



**Bureau
d'économie
théorique
et appliquée
(BETA)**
UMR 7522

Documents de travail

« Fractal and dynamic organizational ambidexterity »

Auteurs

Lesya DMYD, Patrick LLERENA

Document de Travail n° 2016 – 03

Janvier 2016

Faculté des sciences économiques et de gestion

Pôle européen de gestion et
d'économie (PEGE)
61 avenue de la Forêt Noire
F-67085 Strasbourg Cedex

Secrétariat du BETA

Géraldine Del Fabbro
Tél. : (33) 03 68 85 20 69
Fax : (33) 03 68 85 20 70
g.delfabbro @unistra.fr
www.beta-umr7522.fr



Fractal and dynamic organizational ambidexterity

Lesya DYMID*, Patrick LLERENA,

BETA, University of Strasbourg,
January 21st, 2016

Draft 1.0

*Corresponding author: ldymyd@unistra.fr

ABSTRACT

The ability to combine exploration and exploitation activities is a critical factor for organizational sustainability and survival. For the large number of companies, achieving ambidexterity is a desired, but a highly challenging process. Many of them fail to compete for both agendas simultaneously. The reason is the inability to implement a fractal ambidexterity, which is able to replicate exploration and exploitation simultaneously at multiple levels of a company. We argue that ambidexterity is fractal and dynamic phenomenon. By crossing levels of analysis, our research shows that in ambidextrous organizations, exploration and exploitation can emerge in diverse structures and take different forms. Both activities able to appear at diverse levels and change the degree of their intensity. To be sustainably innovative, an ambidextrous company needs to define and to achieve the appropriate proportion of exploration and exploitation simultaneously at different organizational levels.

Key words: fractal organizational ambidexterity, structural separation, multiple levels

INTRODUCTION

Organizational ambidexterity is as the ability to simultaneously exploit existing capabilities and to explore new opportunities. Ambidextrous companies able to combine inconsistent structures, activities, processes and mindsets. Exploitation deals with the improvement and refinement of the existing knowledge, competences and technologies, etc. Exploration, in contrast, aims to search for and experiment with new and yet undiscovered skills and domains.

The conventional wisdom is that a successful organization, that wants to sustain and survive in the long term, needs to pursue both activities in a simultaneous fashion. But because of contrasting and often, contradictory characteristics of exploration and exploitation, their co-existence in a single context might be impossible. Then, the primary question for a sustainably innovative and an ambidextrous organization is how to organize the co-existence of both exploration and exploitation that will sustain?

There are several solutions how a company can both explore and exploit. These are sequential, structural and contextual types of ambidexterity. In sequential ambidexterity, a company can switch between periods of exploration and periods of exploitation, depending on the organizational focus and industry needs. Unlike sequential type, Structural ambidexterity, proposes to address both activities simultaneously in different and structurally separated business units. Finally, contextual approach makes an emphasis on a specific organizational context where individuals can make their own decision on allocation of time and resources for exploration and exploitation.

The resemblance between these three different types of ambidexterity is the common goal, which is to perform both exploration and exploitation. The difference lies in the multiple organizational capabilities that can be used to achieve the state of a balance. Particularly, in the sequential and structural approaches, ambidexterity can be achieved by means of different

combinations of structural elements in space and in time. In contextual type, ambidexterity is a matter of choices and decisions of the individuals. Although we still do not know which option is the optimal one, it is clear that regardless of the chosen solution to achieve ambidexterity, an organization will search to combine and to co-organize both exploration and exploitation in a specific context. What critical to understand is how to attain and sustain a synergy between two activities with contrasting logics.

In the existing literature, exploration and exploitation are rival activities because of their contradictory nature and competition for limited organizational resources (Levinthal & March, 1993; March, 1991). However, they are not the self-exclusive activities, but more likely to be complementary to each other (Chen & Katila, 2008). Their mutual presence is essential for an organization that wants to survive and to sustain in a long-term (March, 1991; Michael L. Tushman & O'Reilly, 1996).

Moreover, studies shows that except sequential, structural and contextual ambidexterity, exploration and exploitation able to emerge in projects (Liu & Leitner, 2012; Liu, Wang, & Sheng, 2012), in communities (Cohendet & Llerena, 2003; Cohendet, Llerena, Simon, & others, 2012; Cohendet & Simon, 2007) and at the leadership level (O'Reilly & Tushman, 2004; M. L. Tushman, Smith, & Binns, 2011). As ambidexterity can take multiple forms and formats, it leads us to our main assumption that exploration and exploitation can replicate and emerge at different levels in a simultaneous fashion.

This paper describes fractal and dynamic characteristics of the organizational ambidexterity. We argue that with different degrees of intensity, exploration and exploitation arise simultaneously at the company, business unit and project levels. To balance exploration and exploitation over time, an ambidextrous organization should define the appropriate proportion of the activities at each of the multiple levels.

To discuss fractal ambidexterity we use the following structure. First, we review the existing literature and theoretical background on exploration and exploitation. Second, using a case of an ambidextrous company, we present a methodology that crosses different levels of analysis and we show how both activities emerge at different levels. Third, we interpret the results, draw the conclusions and define further research directions.

THE EMERGENCE OF THEORY ON FRACTAL AMBIDEXTERITY

Ambidextrous are the companies that can exploit the certainties of the existing business and at the same time, explore new domains. In broad terms, it is the ability to combine contradictory mindsets and to perform in two different dimensions. By doing exploitation, a company improves and refines its current capabilities, and as the result increases its operational performance in the short term. By doing exploration, it searches for and experiments with alternatives. This activity results in the research and the innovations for the distant future. To remain sustainably innovative, an organization needs to develop a critical capability where it can combine and re-combine exploration and exploitation. Still, the open question for the ambidextrous companies is how to co-organize and to balance both activities over time.

To understand whether an organization can sustain the balance between exploration and exploitation, we suggest first, to review the essence of these activities. The common believe is that exploration and exploitation are contradictory and rival activities. Organizational learning literature defines *exploration* as search, experimentation discovery and innovation; *exploitation*, in contrast, deals with refinement, selection, production and efficiency (March, 1991, p. 71). Activities have different objectives: the goal of exploration is “experimentation with new alternatives” (p. 85) by taking risk, dealing with uncertainty and expecting returns in the distant future. In contrary, the goal of exploitation is “refinement of

existing competencies” (p. 85) by making a selection of the best possible option and performing its effective execution.

Exploration and exploitation are driven by contrasting logics, aim for distinct targets and differs in returns. Also, they operate in different environments, use diverse search spaces and apply various processes to achieve their objectives. Moreover, the activities are often in competition for the limited organizational resources such as funding, people and time. The primary task of organizations and their managers is to optimize the allocation of resources between both activities.

We argue that with all contrasts and shades, exploration and exploitation are complementary and even, continuing organizational activities. The reasoning behind the argument is the following. First, as there is no exact definition, it is hard to define what exactly is exploration and exploitation. In different contexts the activities can take different forms. Second, if there is no such clarity, it is impossible to define the borders and scopes of the activities. Finally, as there is no pure forms of exploration nor exploitation (Nonaka, Kodama, Hirose, & Kohlbacher, 2014), it is hard to specify the exact results from these activities. It is particularly hard to predict the distant returns from exploration.

We argue that exploration and exploitation are coupled and continuing activities. As there is no clarity in the concept of the ambidextrous organizations, the essence of the organizational balance can be explained by the theory of knowledge creation. In the recent study, Nonaka et al., (2014, p. 139) suggest that exploration and exploitation “interact in spiraling continuity” and separation between them is “merely artificial”. Companies cannot do either exploration or exploitation, but they will “inevitably always do both at the same time” (p. 139). This process is complex because combinations of activities occur at all levels and in different periods of time. The difference lies in the degree of the intensity of exploration and exploitation in a specific context.

Our research proposes that ambidexterity is fractal and dynamic. Exploration and exploitation can emerge and replicate at multiple organizational levels, e.g. whole company, a business unit, a team or a group and individual. The replication process is justified by the knowledge creation theory. In ambidextrous organizations, innovation is the result of synergies between exploration and exploitation that occur at diverse levels simultaneously.

Exploration and exploitation at multiple levels

The evidence that ambidexterity, as a combination of exploration and exploitation can emerge at different levels and in different periods of time is also found in the existing literature. Scholars in organizational and management studies describe ambidexterity at the corporate (organizational) level (e.g. (Boumgarden, Nickerson, & Zenger, 2012; Boumgarden et al., 2012; Michael L. Tushman & O'Reilly, 1996) individual (Gibson & Birkinshaw, 2004), managerial (leadership) level (Cohendet, Llerena, & Marengo, 2000; M. L. Tushman et al., 2011) in projects (Liu & Leitner, 2012; Liu et al., 2012) and in communities (Cohendet et al., 2012; Cohendet & Simon, 2007).

In particular, at the *corporate* level ambidexterity can take a form of the sequential or structural modes of exploration and exploitation. In sequential type, the activities can be organized in different periods of time, depending on the factors in hands. An ambidextrous organization can shifts between periods of exploration and period of exploitation (Boumgarden et al., 2012; R. A. Burgelman, 2002; Chen & Katila, 2008). However, another stream of literature argues that for ambidexterity the necessary condition is the simultaneity of the activities and propose a structural approach to explore and to exploit (O'Reilly & Tushman, 2004; Michael L. Tushman & O'Reilly, 2002). Then, the ambidexterity is achieved by performing simultaneously exploration and exploitation in structurally separated units. Studies shows that for research and experimentation (exploration) the appropriate structure is

young entrepreneurial unit; whereas production and execution (exploitation) should be devoted to old efficient entities (see Michael L. Tushman & O'Reilly, 2002).

Others scholars argue that exploration and exploitation are dramatically different activities and cannot exist in one or in the similar structures (Birkinshaw & Gibson, 2004). Alternatively, they propose to address ambidexterity at the *individual* level. In contextual mode, an organization creates a specific context where individuals can make their decisions how to allocate time and resources between exploration and exploitation (Gibson & Birkinshaw, 2004).

Although the debates on temporal or simultaneous fashion of exploration and exploitation are still open, scholars continue to expand beyond the existing knowledge and propose that ambidexterity can also emerge at the *managerial* level (e.g. (Cohendet et al., 2000; M. L. Tushman et al., 2011). The ambidextrous leaders cope with tensions between exploration and exploitation and able to solve the conflicts at the higher levels of a company (M. L. Tushman et al., 2011). Also studies propose that not only managers at the executive positions (e.g. CEO) should be ambidextrous, but also those, who have senior management roles. Ambidextrous senior managers should combine executive and entrepreneurial thinking and search for the balance between contrasting objectives (O'Reilly & Tushman, 2004). Other studies propose that also managers can apply different leadership styles to facilitate both activities e.g. transformational leadership to encourage exploratory innovation; transactional – to stimulate exploitation of existing competencies (Jansen, Vera, & Crossan, 2009).

Except corporate, individual and managerial levels, ambidexterity can emerge in *projects* when a team addresses two types of activities. The study from Liu et al., (2012) argues that ambidexterity is typical for large and complex engineering projects, where teams have to deal with exploration and exploitation to fulfill specific requirements and to meet the targets of a complex project. By exploring a project team is able to identify a solution to

unique problem and by exploiting it is able to replicate a solution and to apply it in mass production.

Ambidexterity in projects can be achieved by temporal cycling between separation and integration of both activities (Liu & Leitner, 2012). Separation is necessary to engage in search (exploration) and executive (exploitation) under specific constraints. Integration is needed to link and coordinate both activities. To increase the effect from synergies, managers should promote collaboration and encourage different project teams to work together for a common goal (Liu & Leitner, 2012; Liu et al., 2012).

In addition, exploration and exploitation have a tendency to emerge in *communities*. Communities is the intermediate level which is considered “as the result of the permanent interaction between the individual and organizational levels, where routines are shaped and deterred” (Cohendet & Llerena, 2003, p. 273). These are the groups of individuals based on the functional affiliation, similar practices and/or driven by the creation of common knowledge.

In communities, two activities can be co-organized in a similar way, as in project ambidexterity (Liu et al., 2012) by separation and integration. Studies show that in an organization, communities specializes in a specific domain of knowledge (Cohendet & Simon, 2007). Separation based on specialization is as important as integration. Integration takes place at the collective level (e.g. in common projects) and guarantees systematic coordination between different teams and goals. A solution to integrate different communities and activities can be found in hybrid projects. These types of projects allow managers to separates activities in decentralized structures and integrate them by means of informal integration (Cohendet & Simon, 2007).

Therefore, after reviewing the existing literature we were able to identify at least five different levels where both exploration and exploitation emerge. These are corporate

(organizational), individual, managerial or leadership levels, projects and communities. After reviewing the different stream of literature, it is now clear that exploration and exploitation can occur at multiple levels at the same time. Nevertheless, the main concern on co-existence and balancing between exploration and exploitation remains to be unsolved neither by organizational learning theory, nor by the ambidexterity concept.

Based on the existing knowledge, we propose that for a sustainably ambidextrous organization a critical factor is the ability to achieve synergies between exploration and exploitation in different contexts and in different periods of time. In our research on fractal and dynamic ambidexterity, we suggest to use a multilayer methodology that crosses several levels of analysis. By using a case of an ambidextrous company, we will identify the co-existence of exploration and exploitation at different levels and find out whether a company can sustain the balance over time.

MULTILAYER METHODOLOGY: CROSSING LEVELS OF ANALYSIS

This research is based on a case study method and aims to explore a phenomenon of the fractal organizational ambidexterity (Eisenhardt, 1989; Eisenhardt & Graebner, 2007; Yin, 1994). We develop and apply a specific research method, called in our paper as “the multilayer methodology” that crosses levels of analysis and take into account the time factor. In contrast to the existing studies on ambidexterity that primary has a focus only at one level of analysis (e.g. corporate, individual, project, etc.), we combine three different organizational levels and analyze how exploration and exploitation can co-exist simultaneously in different contexts. This complex multilayer methodology emerged as a response of our progressive study and as the approach to detect and to validate the variables at different company’s levels.

The structure of the multilayer methodology (see Figure 1.) includes three independent, but interrelated levels. These are the corporate, project and the executive levels of our ambidextrous company. Each section consists of different elements such as structures,

activities, processes etc., which are associated with exploration and exploitation at each level. To collect the data, we use multiple research tools and methods that are appropriate for a specific context.

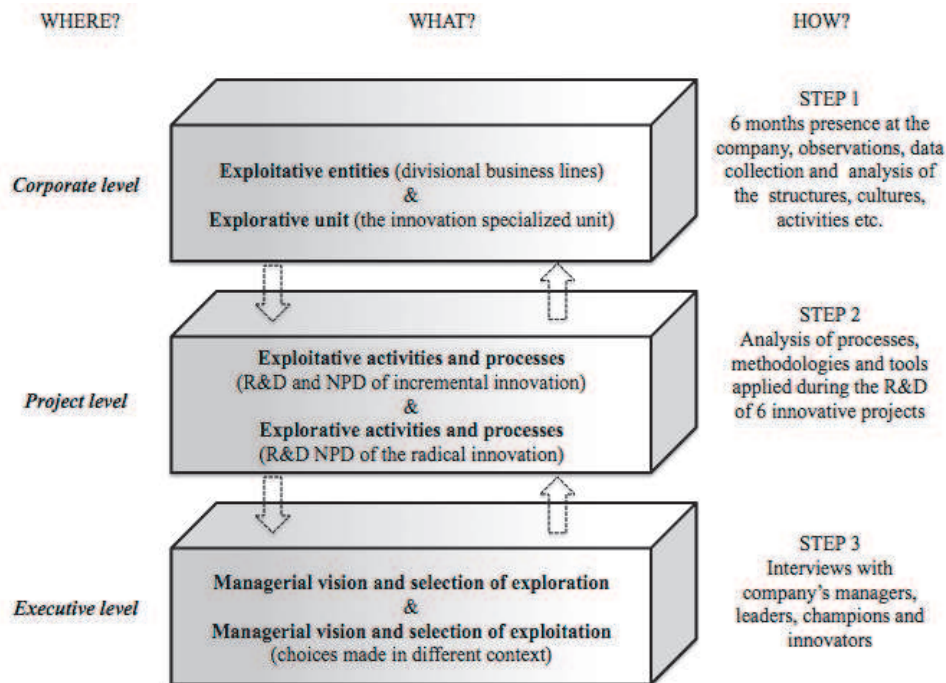


Figure 1. The structure of the multilayer methodology

Technology-based service company

- is an international oilfield service company that provides equipment, technologies, hardware solutions and software services for exploration and production of oil and gas reservoirs. The company is a fully integrated service provider with own development, production, processing and interpretation oilfield services. The core business is the seismic acquisition services on the onshore and offshore markets.

R&D and Innovation

The company is a science-based organization with more than 600 employees involved in the R&D activities. To develop radical and incremental technological innovations, the company uses two types of R&D structures: 1) specialized divisional business lines perform incremental type of development for existing markets; 2) the innovation specialized unit develops radically new technological products and services that creates new markets

In particular, at the *corporate level*, this research includes a single in-depth case study of an incumbent organization. The unit of analysis is a technology-based service company from the energy industry and its business structures, which have focus on exploration and exploitation. To explore and exploit, the company uses structural separation of activities.

Exploitation and execution of short term targets is dedicated to the divisional business lines. These exploitation-oriented entities improve and refine existing technologies for the current markets. Exploration and experimentation with technologies of the future occurs at the innovation specialized unit. This unit is driven by innovations and entrepreneurship. To explore radically new technologies, it uses the legitimacy and the support from the top management of the company.

At the *project* level, we make the analysis of 6 innovative projects of the company. These are the incrementally improved and radically new technological projects. At that stage our goal is to understand the differences and similarities between the intensity of exploration and exploitation during the product development process from the different types of innovations. Finally, at the *executive* level, our research identifies the managerial vision on the ambidexterity and their practices of balancing between exploration and exploitation. It describes managerial motivation and decision making on the allocation of resources between the activities in a given context and under the specific organizational conditions.

In addition to the analysis of the three different levels, the multilayer methodology takes into account the time factor and allows us to observe the dynamics of ambidexterity, localization and evolution of exploration and exploitation. Another advantage of the proposed multilayer methodology is the holistic approach to the question and a solid theory from our in-dept study of an ambidextrous company. To increase the robustness of our findings we apply diverse techniques and methods. The multiple source of evidence and convergence of facts help us to make our analysis and findings convincing and accurate (see also (Eisenhardt, 1989; Yin, 1994).

We collected the data in three steps. The *first step* was at the corporate level. It started from the actual presence of our researcher in the innovation specialized unit of the technology-based service company. During 6 months (in 2013) the researchers has joined the

team of the innovation unit, which was aimed to develop the strategic technological innovations of the company. Being a member of the team, our researcher participated in daily activities, led few project, was involved in structuring and formalization of the activities on exploration, attended formal and informal meetings and events. During this period, the researcher collected and analyzed data on structuring of the company, organization and localization of different R&D activities, firm's strategic orientation, cultures, values, processes and procedures for development of the technological innovations.

The *second step* of our data collection had a project orientation. With the help of the senior innovation manager, we selected 6 innovative projects (3 radical and 3 incrementally improved technologies) and analyzed how exactly they were developed in the company. The differentiation of the innovative projects (radical and incremental) is based on the degree of technological novelty for the company and for the core business. For our research we define ***incremental innovation*** as the improvement of the existing market technology (current market segment and clients). ***Radical innovation*** – is a brand new technology for new markets and clients. To draw these definitions we rely on the existing literature and take into account the specificities of the development process and change in the context of technological innovation (Abernathy & Utterback, 1978; R. Burgelman, Christensen, & Wheelwright, 2004; Ginsberg & Baum, 1994; Henderson & Clark, 1990; Schumpeter, 1934). Also, we assume that for different types of technological innovations, the intensity of exploration and exploitation during the development process is different.

To study how the company creates different types of innovations we selected and invited members of the project teams. The employees had different functions and represented different R&D departments. Among them were initiator and/or project leader, scientists and engineers, technical support specialists, representatives from sales and marketing and operational departments. Some of the interviewees were involved in development of more

than one project. The interviews with members of the project teams has a semi-structured format and included 10 open questions on the creation process from ideation to the commercialization phases. Individuals were asked about decision-making, allocation of resources and coordination between different activities, explorative and exploitative R&D structures of the company.

After the interviews with project teams we moved to our final, and the *third step* of data collection, that was the interviews with executives. The executive is a complementary level to increase the robustness of our results from data collection during the first and second steps. The contribution of this step is the investigation of the actual managerial behavior, decision and selection practices. The interviews with managers had a semi-structured format and included 10 open questions. In contrast to previous step, the discussion with executives were not linked to specific projects, but had more general focus on the ambidexterity in the company. Managers were asked questions about different types of innovations, R&D structures and activities, localization and coordination of activities. The invited managers had diverse profiles such as the leaders of the divisional business lines, senior manager responsible for corporate strategy and integration, senior innovation manager, technology development manager, chief scientists, chief engineer, senior engineer and a senior scientist from the divisional business lines.

In general, our study includes interviews with 24 employees who hold different positions, as members of the project teams, senior and executive roles in the technology-based service company. Some of senior and executive managers were involved in management of the selected innovative projects. All discussions had a minimum duration of one hour and a maximum duration of two hours. Interviews took place in the company's premises and were held by two researchers. All interviews were recorded and transcribed for further interpretation.

RESULTS AND INTERPRETATIONS

Our research shows that in the technology-based service company ambidexterity occurs at multiple levels. Particularly, at the corporate level, simultaneous exploration and exploitation are co-organized in structurally separated units. In the literature, this approach is described as structural ambidexterity (see (O'Reilly & Tushman, 2004; Michael L. Tushman & O'Reilly, 2002)). At the project level, we identified ambidexterity as the ability of the innovation unit to combine different sets of activities and to develop both radical and incremental technological innovations. Finally, ambidexterity at the executive (leadership) level represents the ability of the individuals both to explore and to exploit, independently from the fact whether they belong to the exploration-driven or exploitation-oriented business structures. At this level, the notion of ambidexterity is similar to the contextual approach (Gibson & Birkinshaw, 2004). Further, we propose to have a detailed review of ambidexterity at each of the three levels.

Ambidexterity at the corporate level

To explore and to exploit simultaneously the technology-based service company uses structural separation. Exploration of new domains of business, search and experimentation with radically new technologies is the mission of the innovation specialized unit. Exploitation of the core-business, incremental improvement and refinement of the existing solutions is dedicated to the R&D departments of the divisional business lines.

The separation between explorative and exploitative business structures is justified by the fact that different innovations (as in our case radical and incremental) need different sets of capabilities, skills, knowledge, competences and resources. Strategic management studies show that incremental innovation and change needs formalized and efficiency-oriented organizational structures, which are often large in size, have long and successful histories and are characterized by the efficiency-driven cultures (Michael L. Tushman & O'Reilly, 2002). For

exploitative structures radical innovations and change are extremely difficult. Because the processes and activities which are necessary for the development of new ideas and concepts do not fit into their formalized and routine type of work. The process of creation of new ideas needs flexible and entrepreneurial approach. The more appropriate structure for exploration and experimentation is the entrepreneurial unit(s), which are often young, small in size and have search-driven cultures. In structural ambidexterity, top managers should protect and legitimize the exploratory function of the entrepreneurial unit in order to preserve the potential from new ideas and to avoid their rejection at the early stages of their maturity (see also Michael L. Tushman & O'Reilly, 2002).

In the case of the technology-based service company, separation of the innovation unit and divisional business lines, undoubtedly, is a strategic decision, coming from the top organizational levels. In the interview in 2013, the leader of the innovation unit argued:

“If our radical innovations have been led by R&D departments of the divisional business lines, they would have been killed by business”

In other words, the divisional business lines do not have the R&D appropriate structure, skills and competences to incubate and to develop new technologies that are out of the scope of their routine activity and go beyond their existing business. Business lines are highly specialized, formal and structured departments that primary refine and improve the design and the operational efficiency of the technologies that already exist on the markets. Moreover, the managers of these structures try to avoid new projects with height degree of uncertainty and risk and prefer to focus on the execution of their efficiency-oriented short term plans.

The dramatic difference is in the organization of the innovation specialized unit. Founded in 2009, the unit is formed from more than 30 individuals (internal data, 2013) who are driven by innovation and able to act as internal entrepreneurs. Many of them have

competences and experience necessary for the development of radical technological innovation. The mission of the unit is to develop strategically important projects, complex and radically new products and services. The unit performs research and co-development projects in partnerships with universities, private and public organizations. Also, to perform its exploratory activity, it relies on the strong support and protection from the top management of the company.

The reason why does the technology-based service company separates exploration and exploitation in different business structures is explained by the necessity to combine inconsistent sets of activities, processes and innovations. In 2014 in the of the interviews, an R&D project leader from the innovation unit explained the drastic difference between explorative and exploitative structures of the company:

“In divisional business lines we use rather basic technologies and focus on the current business needs of the existing markets. Their primary objective is to deliver new technology in the short terms. In the innovation unit, we create advanced technologies that can completely change the industry. This process can take us 5 to 10 years...”

Structural separation is needed to cope with tensions and conflicts that emerge between exploration and exploitation. However, some scholars propose that only separation is not a sufficient condition to achieve and sustain ambidexterity (Kauppila, 2010). Solely exploration often results in high costs of experimentation and as the rule, has low returns (Levinthal & March, 1993; March, 1991). Moreover, separated explorative structures can suffer from the isolation. They can be too far from the exploitative structures and hence, be incapable to implement and to exploit the results of their research and experimentation at the other parts of the company (Birkinshaw & Gibson, 2004).

This leads us to our next assumption that in ambidexterity separation is as important as the integration. To benefit from exploration and exploitation, organizations and managers

should search for synergies between the both. Otherwise, uncoordinated activities will result in isolated and unprofitable exploration as well as in the inability to benefit from it.

To avoid the “ivory tower” effect and to resolve the problem of uncoordinated activities, the company has integrated explorative and exploitative structures at the process level. The stage-gated process of development of innovations, that exists in the company aims to link and to integrate the results from exploration in the innovation unit and the exploitation activity in the divisional business lines. In the interview in 2013, the leader of the innovation unit argues:

Radical innovation means that we break the barriers and create completely new markets. But the innovation unit does not work alone. Our process is linked to the divisional business lines. We stop exploration in a specific phase of the development and then transfer a successful technology to the business lines for further exploitation”

By direct observations, collection of internal data and interviews we identify that at the corporate level, the technology-based service company explores and exploits in separated structures. This approach helped the company to settle the ambidextrous design and to co-organize exploration and exploitation and the development of different types of innovations in the innovation unit and in divisional business lines simultaneously. Specialization of functions and sharing of a single stage-gated development process aimed to integrate the explorative and exploitative structures of the company. However, at the project level, our research got the contradictory results, particularly about the exploratory activity that existed at the innovation unit.

Ambidexterity at the project level

At the project level we analyzed the development of 6 different projects, including 3 radical and 3 incremental technological innovations. These projects were initiated at different parts of the company, but all of them were managed by the team of the innovation unit. At

this step, our objective was to find out what was the intensity of exploration and exploitation in different innovation project. The study of the innovative projects shows that, in fact, the innovation unit develops not only radical innovation, which is its primary goal, but also performs research for the incrementally improved existing technologies. At the same time, there is an important distinction between radical and incremental types of projects, which is the degree of exploration.

During the development process of radical innovations, large portion of resources is dedicated to the research, discovery, creation of new knowledge and experimentation. At that stage, a new technology is not yet defined. To explore new ideas, the innovation unit organizes cross-divisional brainstorming sessions, invites experts in specific fields to work together on solving a problem and proposes some solutions to solve emerging technological challenges. The unit works with partners to create new knowledge and competences in a new domain. In large scientific projects, it co-develops with research institutions, clients-petroleum companies and works with subcontractors to perform specific studies and experiments.

The process of development of radical innovations has high intensity of exploration. For radically new technologies, the initial phases are time consuming, have high degree of uncertainty and risks and require investments of significant resources. The analysis of the projects shows that the approximate duration of the research and experimentation at the early phases of the product development is 2 - 3,5 years. After that period, the unit is able to demonstrate technical feasibility of a new technology. The development process takes place at the innovation unit. It is fully supported and protected by the top management of the company. Usually, the executives are the project sponsors and allocate large portion of resources for the development of the strategically important technological projects.

Our analysis of 6 projects shows that in parallel to the development of radical innovation, the innovation unit works also on the projects of incremental innovation. For these projects, the function of the unit is to search for new approaches on how to improve and to refine the already existing model of a technological solution.

In contrast to the brand new technologies, the development process of the incrementally improved technologies do not require heavy research and experimentation, have less risks and low uncertainty. The exploration is less consuming because for such types of projects, the main concept and technology is already exist and is utilized on the markets. For the analyzed projects of incremental innovations, the phases of exploration takes approximately 1-2 years. After that period, the unit is able to demonstrate feasibility of the improved technology and transfers a project to the divisional business lines for exploitation and market launch.

Except the difference in the intensity of exploration activity between radical and incremental innovative technologies, another contrast is in the organization and allocation of resources for these projects. The innovation unit does not own the development of the incremental innovations, but organizes the process it in the cross-divisional development and serves as a hosting and the advisory board. The unit creates linkage between diverse divisional business lines, facilitates the development process, performs and sponsors research and experimentation phases and ensures the technological feasibility and business efficiency of a refined technology.

The analysis of projects shows that the innovation unit combines different activities. With time, it re-defines the focus and its “purely” explorative knowledge, competences and skills and applies these capabilities to the projects with lower degree of risk and uncertainty. By creating both radically new and incrementally improved technologies, the innovation unit shifts from exploration to a combination of exploration and exploitation activities. To

understand why there is a contradiction between corporate and project levels, we decided to interview senior and executive managers, who had a power to make decisions on exploration and exploitation.

Ambidexterity: A view from the top

To extend our analysis of ambidexterity, we question exploration and exploitation at the executive level of a company. It is a complementary level, which focuses on the decision-makers, on the senior and the executive managers of the explorative and exploitative structures and of the whole company. Those managers were asked about separation of the activities, functioning, efficiency and coordination between different organizational structures and on the different types of technological innovations. Our main goal was to find out why did the innovation unit develop radical and incremental projects, if its primary mission was to explore. To understand the answer, we needed to re-consider the analysis at the previous two levels.

From the first glance, the technology-based service company uses structural separation to be ambidextrous. As we defined earlier, at the corporate level, exploration of brand new products and services is dedicated to the entrepreneurial-driven innovation unit. Exploitation and improvement of the existing technologies is the job of the efficiency-oriented divisional business lines. There is a clear differentiation of R&D functions, processes and projects between explorative and exploitative business structures. Because of the inability to explore and, at the same time to exploit, the company has found a solution in structural separation of activities. In an interview (2014), a chief engineer who is a member of the innovation unit argued:

“In the company, we started to have emerging a nice idea that divisional business lines are mostly here to do incremental improvement. Radical innovation and the really risky stuff could be done in the innovation unit, where we explore and prove a feasibility of a new technology and then decide how to make it faster to a market”

In the company, the innovation specialized unit aims to search for and introduce radically new technologies to open new markets and to change the existing way of doing operations in the oilfield industry. Divisional business lines, in contrast, are seen as operational, efficient and profitable business entities, which can deliver rapid returns in the short term. In 2014, a technology development manager from the innovation unit explained:

“Divisional business lines have to deliver benefits and results in the end of each quarter. They do not put money into high risk and long projects, knowing that in some point of time they will get those strategic projects from the innovation unit. This is a purely financial aspect. People in the business lines have to deliver results”

Let us think what could be the circumstances from the separation of activities in the long term? In the case of our company, exploration had low returns and increasing costs from research and experimentation. With time (mid. 2014), the innovation unit got isolated from the rest of the company. For the divisional managers, the unit was as a risky and unprofitable structure. The results from its exploration were not well utilized and sometimes rejected by the divisional business lines. Now, the explorative and exploitative business structures were put into the internal competition for resources, allocated from the top management of the company. And even the linking mechanisms that aimed to integrate both structures and activities at the level of the stage-gated development process were not sufficient enough to decrease the arising gap. In the interview in 2014, a chief engineer from the innovation unit explained why the activities were “disconnected”:

“In the innovation unit we have a good knowledge on complex product development compare to other parts of the company. The bad news is that we are not really closely linked to the rest of the company. People think that we are an “ivory tower”. Another problem is that our product development knowledge are not always well utilized and engaged in the divisional business lines”

Differentiation of labor and separation of activities in different business structures allowed the company to perform both simultaneously. But, at the same time, uncoordinated exploration and exploitation resulted in the isolation of the innovation unit and in the inability to apply and to exploit the returns from exploration by the divisional business lines.

For the innovation unit it means first, the increasing competition for the resources allocated from the executives and second, the necessity to demonstrate the legitimacy and creditability of its actions. To prove the efficiency and, in fact, to survive without previously strong support from the executives, the innovation unit has started to develop the incremental projects in parallel to the development of radical innovation and hence it became itself ambidextrous.

EVOLUTION TOWARDS THE FRACTAL AMBIDEXTERITY

After questioning and observing the co-existence and coordination of exploration and exploitation simultaneously at different organizational levels, we argue that ambidexterity is in fact, fractal and dynamic. In an organization, the proportion, degree and localization of exploration and exploitation can change over time and might depend on the influence of the environment (see Figure 2). Fractal is a phenomenon of the repeating patterns that can emerge at different levels. *Fractal ambidexterity* is the ability of exploration and exploitation to emerge at different organizational levels in the simultaneous fashion.

In case of our technology-based service company, fractal ambidexterity is represented by the repeating exploration and exploitation activities at the corporate, at the project and even at the executive levels. The dynamic aspect is explained by the re-configuration of the capabilities in the explorative structure when the innovation unit shifted from being exclusively focused on the development of radical innovation to a combination of radical and incremental innovations.

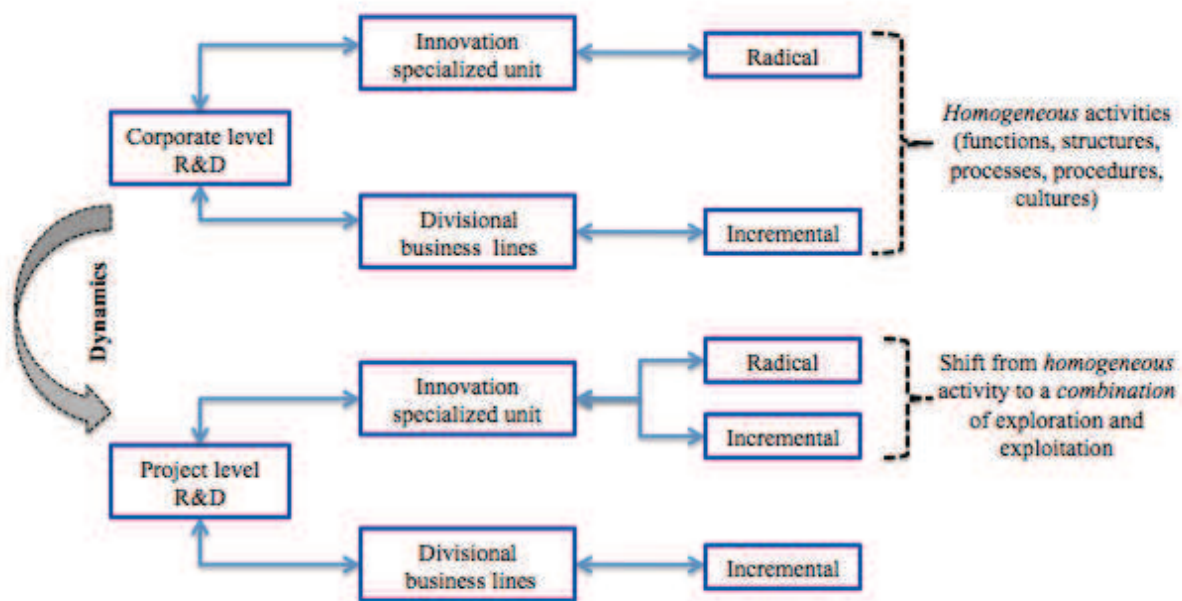


Figure 2. Fractal ambidexterity: localization and dynamics of exploration and exploitation (on the case of a technology-based service company)

Our research shows that at the corporate level, exploration and exploitation are separated in different business structures. The innovation unit is an entrepreneurial structure, that aims to explore new business opportunities, search for new areas and develop radical technological innovations for distant future. Divisional business lines are operational and effective entities that improve and refine effectiveness and performance of the existing technological products and services.

Integration between these two organizations occurred at the levels of a process. Precisely, the structures were sharing the stage-gated development process, where the innovation unit was responsible for exploration at the initial phases of the development and divisional business lines worked on exploitation and market launch of an innovation.

However, the linkage between exploration and exploitation was not always guaranteed. In fact, because of the unutilized returns from exploration, the innovation unit got isolated from the divisional business lines. Very often, it was unclear how divisional R&D managers could exploit new concepts and prototypes of radical innovations, received from the

unit. The projects of new technologies were postponed or got rejected and assessed as not enough mature for development in business lines and not ready for the markets.

To decrease the gap between the structures and between the activities, the innovation unit decided to perform a portion of research and experimentation for the projects that needed incremental technological improvement. In parallel to the development of strategic radical innovation, the unit engaged in cross-divisional incremental projects and served as an advisory board during the exploration phases.

However, isolation of the innovation unit from the divisional business lines was not the only reason for turning into an ambidextrous structure. Another, more important cause was the decreasing support from the top management and the need to demonstrate the efficiency from the exploration. For the unit, it was the time to pay back the large amount of investments, allocated by the executives for the exploration of radical innovation.

Maturity of the innovation unit (2013-2014) occurred in parallel to the important change in the industry. Declining support of the exploration from the side of the top management is explained by the drastic shifts in the oil and gas industry as well as in the organizational capability to continue the funding for the R&D of strategic innovations. Industry crises that gradually have started in 2014 and the dramatic drop of oil and gas prices put the pressure on the large and small organizations that operate in this sector. Many of them were forced to re-configure their capabilities to explore and to explore.

The shift in the environment had a significant impact for the technology-based service company and for the innovation unit in particular. The executives decided to re-consider the strategic orientation of the company, mainly by cutting down the number of projects that required long and costly exploration. In 2014, in the interview with a senior manager, responsible for the corporate strategy, he explained it as the following:

“Today we do not have any innovations in our current strategic plans because our markets and the industry are not in a great shape. It is more a follow up approach...”

In conditions when financial and business operations of the company have decreased, the innovation unit was put in the internal competition for the R&D resources. Without previously strong support and protection from the executives, the unit needed to compete with the divisional business lines. The way to demonstrate its legitimacy and credibility was found in the re-configuration of the exploration. To show the profitability from exploration to the managers in divisional business lines and to the executives, the unit started to work on larger number of innovative projects of incremental technological improvements. To survive in times of industry and organizational change, the unit switched to a combination of exploration and exploitation and hence, it became itself ambidextrous.

CONCLUSION

Our research defines organizational ambidexterity as the fractal and dynamic phenomenon. In fractal ambidexterity, exploration and exploitation have the ability to emerge and to replicate simultaneously at different organizational levels. The localization of exploration and exploitation and the degree of their intensity can change over time and depends of the environmental factors.

By using a case of the technology-based service company and by applying our multilayer methodology we were able to demonstrate the existence of fractal and dynamic patterns of ambidexterity. We saw ambidexterity at the corporate level when the company separated exploration and exploitation in different organizational structures. Similarly, we identified ambidexterity at the innovation unit, which combined the development of radical and incremental innovations.

From the discussions with the senior and executive managers, we assessed that many of them were able to act as an ambidextrous leaders. In particular, they combined entrepreneurial and executive mindsets and were applied in different types of activities, in development of radical and incremental innovative projects. Regardless of the dependence to

the specific business entities, these leaders were expressing a high interest and concern about the importance of exploration and creation of brand new products and services. But at the same time, they clarify that not all managers especially those at the exploration-oriented structures, supported such initiatives. Only the innovation unit encouraged and promoted among individuals to explore new concepts, to take risk and to experiment with new technologies. The individuals in other parts of the company were mainly focused on the execution and delivery of short term plans.

The example of the technology-based service company shows us that ambidexterity can replicate and change over time. The proportion and intensity of exploration and exploitation depend of the available factors, e.g. as the change in the environment and can change over time. Another lesson learned is that structural solution to explore and to exploit simultaneously (structural ambidexterity) can sustain only if there is a permanent strong support, protection and legitimization of the exploration activity from the top management of an organization.

Without patronize provided by the executives, the entrepreneurial innovation unit will not be able to survive in the long term. Separated and uncoordinated exploration and exploitation will result in the isolation of the explorative structure and in the inability to utilize and to exploit the results from the research. If the entrepreneurial unit is not be able to compete with the efficiency-driven entities, prove its legitimacy and to demonstrate creditability, it will be restructured or fully liquidated as unprofitable organization.

It seems that for the ambidextrous companies the capability to explore is the important one. But the most critical for successful organizations is the ability to sustain the appropriate degree of exploration and not to loose it as unprofitable activity. Similar is explained by scholars in the organizational learning (Levinthal & March, 1993). Many companies tend to prioritize exploitation and devote little attention to exploration. Execution and operational

efficiency have higher impact on the organizational performance in the short term. For companies, exploitation is more a preferable activity, than uncertain, high risk exploration with distant returns. Organizations should learn how to sustain the appropriate proportion of exploration, even in times of change and shifts of the environment.

For organizations, that want to be sustainably innovative we suggest to apply the logic of fractal and dynamic ambidexterity. The continually ambidextrous organizations should be able to settle the appropriate intensity of activities and to re-combine the proportion of exploration and exploitation at each of the organizational levels, depending on the available factors.

This theory on combination and the replication is justified by the fact that exploration and exploitation are inconsistent, but not the opposite activities. There is not clear definition, no rigorous scopes and borders of exploration and exploitation. These are the continuous activities, as exploitation will always contains a part of exploration. An innovation, a product, a technology cannot be improved without being explored and invented first. Any organization will inevitable do both exploration and exploitation but in a different proportion. In the same way, a business unit, a project team and even an individual cannot engage only in exploration or exploitation if it wishes to survive in the long-term.

To sustain, the primary goal of an organization would be to establish the right degree of the activities at the different organizational levels and to re-configure them, depending on the needs. For managers this means that they need to pay more attention to the intensity of activities and be more reasonable in the allocation of resources at each of the levels.

Even March (1991, p.72) did already propose that it is particularly difficult to find the balance, because “the same issues (selection and choice between exploration and exploitation) occur at the levels of a *nested system*-at the individual level, the organizational level and social system level”. Hence, for organizations, it would be inappropriate to search for the best

solution to ambidexterity, ignoring its different organizational levels. The managerial favorable solution is to search and to set up the appropriate proportions of exploration and exploitation at each of the organizational levels.

The limitation of this paper is a single case of a company. Further research should investigate a larger number of ambidextrous companies and define how do they co-organize and deal with exploration and exploitation at different levels. Additional studies are necessary to expand the knowledge on fractal and dynamic ambidexterity. It would be critical to understand how an organization replicates exploration and exploitation and what is the priority of these replications in order to achieve a sustainability of the organizational ambidexterity.

REFERENCES

- Abernathy, W. J., & Utterback, J. M. (1978). Patterns of industrial innovation. *Technology Review*, 64, 41–47.
- Birkinshaw, J., & Gibson, C. (2004). Building ambidexterity into an organization. *MIT Sloan Management Review*, 45, 47–55.
- Boumgarden, P., Nickerson, J., & Zenger, T. R. (2012). Sailing into the wind: Exploring the relationships among ambidexterity, vacillation, and organizational performance. *Strategic Management Journal*, 33(6), 587–610.
- Burgelman, R. A. (2002). Strategy as vector and the inertia of coevolutionary lock-in. *Administrative Science Quarterly*, 47(2), 325–357.
- Burgelman, R., Christensen, C., & Wheelwright, S. (2004). *Strategic Management of Technology and Innovation*, McGrawHill.
- Chen, E. L., & Katila, R. (2008). Rival interpretations of balancing exploration and exploitation: Simultaneous or sequential? *Handbook of Technology and Innovation Management*, 197–201.
- Cohendet, P., & Llerena, P. (2003). Routines and incentives: the role of communities in the firm. *Industrial and Corporate Change*, 12(2), 271–297.
- Cohendet, P., Llerena, P., & Marengo, L. (2000). Is there a pilot in the evolutionary firm? *Competence, Governance, and Entrepreneurship: Advances in Economic Strategy Research*, 95–115.
- Cohendet, P., Llerena, P., Simon, L., & others. (2012). *The routinization of creativity: Lessons from the Case of a video-game Creative Powerhouse*. Bureau d'Economie Théorique et Appliquée, UDS, Strasbourg.
- Cohendet, P., & Simon, L. (2007). Playing across the playground: paradoxes of knowledge creation in the videogame firm. *Journal of Organizational Behavior*, 28(5), 587–605.
- Eisenhardt, K. M. (1989). Building Theories from Case Study Research. *The Academy of Management Review*, 14(4), 532–550.
- Eisenhardt, K. M., & Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. *Academy of Management Journal*, 50(1), 25–32.

- Gibson, C. B., & Birkinshaw, J. (2004). The antecedents, consequences, and mediating role of organizational ambidexterity. *Academy of Management Journal*, 47(2), 209–226.
- Ginsberg, A., & Baum, J. A. (1994). Evolutionary processes and patterns of core business change. *Evolutionary Dynamics of Organizations*, 127, 151.
- Henderson, R. M., & Clark, K. B. (1990). Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms. *Administrative Science Quarterly*, 9–30.
- Jansen, J. J., Vera, D., & Crossan, M. (2009). Strategic leadership for exploration and exploitation: The moderating role of environmental dynamism. *The Leadership Quarterly*, 20(1), 5–18.
- Kauppila, O.-P. (2010). Creating ambidexterity by integrating and balancing structurally separate interorganizational partnerships. *Strategic Organization*, 8(4), 283–312.
- Levinthal, D. A., & March, J. G. (1993). The myopia of learning. *Strategic Management Journal*, 14(S2), 95–112.
- Liu, L., & Leitner, D. (2012). Simultaneous pursuit of innovation and efficiency in complex engineering projects—A study of the antecedents and impacts of ambidexterity in project teams. *Project Management Journal*, 43(6), 97–110.
- Liu, L., Wang, X., & Sheng, Z. (2012). Achieving ambidexterity in large, complex engineering projects: a case study of the Sutong Bridge project. *Construction Management and Economics*, 30(5), 399–409.
- March, J. G. (1991). Exploration and Exploitation in Organizational Learning. *Organization Science*, 2(1), 71–87. <http://doi.org/10.1287/orsc.2.1.71>
- Nonaka, I., Kodama, M., Hirose, A., & Kohlbacher, F. (2014). Dynamic fractal organizations for promoting knowledge-based transformation—A new paradigm for organizational theory. *European Management Journal*, 32(1), 137–146.
- O'Reilly, C. A., & Tushman, M. L. (2004). The ambidextrous organization. *Harvard Business Review*, 82(4), 74–83.
- Schumpeter, J. A. (1934). *The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle* (Vol. 55).
- Tushman, M. L., & O'Reilly, C. A. (1996). Ambidextrous organizations: Managing evolutionary and revolutionary change. *California Management Review*, 38(4), 8–28.
- Tushman, M. L., & O'Reilly, C. A. (2002). *Winning Through Innovation: A Practical Guide to Leading Organizational Change and Renewal*. Harvard Business Press.
- Tushman, M. L., Smith, W. K., & Binns, A. (2011). The ambidextrous CEO. *Harvard Business Review*, 89(6), 74–80.
- Yin, R. (1994). *Case study research: Design and methods*. Beverly Hills, CA: Sage publishing.