**Radical innovation or breakthrough innovations**

Along the same lines as the foundational research done by Abernathy and Utterback (1978)

on dominant design, one strain defines radical innovations by the performance differential that new technologies bring vis-à-vis those most prevalent in the existing market space. The "radical" aspect of the innovation is observed after the fact, when "the product and its attributes have gained acceptance by the majority of market players" (Utterback, 1994). This research focuses on comprehensive industrial sectors, but does not directly focus on the act of innovation. The research serves to qualify market breakthroughs. The notion of discontinuous innovation (Anderson and Tushman, 1990) advances this research well, in that innovation is viewed as one step in a long-term process. Revolutionary or paradigmatic changes (new technologies, for example) modify a company's technological path. From qualifying the breakthrough, a company advances to a given moment in time, within a long-term process, that transforms the company's routines. A classical example of such radical innovation is provided by the shift from sailboats to steamboats for the transportation of goods in the XIXth Century.

**Disruptive innovations**

Along the same lines as research on radical innovation, Tushman and Anderson (1986) introduced the distinction between radical innovation and incremental innovation, depending on how new a product is when marketed for the first time. Christensen (1997), however, advances that qualifying an innovation as "incremental" or "radical" bears little relevance to innovation management concerns. It would be better to focus on the logical frameworks according to which innovations are marketed, in terms of performance gains vis-à-vis existing solutions. Christensen distinguishes two approaches in this sense. On one hand, certain innovations target improved performance of existing applications alone. Christensen qualifies these as sustaining innovations, regardless of whether the innovations are incremental or radical. On the other, we have innovations geared toward creating new markets, by changing

up the established dominant designs, bringing about new behaviors and new uses, such as when Sony invented the first portable radio, which it proposed as an alternative to the RCA living room models. Christensen refers to such innovations as disruptive innovations, for they propose the realization of "activities that one couldn't previously perform" (Christensen and Raynor, 1999). In other words, sustaining innovations improve existing systems, whereas disruptive innovations transform the rules of the game, by changing the dominant design of products and modifying uses. The proposed vision of disruptive innovation thus incorporates the rules and uses in effect thus far on markets, as opposed to merely focusing on the technological dimension advanced in qualifying innovation as radical or incremental.

**Value innovation and business model innovation**

Value innovation (Kim and Mauborgne 1999, 2005) presents a renewed approach to competition strategies in the context of hyper-competition (D'Aveni, 1994). Kim and Mauborgne studied new market spaces breaking with established markets, qualifying those spaces as "blue oceans" in contrast to "red oceans", which designate head-on competitive struggle spaces focused on price or quality. The targeting of non-consumers and the invention of new markets take precedence over innovations in established markets, in that they allow new arrivals to position themselves without fearing reprisals from leading companies equipped with significant assets such as client portfolios, distributor networks, and solid branding positions. These "virgin" spaces of non-consumership are of two-fold interest; in not being previously identified or valued by leaders in the market, they are ideal markets for learning. Kim and Mauborgne construct "value curves" around an industrial sector or segment. They revisit the components of value chains by focusing on shifts in competition standards and in the invention of new business models for non-consumers. In other words, the authors are not so much explaining a mechanism for creating new values as they are a

mechanism for differentiating oneself from existing business models. Authors such as Chesbrough (2010) or Osterwalder and Pigneur (2010), for their part, promote breaks with corporate business models. In this sense, innovation occurs as much vis-à-vis business models as it does product or service offerings in the strictest sense (Teece, LRP 2009).

**Meaning Innovation**

The literature on "design-driven innovation" analyzes the success that certain innovative firms have had in areas such as the implementation of an innovation strategy based on product meaning. Verganti (2009), for example, considers that clients are in search of new meanings through the purchase of certain products. Clients use products for emotional, psychological, or socio-cultural reasons, as much as for functional reasons. This approach supplements more traditional approaches to innovation, which focus on the company's ability to market products or services that are based on new technologies or on the ability to comprehend users' needs and to incorporate uses to the development process (so-called "user-centered innovations"). Knowledge gleaned from relationships with "interpreters of meaning" is incorporated by the company into an in-house research and experimental process, which allows the company to develop new meanings. This process of searching for new meanings, which occurs previous to product development, is exploratory in that it aims to create a new, "breakthrough" product line, or a new business.

As the table below summarizes, finally, the various forms of "breakthrough" that in the literature qualify the notion of innovation fall short of providing an exhaustive definition, despite defining the properties of the notion of exploration.

| Types of innovation defined in the literature | Characteristic of corresponding breakthroughs |
|---|---|
| Radical or breakthrough innovations | Technological breakthrough, renewal of dominant design |
| Disruptive Innovation | New market, new uses |
| Value innovation, Business model innovation | New rules of the game, new value propositions |
| Meaning Innovation | Change in the identify of objects, new meanings of use |

The notion of exploration and the process of exploration present new challenges vis-à-vis these traditional categories that we have just eliminated. If one is interested in exploratory activity, for one, that which marks a breakthrough from either "before" or "after" cannot be directly exploited from a managerial point of view; such markers serve to define a breakthrough, rather than explaining how such a phenomenon comes about. In addition, most of the time, exploratory innovation may seem to be synonymous with radical innovation (Li et al. 2008) or as a combination of radical innovations (a new technological trajectory); this is why we need to characterize exploratory innovation as a process defining various types of breakthroughs, rather than as merely a technological breakthrough or a market-based breakthrough.

### 1.2. Exploration and developed knowledge

According to March (1991), an organization's long-term success depends on its ability to exploit its current capabilities while fundamentally exploring new competencies. Originally,

exploration was associated with organizational learning, qualifying the pursuit and acquisition of new knowledge (March, 1991). Scholars often interpret exploration as a search for distant knowledge, and exploitation as a local knowledge search (Benner and Tushman, 2002, Sidhu et al. 2007). The distance of knowledge search would lead, more or less, to learning on a continuum (Gupta et al. 2006), which in turn would foster innovation by augmenting a firm's knowledge base and knowledge variety inside the firm (Sidhu et al. 2007). Building on this knowledge-based view of exploration, some scholars have tried to better characterize the concept and to go beyond the original list of "things" suggested by March (1991). For example, Sidhu, et al. (2007) conceptualize the knowledge search in exploration as falling within three dimensions: supply search, demand search, and spatial search. Supply search relates to technologies and product design wherein the search for demand describes knowledge about aspects such as targeting new customers, understanding customer needs, market preferences, and product use patterns, among others. The authors furthermore argue that searching for opportunities in different geographic regions is a central aspect of the exploration activity, which is of a different nature as the two former dimensions (supply and demand). This is in line with the proposition of Li et al. (2008), who distinguish between three types of distance of knowledge: cognitive distance, spatial distance, and temporal distance. Cognitive distance can encompass supply and demand search in so far that knowledge of new types of customer use or on new technologies involves a cognitive effort to assimilate this knowledge. Li et al (2008) also suggest taking into account the criteria of temporal distance, meaning that searching for historical data is a form of distant knowledge searching.

In sum, this knowledge-based view of exploration tries to characterize the distance of knowledge in various dimensions: cognitive (supply and demand), geographical and temporal.

### 1.3. Exploratory innovation: A definition

Another, complementary view of exploration is more explicitly linked to the innovation activity, and leads to the concept of exploratory innovation. Sometimes, the concepts of exploration and exploratory innovation are not clearly distinguished, leading to a certain conceptual confusion. This confusion between exploration and exploratory innovation may be due to the fact that innovation is often seen as an outcome of exploration due to the generation of knowledge variation (Mc Grath, 2001). Thus, when considered as a process, the concept of exploratory innovation is often mixed up with the concept of exploration and viewed as an information processing activity based on distant knowledge search (Jansen et al. 2006; Li et al. 2008). When considered as a result, exploratory innovation may be seen as synonymous with radical innovation (Li et al. 2008) or as a combination of radical innovation (with a new technological trajectory) and new markets or customer segments (Benner and Tushman, 2002; Danneels, 2002). However, Greve (2007) refers to "exploration in product innovation" and defines the notion of "organizational exploration" as the "search for new knowledge, use of unfamiliar technologies, and creation of products with unknown demand." This definition is clearly oriented towards innovation but does not refer to the concept of exploratory innovation as in other research. Hence, authors studying exploratory innovation do not share a common definition. This is why we need to characterize exploratory innovation as a process, going beyond the knowledge search activity, which forms, in our view, only one part of the process. Indeed, some authors recognize that innovation is not always driven by new scientific discoveries or technological innovation, but, for example, by new business models (Teece, 2009), new social needs (Li et al. 2008) or even new meanings (Verganti, 2009). All this can be defined as "value innovation" (Kim and Mauborgne, 1999, 2005). Therefore, one central activity of exploratory innovation is the definition of innovative value propositions,

based on the combination of distant knowledge pieces put together according to the firm's own strategic vision. In his book on "design-driven innovation", Verganti provides many examples of innovations based on a new strategic vision and the formulation of new value propositions. For example, the Italian company Artemide, with its Metamorfosi lamp, has not designed a lamp with improved features or performance, but has proposed a new meaning of a lamp contributing to a light ambiance making people feel better at home. Verganti names "design-driven innovations", innovations articulating a shift in the technological trajectory and the emergence of new meanings.

In sum, distant knowledge search would be for us an antecedent of exploratory innovation, whose central characteristic is both a shift in the technological trajectory and the search for new value propositions (including what Verganti calls "new meanings"). Following Danneels (2002), we consider that the exploratory innovation activity, if it succeeds in bringing new products or solutions on the market, will renew the strategic competencies of the firm and contribute to organizational learning (Figure 1).

We will base therefore our research on the following definition:

*Exploratory innovation is a knowledgeable and manageable process that involves a shift in the existing technological trajectory of the firm and a search for new value propositions that may lead to its strategic renewal.*

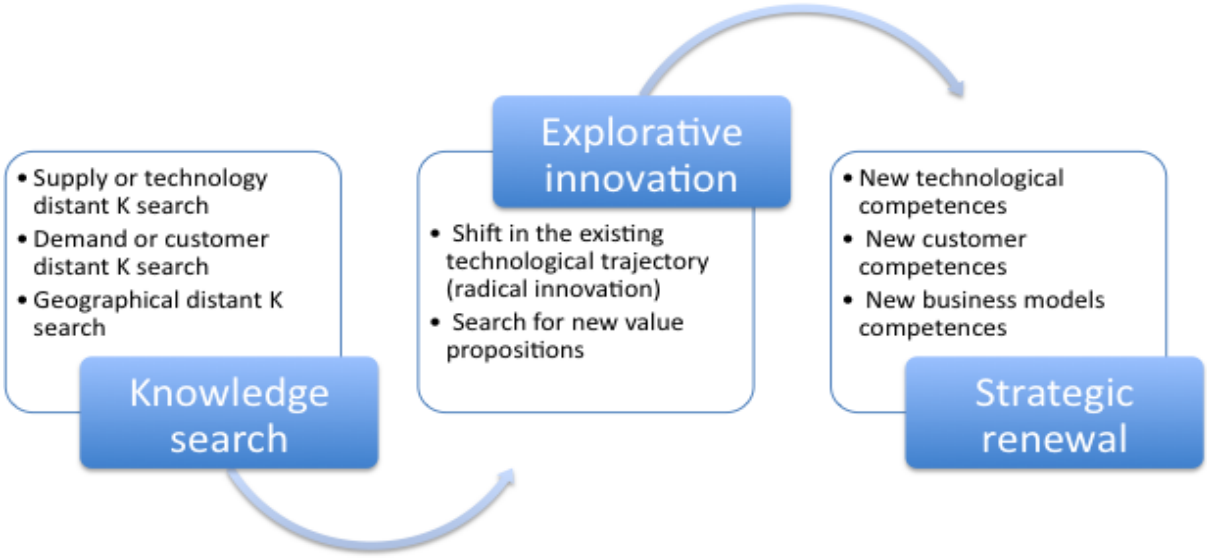



Figure 1. A model of exploratory innovation

## 2. How to manage exploration: An analytical framework

Now that the phenomenon of exploratory innovation has been characterized, this second part examines the areas in which companies can act to manage these exploratory innovation processes. The literature cited above is much more prolific in terms of characterizing the phenomenon of exploratory innovation than it is on studying these areas. We will show that exploratory innovation is a process that, for pioneering companies, relies on clearly identifiable management mechanisms.

With reference to literature that uses longitudinal analyses of processes leading to exploratory innovation as defined above, we identify two main levels for managing exploratory innovation, for which we characterize the underlying logic, the practical modalities, and

associated learnings: the management of **strategic domains of innovation** and the management of creative experimentation. For each of these levels, two examples are referenced to illustrate the practical modalities of implementation: the Domauto[1] case, which illustrates management of a strategic domain of innovation by a car manufacturer, and the Axane case, which illustrates implementation of **creative experimentation** directed toward potential clients in new areas of application.

### 2.1. Managing strategic domains of innovation

Research on organizational ambidexterity has pondered which management methods enable one to at once conduct exploratory innovations, as previously defined, and exploitation innovations. Several authors recommend dedicating an organizational entity to exploratory innovation (Tushman and O'Reilly 1996, Benner and Tushman 2002, Christensen 1995), postulating that exploratory innovation requires specific management methods. Other authors, on the contrary, suggest that the same individuals, in the same units, contribute to both exploration and exploitation, underlining the complementarity between exploitation learnings and exploration learnings (Gibson and Birkinshaw 2004, Greve 2007).

In the end, literature on ambidexterity particularly focuses the debate over which organizational structures are most apt to support exploratory activities, rather than on the methods for managing exploration, regardless of the structure at hand. An initial difficulty, then, for a company that wishes to develop exploratory activities, relates to defining the field or area to be explored. Exploration being by definition an activity that is based on knowledge sets that are distant from those mastered by the company, defining a new area for exploration becomes a strategic decision. Exploration management cannot be reduced as such to organizational concerns. In empirical cases analyzed in research on ambidexterity, whether in

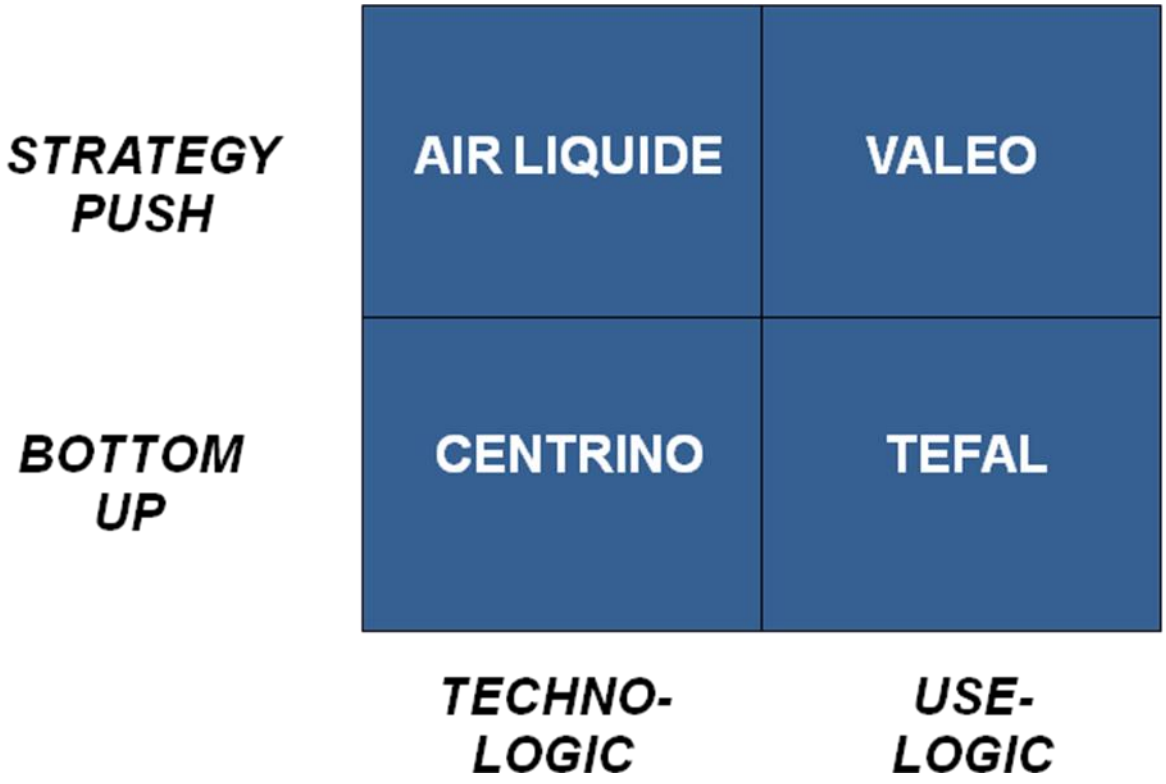
[1] Actual name of the company has been changed.

relation to USA Today and digital media (O'Reilly and Tushman 2004), or Walgreens and online pharmacies (Westerman et al. 2006), for example, one can distinguish an area in which the company is pondering which performance-enhancing strategies to deploy and the innovations that will support them. If, furthermore, as Danneels suggests, exploratory innovation must contribute to the renewal of core competencies, this requires a framework for capitalizing on knowledge. Our first proposal (P1) therefore is as follows:

If exploratory innovation is to contribute to strategic renewal, it requires a method for strategically framing the exploration activity and for capitalizing on experiences. This is the notion of the strategic domain of innovation.

### 2.1.1. How is a strategic domain of innovation defined?

The definition of a strategic domain of innovation can follow several lines of logic: the domain can correspond to one of a company's strong strategic focuses (strategy-push logic), or can also emerge from a successful experiment in innovation (bottom-up logic). The strategic domain of innovation can furthermore find structure around a new technology through which opportunities are sought (techno-logic), or new solutions to use-related issues that are sought (use-logic). From this basis, we propose that a distinction be drawn between four ways of defining strategic domains of innovation (Table 1).




A strategic domain of innovation can result from a strategic analysis that identifies a set of new opportunities or threats in relation to which the company wishes to specify its innovation trajectory. Such opportunities or threats can be related to a new technology. This is the case with digital technologies for a traditional media outlet or internet outlet, or for fuel cell technologies (technologies using hydrogen to produce electrical energy) for Air Liquide, a leading manufacturer of hydrogen. Indeed, if these technologies are developed, the company will face an entirely new market, which could by nature lead to robust growth.

*Strategy-push / Use-logic*

Opportunities and threats can be related to new uses or new use values. This is the case of carbon dioxide emissions in the automobile industry, as increasingly strict regulations are leading manufacturers and suppliers alike to quickly develop innovations that help reduce these emissions, be they systems related to the recovery of braking energy, to exhaust, to the optimization of heat engines, to stopping engines at traffic lights, or to electrical motor

systems, among others. In this case, it is not a technology that drives exploration, but rather, a use value; i.e., the reduction of carbon dioxide emissions.

The definition of a strategic domain of innovation can result from the opposite of a bottom-up or emerging logic (Mintzberg and Waters 1985, Burgelman 1994):

*Bottom-up / Techno-logic*

Local findings of research on a given technological issue can lead to the emergence of a strategic domain of innovation. At Intel, for example, technological limitations related to heat dissipation led researchers to seek microprocessors that were energy-efficient in operation. From these initial developments managed locally at its Israeli research center, these new operational angles guiding an original microprocessor design were perfected and a larger-scale project was launched. This research orientation coincided with a market need related to the autonomy of laptop computers. As a result, this new, more economical microprocessor became a strategic focus, grouped with other components to constitute a new development focus for the Centrino brand.

*Bottom-up / Use-logic*

This was the case, for example, with Tefal, a french company specialized in household electrical appliances, which in the late 1970s introduced a non-stick waffle pan that met with huge success on the market. Analysis of this market craze led to the identification of new consumer behaviors and consumer receptivity to utensils that would allow for greater ease in cooking for guests. (Le Masson, Weil and Hatchuel, 2010). The creativity of individuals working initially with a small-scale focus led to the realization that the success of one product in fact indicated a new market trend: utensils for preparing meals for guests. This new area

was thus identified, and led to a variety of innovative products such as raclette sets and crepe-party sets, among others. Uses and use values were what grouped these products within one domain.

### 2.1.2. The strategic domain of innovation: A space for capitalizing on experiences and knowledge

Some research has situated the management of exploratory innovation at the project level (Lenfle, 2008; Midler and Beaume 2010), which excludes the view of an across-projects learning dynamic. Other research situates the knowledge building dynamic at the portfolio level, i.e., a portfolio of innovative projects that interlink. Hatchuel, Weil and Le Masson (2010) advance the idea of chains of innovation, which lead to products that break through while also capitalizing on expertise or "pockets" of knowledge. O'Connor (2008) also underlines the importance of accumulating experience and driving transformational experiences (King and Tucci 2002, Argote 1999). O'Connor considers that accumulation is made possible when a specific team is constituted to steer several exploration projects.

These various works of research together highlight the dynamic of capitalizing on knowledge sets, which plays out at the strategic domain of innovations. This learning dynamic, in situations of uncertainty, is underdeveloped in research on organizational ambidexterity.

The case study below illustrates these two aspects of managing the strategic domain of innovation: defining the area, and capitalizing on knowledge.

**Strategic domain of innovation: The Domauto case study**

This case study is based on longitudinal research conducted with a top-ranked automotive equipment supplier, Domauto[2], (Ben Mahmoud-Jouini & Charue-Duboc 2008, Ben Mahmoud-Jouini, Charue-Duboc & Fourcade, 2007). The company created an entity – the PWT domain of innovation – responsible for proposing radically new innovation products designed to improve power train efficiency.

It is not surprising that the power train was identified as an area in which innovation is needed, in view of the objectives imposed on automakers concerning automotive carbon-dioxide emissions. Even so, it is a much more delicate matter to determine the components that should be included in the scope: should they be limited to engine components, or should they encompass the entire power transmission line, including the wheels? Limiting focus to the engine would reduce the domain of innovation to a subset on which the supplier under review has no differentiating competencies; on the other hand, broadening the scope to include the wheels could lead to the consideration of an extremely heterogeneous set of innovations, requiring the development of knowledge in very different directions and thus raising capitalization problems. As a result, the team's first job was to agree on the specific scope designated by the acronym PWT (power train). It was decided that it would include accessories directly driven by the engine, particularly the alternator-starter, cooling system, drive system, turbocharger, air-intake systems, and the engine and its computer-controlled management system. The scope thus covered components over which the firm had differentiating competencies, as well as other components that are either geographically close or functionally related.

This scope was much broader than existing product lines (i.e. the alternator, cooling system and other comfort-related accessories, for the most part), meaning that innovations involving components other than those marketed by the firm could be considered, such as electric turbochargers, for example, or architectural innovations such as optimal accessory coupling, as well as completely new solutions that do not follow pre-existing divisions between product lines, such as braking energy-recovery systems.

A certain number of themes were defined. The underlying exploration logic was related to a value focus (strategy-push/use-logic, Table 1). The themes emerged from an analysis of the systems on which the company could innovate to address the issue of reducing carbon dioxide emissions:

- Reduction of accessories' fuel consumption (e.g. through the drive system, by optimizing their operation, through centralization and by disengaging the accessory).
- The air injection system.
- Recovery and temporary storage of energy.

Several projects underway on each of these themes are developing different technological approaches in order to pinpoint their contributions and limitations, and a balance between these various themes is achieved via management of the project portfolio.

This dynamic resulted in the marketing of a new product line, as well as in a reorganization of the company's product lines.

[2] The actual name of the company has been changed

Although the strategic domain of innovation may indicate significant stakes for the company, it does have ambiguous contours. For example, which products will actually be marketed in response to market demands for potluck dinners, or to the requirement of reduced carbon dioxide emissions? This remains to be seen. It is various prototypes, new developments, interactions with customers, that will shed light on how to progressively define the associated portfolio of products and market segments. It is the shift from a strategic vision to its implementation, from a concept to a new product, that is at stake. This shift takes place through the performance of creative experimentation.

### 2.2. Managing creative experimentation

In his definition of exploration, March (1991) stresses that "the essence of exploration is experimentation with new alternatives." Generally speaking, experimentation is defined as an experience provoked in order to observe the result(s). Experimentation is a return to trying out, learning and discovering through experience. We will show what creative experimentation specifically offers by repositioning experimentation within the context of a specific problem and then setting out the tools for implementation.

#### 2.2.1. Experimentation within the pragmatic approach of situated action

The theories of situated action and sense-making (Suchman, 1987, Weick et al., 2005), which are part of the philosophical movement of Pragmatism started by Dewey (1938), highlight the role of collective experience in the production of knowledge and renewal of potential value (valuation). Experience can be organized and orchestrated, and thus becomes

experimentation. This is a creative form of action (Joas, 1999) in which thought does not precede action but in which all ends and means become objects of reflection and action. Contrary to the hypothetical-deductive approach, in which experimentation entails claims and protocols that are clearly defined upstream, the pragmatic approach of situated action involves the formulation of new questions and hypotheses, a phenomenon that Peirce termed "abduction" (Peirce, 1935).

This unexpected element stresses that experimentation takes place in uncertain situations that are more or less difficult to control (Loch & al., 2006, Knight, 1921), since the more uncertainty about the phenomena under examination, the more difficult experiments are to carry out. Loch identifies three levels of uncertainty: low risk, in which the distribution of probabilities on the phenomenon under examination and the variables allowing action upon it are known, medium risk, in which the distribution of probability is not known but the variables are known, and high risk (unknown unknowns), in which the phenomenon is poorly defined and therefore neither the probabilities nor the variables for action are known. We propose that creative experimentation belongs in this final category. Experimentation aims to organize the processes of learning and knowing about objects, prototypes or tools, in order to reduce uncertainty. It most often resembles DIY, in which the assumptions, experimental measures and results analysis are carried out during iterative processes.

### 2.2.2 Validation-driven experimentation (VDE) versus creative experimentation (CE)

For writers such as Van de Ven et al. (1999), innovation is the result of processes of trial and error and hesitant progress. Experimentation is therefore a necessary movement to action. It enables progress using a strategy akin to poker, in which the organization "pays to see" while the target design is not fully defined. It is a source of learning about business technologies,

customs and models and allows for new knowledge to be developed and value potential to be identified. It also generates new relations (between players not necessarily aware of each other ex ante).

This concept of experimentation, which we call creative experimentation and which is close to Pragmatism, should be distinguished from another form that is equally common in new product development literature: validation-driven experimentation (VDE), which belongs in a hypothetical-deductive epistemology.

In works on new product development, the experimentation phases with future users are validation stages in a stage gate process (Ulrich and Eppinger, 2000; Wheelwright and Clark, 1992). Employees know what they want to verify and have precisely defined this in advance. For example, prototypes in the automotive industry serve to validate technical solutions and their compliance with the specifications set out for each function (Thomke, 2003). Customer knowledge has been activated upstream to model relations between the product attributes (a range of products, for example) and its market value. Experimentation is a "full-scale" test in conditions representing a situation imagined in advance. The aim is to reduce the risks (of design and related to market uncertainty), to protect against late discoveries that could necessitate expensive changes, and thus maximize value (keeping the attributes or improving them in a targeted way).

By contrast, in an exploratory design approach, experimentation helps to create product concepts and the challenge is broader than the validation of previously specified functions and already identified solutions. It involves identifying new uses and the associated value. Market studies provide only a small amount of viable information on future users and future uses. Thus, Verganti (2009) points out that questioning users about their requirements does not often result in incremental innovations. Lynn, Morone and Paulson (1996), studying the development of radical innovations, advocate experimentation approaches that they define as:

"introducing an early version of the product to a plausible initial market". They point out that it is difficult to interact with potential users when designers have only an incomplete picture of the performance of the new technologies planned, but they nevertheless regard this as the best approach. Experimentation thus aims to identify new value criteria and unprecedented functionalities, "probing potential markets". These are precocious and repeated experiments - "low cost probes", which will allow for this type of learning. The richness of the experimentation lies in the value potential discovered during the process. It involves generating knowledge by experimentation that increases the diversity of envisageable routes. It is creative experimentation and creates divergence.

In this perspective, the "customers" (we prefer to say "recipients") on whom innovative solutions are tested out do not have to be representative of a market segment. In fact, there is uncertainty about the value axes associated with the innovation and therefore about segmentation.

In what we call creative experimentation (CE), the aim is therefore to trigger new value proposals and to structure a strategic domain of innovation, not to validate a technological solution and its functionalities and its target in terms of market segment. We contrast this with validation-driven experimentation.

Finally, our second proposition (P2), relating to the management of exploratory activities, is as follows: in order to integrate "distanced" knowledge into new value proposals, we have to conduct experimentation that we call "**creative experimentation**" because it does not consist in simple tests of hypotheses: it is the action that generates knowledge. Experimentation enables new knowledge (about technology, value and use) to be created.

### 2.2.3. Tools for creative experimentation

We have identified two tools for conducting exploratory experiments: prototyping and calling on players with a range of expertise.

1 – Prototyping

The first tool involves practical procedures that allow for action and rapid learning. Many writers insist on virtual prototyping as a rapid learning method (Eisenhardt and Tabrizi 1995; Thomke, 2003). The most general purpose of prototyping is to "create a reaction". For Ulrich and Eppinger (2000), the prototypes, physical and virtual, used in experimentation for the development of new products have four functions: learning, communication (between designers), integration (technical integration of the product) and marking out (of the project). Within a dynamic of exploration, the prototype is a movement to action that formalizes the choices that will enable potential recipients to assess performance.

2 – Players with a range of expertise

The second tool involves calling upon expertise during experimentation. Experimentation relies on the activation of networks of organizations and very varied independent players: customers, pilot users (Von Hippel, 1988), "interpreters" (Verganti, 2009), competitors, suppliers, social networks, crowd intelligence and crowdsourcing (e.g. development of open-source software is based on the coordinated work of thousands of programmers on a global platform). Experimentation often entails collaborative systems. Gawer and Cusumano (2002) explain that Intel organizes "Plug Fests" during the development of its projects. The company rents a hotel to which it invites everybody involved in an interface innovation, so that they

can test the compatibility of their prototypes with the future standard and help, if appropriate, to change the definition of the interface.

We will explain this creative experimentation approach using the example of Axane (box 2).

**Creative experimentation: Axane**

This case is based on longitudinal research carried out between 2003 and 2009 at Axane, a subsidiary of the Air Liquide group, by about 30 people who explored the commercial applications of the fuel cell (Rosier, 2007). This company had to create and market profitable professional applications using fuel cell technology. Axane decided not to target the automotive market (which was promising, but for the longer term), and instead looked at niche markets, or larger markets yet to be determined. The company had to create applications based on imperfect scientific and technical knowledge, with no market or explicit need, and without an industrial sector… Axane could not achieve its aims by calling upon the corporate R&D of Air Liquide (which produces knowledge based on definite questions) or by managing projects (how would they have defined the specifications?). It had to progressively structure an exploratory approach.

Without customers to question, the company decided to interact with potential recipients. Axane prototyped fuel cells and left players to test them to reveal any useful effects. Useful effects are the effects of a high-potential offer on recipient conditions of activity (Gadrey and Zarifian, 2002). This approach includes changes in the framework of activity of potential users and therefore suggests experimentation of the technology and evaluation of potential uses in situ (Garel and Rosier, 2008). Formulating useful effects and proposing them to future users is a change of perspective. It does not so much involve suggesting new turnkey uses as give a sense of the transformation potential of activities. This approach was tested as part of the research carried out at Axane. The first fuel cell prototypes created by Axane were low-power and similar to non-polluting generators, fuelled by hydrogen gas bottles. The first users questioned were professional users of generators: firefighters and construction workers. Initially, looking at the new generator in the perspective of their normal activities, they saw it as more fragile and did not perceive any necessity (any "need" in market research) to have a non-polluting generator. Firefighters already have mobile energy sources. However, in the course of experimentation, several useful effects emerged: the silence of the fuel cell, the ability to work without asphyxiation in confined spaces, the advantages of intermodal energy, i.e. that can move between external and confined spaces (some equipment, such as incubators or ice-boxes for carrying organs, must have a continuous power supply regardless of the environment). In the end, the Axane team uncovered new paths to explore and new value potential, when an approach of simple substitution of solutions in place led to an impasse. Creative experimentation thus implies repeated application and in situ experiments with potential users, particularly based on prototypes demonstrating technical know-how and revealing a design. Here, ad hoc fuel cell prototypes were provided to firefighters. The experimentation gave rise to new values beyond the functionalities initially targeted and, finally, to the value proposal.

## Conclusion

Management literature on exploration focuses mostly on organizational aspects (ambidexterity), without delving into more well-suited structures, and without providing contingency criteria (which types of exploration would justify a separate unit – structural ambidexterity – or an integrated unit – contextual ambidexterity).

We chose to focus here on the specific nature of exploratory innovation, and on how it is managed. Research on ambidexterity has been based on the hypothesis that exploration activities require different management methods. We have hoped to specify the methods of managing exploration activities, with a perspective that is at once deductive and inductive.

The notion of exploratory innovation is more fruitful, in our view, than the competing notions of breakthrough innovation, radical innovation, and disruptive innovation (among others), in that it focuses on the exploration itself, rather than on the results.

We have identified two levels of exploratory innovation management:

1. Managing strategic domains of innovation
2. Conducting creative experiments within a specific area

In each of these two levels, we have defined specific methods with reference to case studies in existing literature. As such, we have identified four logical categories for defining a strategic domain of innovation. From a managerial point of view, this model can help innovation managers to identify the logic according to which they can define such domains. From a theoretical perspective, this model opens new lines of questioning: What is the optimal number of domains to be managed? What is an domain's lifecycle? Can one company use more than one logical category to define these domains?

In terms of experimentation, we have shown that creative experimentation can be distinguished from validation-driven experimentation typically defined in innovation literature, the latter relating more to testing. We propose that these creative experiments be qualified, because they relate to the building of new knowledge within a logical framework that diverges from, rather than converges toward, a given result. Two areas of leverage appear particularly important to us: prototyping and opening up to outside networks, mixing users, experts, and creative thinkers. While these two areas of leverage have already been the subject of numerous works of research, the combination of the two opens new research perspectives, particularly with the development of shared design mechanisms such as “fab-labs”: how can the mobilization of broad networks of users and experts around rapid prototyped tools help to renew the practice of creative experimentation within companies? Do these tools truly allow for the management of exploration activities? How can one capitalize on the results of design, which most often are open and shared, within a strategic domain of innovation, which itself is strategic and protected?

Finally, this initial study aimed at marking up the activity of exploratory innovation, in defining this process as singular, poses the question of which actors can take the lead on, and manage this process. The traditional functions of engineering or marketing cannot manage the exploration process. As such, determining the profiles of exploration project managers and strategic area directors, and how they are to be recruited, is a wholly separate area of focus for exploration-focused companies and for the researchers who study them.

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