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Organizational ambidexterity : a fractal and dynamic case

Lesya Dymyd

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UNIVERSITÉ DE STRASBOURG

ÉCOLE DOCTORALE AUGUSTINE COURNOT

Bureau d'Economie Théorique et Appliquée, UMR 7522

THÈSE présentée par:

Lesya DYMYD

Soutenue le: **21 Mars 2016**

pour obtenir le grad de: **Docteur de l'Université de Strasbourg**

Discipline/ Spécialité: **SCIENCES DE GESTION**

Organizational ambidexterity: A fractal and dynamic case

THÈSE dirigée par:

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Dedicated to my parents, Maria and Mikhail, who put my education ahead of their personal interests and always supported me during my studies in France

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GENERAL INTRODUCTION

A successful and sustainable organizational performance is the main objective in management of any organization. Both efficiency and competitiveness are necessary for organizational survival in the long term.

Operational efficiency is achieved by exploitation of existing capabilities and by fulfillment of the short term company's needs. This process is often linked with the improvement and refinement of the existing knowledge, skills, competences and technologies and it results in the production of incremental types of innovation, of product and service's improvements.

Strategic competitiveness, in contrast, requires a vision of the future and can be achieved by exploration of new opportunities in the long term. This activity deals with research and experimentation with new knowledge, competences and technologies and results in creation of radical innovation and brand new products and services.

The organizational ability to innovate requires a combination of exploratory and exploitative capabilities. It needs exploration to search for and create an innovation. The same way as it needs exploitation to refine and improve a product, a service or a process. The sustainable innovative organizations succeed to combine these two contrasting activities. They are capable to organize and manager different set of structures, processes and activities to pursue exploitation and at the same time exploration.

Not only the ability to innovate, but also the organizational sustainability and survival depends on how an organization is able to balance between the contrasting activities. Without exploration, a company is more likely to suffer from inability to change. Without exploitation, it will be incapable to adapt these changes and will suffer from high costs for experimentation and low returns.

The ability to organize and to manage both activities simultaneously is particularly, important for large incumbent organizations. Often, the smaller in size companies are able to be flexible and creative, they tolerate risk taking and entrepreneurial approach to organize working processes. Large organizations with long histories have tendencies to prioritize efficiency over innovativeness. To maximize the chances of success, they avoid failures, put under pressure the internal entrepreneurs, limit or reject creative and non-standardized approaches to work. Another important issue is the organizational environment. The type of industry and the speed of change are the important factors that can influence on the company's ability to combine and balance exploration and exploitation.

In the long term perspective, the absence of balance and large disproportion of exploration and exploitation might be dramatic for organizations. It will result either in the

organizational inability to envision change or to adapt to change. Neither of these scenarios is appropriate for the sustainable organizational performance.

In spite of the importance of both activities for company's survival, the ability to co-organize and pursue exploration and exploitation simultaneously is a major challenge for organizations and in particular, for firms that want to remain innovative over time. The first reason is that for organizations, it is not always easy to put in place and ensure the co-existence and coordination between different structures, processes, activities and objectives, which are essential to be innovative and at the same effective. The second reason is that due to the scarcity, it is not always possible to guarantee the allocation of sufficient amount of organizational resources both for exploration and exploitation. Our main objective is to explore how organizations, by achieving ambidexterity are able to meet these challenges.

The purpose of our dissertation is to examine the organizational ability to co-organize and to manage simultaneously both activities. In the literature, the successful companies, which are able to perform them equally well, known as *ambidextrous organizations*. They combine different capabilities, structures and processes, create and produce radical and incremental innovation.

An organizational solution to ambidexterity is structural separation of activities. It is a form of organizational design, where the exploratory entity, often an entrepreneurial innovation unit, has a function of exploration of new ideas and creation of new knowledge and technologies. The exploitative structures, usually large and efficient business units, perform the exploitation function, refinement and execution. Structural and functional separation allows an organization to address exploration at the same time exploitation, produce radical and incremental innovation. But it is still unclear how exactly companies achieve ambidexterity through separation and whether it is a solution that can sustain over time.

Over the last 20 years, scholars accumulated knowledge and received major achievements in the fields of ambidexterity and organization learning. The studies presented at the symposium, dedicated to ambidexterity (for more details see *The Academy of Management Perspectives*, 2013, Vol. 27 No. 4) summarize the existing knowledge and demonstrate the advancement of the research on exploration and exploitation as well as identify the research gaps and define future directions. These studies (see Birkinshaw and Gupta, 2013; Junni et al., 2013; Markides, 2013; O'Reilly and Tushman, 2013) prove that none of the existing literature provides an explicit answer on how an organization can achieve the balance and perform exploration and exploitation equally well. Striving to find a valid

organizational solution to exploration-exploitation balance that can sustain over time, we define our research question for dissertation as following:

How to simultaneously co-organize and manage exploration and exploitation to ensure a sustainable and successful organizational performance in the long term?

To make the in-depth analysis of the activities in an ambidextrous company, we develop and apply a cross-level research method, described in our dissertation as the “***multilayer methodology***”. It is an original approach, which consists from a combination of research methods and techniques applied to analysis of exploration and exploitation at different organizational level. Our multilayer methodology has the following advantages: first, it simultaneously analyzes the activities at three different levels; second, it takes into account the time factor, and in particular, the level of maturity and evolution of the structure, responsible for the exploratory function. As a complementary feature, our method includes the vision and choices related to ambidexterity, received from the senior and executive managers of the company.

The multilayer methodology has three levels of analysis and steps of data collection. The first step is at the ***corporate level***, which includes the analysis of the activities and processes of the exploratory and exploitative structures of the company, the means of their structural and function separation and mechanisms for linkage, integration and coordination. This step includes a half-year presence of our researcher as a part of the team of the innovation unit of the company as well as observations and collection of data on innovation activities, processes, cultures. The second step is at the ***project level***, which consists of the in-depth study of 6 projects of radical and incremental technological innovations and their development process. Finally, the third step is at the ***executive level***, which represents visions, decision and choices on exploration and exploitation, similarly as on coordination and integration of structures and their processes. Also, it is a complementary level to evaluate the results from our analysis at the corporate and project levels.

We apply our multiplayer methodology to a case of an ambidextrous company, which is a technology-based service company belonging to the oil and gas industry. The company is an oilfield service provider for organizations in the oil and gas exploration and production businesses. It is a large, fully integrated and a science-based company, with significant R&D capabilities and international market operations. It searches for and develops different types of technological innovations, product and services for geological exploration of natural resources.

The major R&D activity of the company focuses on the production of incrementally improved technologies to increase the operational efficiency from the existing geophysical services. At the same time, the company has an innovation unit that concentrates its activity on exploration, research and experimentation with new and advanced technologies. This unit creates and develops radically new products and services and opens up new markets. To achieve ambidexterity, the company structurally separates the two different entities and dedicates exploration and R&D of radical innovation to the innovation unit, exploitation and R&D of incremental innovation to the divisional business lines.

The relevance of our multiplayer methodology applied to the in-depth study of the ambidextrous company from the oilfield service sector is defined by the existing gaps in the literature. Moreover, there is a combination of theoretical and practical reasoning. From the *theoretical perspective*, the concepts of exploration, exploitation and ambidexterity have received increasing interest from scholars in the last two decades. Existing studies gathered a significant amount of knowledge on ambidexterity and proposed multiple solutions to balance two activities. But at the same time, much remains unexplored and a solution to achieve and sustain ambidexterity is yet to be found.

In recent studies, presented at the symposium on ambidexterity (e.g. Birkinshaw and Gupta, 2013; Markides, 2013; O'Reilly and Tushman, 2013) scholars propose that the term ambidexterity started to lose its meaning. Ambidexterity has been addressed to solve a broad number of organizational questions and many of them were not always directly related to exploration and exploitation challenges. The aim of our dissertation is to stay focused on the problem of balancing between exploration and exploitation, identified by March (1991) and to study about organizational ability to cope with contrasting activities to create different types of innovation. In our research, we use the term ambidexterity to describe the ability to explore and exploit in a simultaneous fashion and to develop radical and at the same time, incremental innovation.

Our research applies the recommendations on ambidexterity, proposed by scholars from the symposium, which was mentioned previously. In particular, to fill the gaps in the existing knowledge, we propose to analyze simultaneously exploration and exploitation at three different organizational levels: corporate, project and executive and include the evolution of the function of the exploratory structure. In more general terms, our research crosses several levels of analysis, takes time into account (see e.g. Birkinshaw and Gupta, 2013; O'Reilly and Tushman, 2013) and defines the role of managers in balancing between exploration and exploitation (see e.g. Birkinshaw and Gupta, 2013; Junni et al., 2013; O'Reilly and Tushman, 2013).

From more *practical perspective*, there is a need to understand how an ambidextrous organization that uses structural separation should differentiate innovation-related processes and functions and, at the same time, integrate them to achieve synergies. It is important to define when and how the separation and integration take place and what is the role of senior and executive managers in coordination and in achieving balance. For this purpose, the cross level analysis, that includes corporate structures, processes and managerial decision making would be an appropriate approach to study the phenomenon by using practical evidence from the case.

As the basis for our research, we use the existing knowledge on ambidexterity and in particular, give much of attention to its structural mode. We project the model of structural ambidexterity (will be described in Chapter 2) and compare it with the practical evidence from our case study. Our multiplayer methodology in combination with the in-depth study of the ambidextrous organization provides us with the detailed description and actual data on how the company can achieve the exploration-exploitation balance through structural separation and whether it can sustain the proportions of activities over time.

In our dissertation, there are several key definitions. The term *ambidexterity*, which can be applied at the diverse levels of our analysis, will refer to the organizational ability to both explore and exploit and to develop radical and incremental innovation. *Structural ambidexterity* is defined as an organizational solution to achieve simultaneous exploration and exploitation by means of structural separation of activities. In our case these are the innovation unit and the divisional business lines. We also apply the term *(new) product development* (NPD), which is used to describe the whole process “from idea to a product” or a part of this process (a phase). In our context, it refers to the process of creation and development of technological innovation.

Our dissertation consists from five chapters. **Chapter 1** introduces the case and presents the description of the technology-based service company, its internal and external organizational characteristics and capabilities. It defines why the company is an ambidextrous organization, presents its innovative and core activities and the innovation-related functions. This chapter identifies separate exploratory (the innovation unit) and exploitative structures (the divisional business lines), describe the way they are structured and presents main characteristics of their activities, roles and functions.

Chapter 2 is dedicated to the theoretical and methodological aspects of our research. It includes three parts. The *first part* focuses on theoretical background of exploration and exploitation: the essence of the activities, their inconsistent characteristics and the question of balance. Separately from exploration and exploitation, we observe the existing theory on the

concept of organizational ambidexterity. The *second part* of the chapter introduces the meaning of organizational ambidexterity, describes existing organizational solutions to achieve it and discusses the complexity and the intermediate stage of the development of the concept. The *third part* is a methodological one. It begins with the presentation of the theoretical model of structural ambidexterity, which we use in our research. After, it introduces our multiplayer methodology and explains different steps for the collection of data.

Chapter 3 presents the evidence on structural ambidexterity received from the case of our ambidextrous company. It covers the analysis at the corporate and at the project levels, and prepares the data to be used at the executive level in the next chapter. In particular, in this part of the dissertation we identify the actual activities, functions and processes in separate exploratory and exploitative structures as well as the existing mechanisms for their coordination and integration. Also, the chapter includes the detailed description of development processes for 6 projects of radical and incremental technological innovation. For each of the projects, we present the story of creation, maturation, engineering development and launch and conclude with a short resume on the observed processes.

Chapter 4 integrates the results from three levels of our analysis (corporate, project and executive) and discusses the evolution and dynamics of ambidexterity in the company. At the *corporate level*, exploration and exploitation are identified in separate exploratory and exploitative structures. At the *project level*, both activities are present in the innovative projects of the innovation unit, which originally, is an exploration-oriented part of the company. At the *executive level*, we confirm the results from the previous two levels and identify the similar behaviors as described in the literature on the ambidextrous individuals, among the senior and executive managers, those, who are capable to manage the tensions between exploration and exploitation.

In addition, we present the story of initiation, maturation and growth of the innovation unit and its relation with the exploitative structures and the executives of the company. The growth cycle is used to explain and justify its evolution, the shift in the previously strong support from the top management and emerging dynamics of exploration and exploitation inside the innovation unit.

Finally, **Chapter 5** introduces and clarifies the new concept on *fractal and dynamic ambidexterity*, which originated as the results from our analysis of exploration and exploitation and observations of their dynamics at multiple organizational levels. The processing and reasoning on the data from the multilayer methodology resulted in the emergence of the new theory, which is defined as fractal and dynamic ambidexterity.

In this part of the research, we draw implications from our methodology, present the main contribution and summarize the dissertation. We explain that the existing theoretical understanding of structural ambidexterity has only a static representation, with serious limitations e.g. isolation of the exploratory unit caused by uncoordinated separation and organizational inability to explore without strong top management support.

By using a case of the company, we show the practical evidence on the existence of the multilevel dimension of ambidexterity and prove that exploration and exploitation can simultaneously emerge at the corporate, at the project and executive levels. For every level, we identify the dynamics of activities, which demonstrates that proportions and intensity of exploration and exploitation are not fixed, but can change over time. The answer to our research question is in the fractal and dynamic ambidexterity, which is a new solution for successful organizational performance and survival in the long term.

CHAPTER 1.

SETTINGS OF THE CASE STUDY: THE COMPANY AND THE ENVIRONMENT

This chapter provides an overview of the organizational and environmental settings of the case study at the centre of the present dissertation. It is aimed to introduce the reader into the context of the research as well as to provide the necessary information on the ambidextrous company used as a case study, including market segments, industry and company's environment in general.

Organizational learning literature defines diverse factors that influence the organization to pursue both exploration and exploitation. March, (1991) for example, refers to the time factor and necessary resources for exploration and exploitation activities. He argues that change and turbulence of the environment can also impact the decisions and the organizational choices between these activities.

Similarly, the innovation management literature explains that the speed of change and technological development are important factors for an organization that is willing to remain sustainable in the long term. Companies should define their strategies carefully and base their decisions on change in their industries and markets. In fact, the choice and selection between exploration and exploitation activities should depend on the state of the company and its environment. For different companies, selection and allocation of resources between the activities would be different. It will also depend on the speed of change and state of a particular organizational environment (e.g. stable or dynamic).

The literature on organizational ambidexterity does not provide a clear argument on how such factors as company's environment, technological and industry change can influence organizational decisions on selection and allocation of resources between exploration and exploitation activities. Scholars still do not know whether a particular approach to achieve ambidexterity (e.g. sequential, structural or contextual mode) could be more suitable for specific companies. For example, differentiation can be made based on type of industry, speed of change and state of the environment. In existing literature there are only a few studies that observe the question of ambidexterity and the question of balance for companies

operating in stable and dynamic environments (e.g. Burgelman, 2002; Chen and Katila, 2008; Katila and Ahuja, 2002) and in the context of different industries, such as high-technological, manufacturing or services (Junni et al., 2013).

Our dissertation includes internal and environmental factors and observes their role and importance in the context of ambidextrous organizations. This research makes the in-depth analysis of an ambidextrous company, including its environment and observes them as a unique system and takes into account the dynamics of the industry and market change.

In particular, this chapter defines characteristics of the technology-based service company and describes the main feature of its industry, markets and environment. The company from our research is an oilfield service provider of the technological solutions and software services for oilfield exploration and production of natural resources in the energy sector. It operates on the markets of seismic services and provides diverse technologies for petroleum companies to search for and analyze new fields with energy resources.

The objective of this chapter is to answer the following questions:

What are the characteristics of the technology-based service company?

What is the environment of the company?

What are the company's abilities to be an innovative organization?

The chapter has a following structure. First, it provides a general description of the company, business activities and segments of the market. Second, it describes the scope of the business activities of the company. Third, it characterizes the structural elements and organizational activities that make this company an innovative organization.

1.1 General presentation of the company and the industry

This study is an in-depth case study of an oilfield service company. The firm is a *technology-based service company* that develops and produces engineering, technological and software products and services (solutions) for exploration, development and production of natural resources. The company is a geophysical service provider for large and small petroleum companies. Geophysical services include a combination of diverse technologies, software programs and processes with an objective to discover, to explore and to provide a detailed analysis of reservoirs with oil and gas resources in diverse environments (offshore, onshore, etc.).

The technology-based service company is a geophysical service company, which can be characterized as follows:

- Leading and long-living;
- Science-based;
- Fully integrated;
- Innovation-oriented.

The company is a *leading, long-living* incumbent organization. For more than 80 years, the French-based organization, with headquarters in Paris, has developed cutting edge technological and software solutions for exploration of reservoirs with natural resources worldwide. It holds a leading position on the market of service providers and is a leader among competitors in the domain of geological and geophysical services for the offshore oil and gas exploration process. In this company, services and solutions are provided to the world's largest petroleum companies such as Saudi Aramco, BP and Royal Dutch Shell. In the international arena, the firm works with a number of large, medium and small companies that represent private, public and national and global organizations and operates in all geographical areas (North and Latin America, Europe, Africa and Middle East, Asia Pacific).

The technology-based service company is a *science-based organization*. The core of the company is its R&D activity. According to the public corporate data (2013), more than 10,000 employees worked in 75 different locations and among them 700 people were dedicated specifically to R&D and involved in scientific, research development activities and operational improvements.

In 2013 after the successful execution of merger and acquisition strategies, the firm became a *fully integrated* company. As fully integrated, the firm is able to develop and to provide the full spectrum of engineering technologies and software solutions for geological,

geophysical and geosciences services in diverse environments: on traditional land and marine areas, in urban areas, in remote regions and in fields with extreme climates. The company describes its products as “solutions that go beyond the limits of exploration and increase field production taking into account high safety and environmental requirements” *.

The company is an *innovation-oriented* organization that promotes the culture of innovation. The vision of the company is to become the number one partner for the clients. The company’s mission prioritizes the creation of values through processes of discovery and analysis of reservoirs with natural resources. By working on the development of the innovative solutions, the firm seeks to remain a leader in the oilfield service sector. Optimization of processes and activities devoted to exploration and discovery of oil and gas resources create the organizational added value. As a part of its innovation orientation, the company is constantly working on the reinforcement of environmental sustainability and safety issues.

In the following sections, our research provides a description of the oilfield services at the energy sector as well as the bases of the geosciences. We describe the principles and give several examples of technologies and services for geological and geophysical oilfield exploration of reservoirs with natural resources. This information would be necessary to build a general understanding about the core business and some innovative activities of the technology-based service company from our research.

1.1.1 Oilfield services, what are they?

The technology-based service company is an oilfield service provider of technological and software solutions for geological and geophysical services. The core competence of the company is geological science. **Geoscience** is a multidisciplinary science that deals with Earth discovery in order to search for and explore reservoirs and produce energy resources.

The purpose of geosciences is the process of search for and analysis of new fields with natural resources (oilfield exploration). The process of discovery of natural resources is formed by several principal activities. It starts from the search and identification of the reservoir. Natural resources, such as oil and gas can be found in the reservoirs and pieces of rocks. Using a particular technology, called the source, geosciences specialists search for localization of the reservoirs and rocks that contain resources. Specialists use different

* Company’s report on sustainable development, 2013 (public document)

software models and technologies to obtain the detailed analysis of the available data, to identify the exact localization and to learn about the characterization of the reservoirs.

If the resources are found in the rocks, then geophysicists use a drilling or fracking technology. Drilling is used to cut the rocks and to analyze if there are any microfossils in the pieces of rocks. This technology is used in geophysical and geological surveys to explore areas with resources. In addition to the search for and discovery of resources, geosciences also include studies on reservoir rocks, their composition and the description of their physical properties by using different technologies and software solutions.

To explore areas with energy resources, oilfield service companies use specific solutions that are represented by a combination of particular technologies, methods, tools and software programs. Geological data and geophysical properties of the reservoirs can be explored and analyzed by two principal activities: by acquisition of data and by processing and interpretation of the received seismic data. Further, we suggest to define and to review these activities.

Seismic data acquisition (or seismic surveys in diverse environments) is the activity based on seismic and geophysical surveys and methods. Seismic surveys are necessary to collect geological and geophysical data about the areas with natural resources. The objective of the surveys is to investigate underground structures and to analyze the geophysical properties of these areas with a purpose to discover areas with energy resources. In seismic surveys, the main activity is the measurement of the reflected waves that are created by the seismic source. Depending on the novelty of a technology in the industry, it could be for e.g. dynamite, air gun, sound source, vibrator, noise, etc.).

In general, seismic surveying is the important part of the energy exploration and production cycle. In brief, the exploration process can be described as following. When petroleum companies want to produce energy from the new areas, they first need to explore these areas, because oil and gas resources are hidden in the reservoirs and rocks. Often, to discover new fields, petroleum companies subcontract the exploration process to the oilfield service companies, as these providers have the expertise and technologies to perform costly seismic surveys. The surveys help to determine the location of the reservoirs and rocks, their types and structures.

The results of the seismic surveys are the *images* that contain valuable information about the localization of the reservoirs and characterization of their properties. The images with the seismic data may differ in terms of quality and resolution, which also depend on the technology applied to seismic surveys and analysis. Some recent technologies can produce high-quality and high-resolution images and seismic data in 2D, 3D and 4D formats. The

images contain the data that will be used by service firms and particularly by the petroleum companies to make decisions on the additional analysis and further production processes of reservoirs with natural resources from new areas. The high-quality images allow petroleum companies to receive precise data on reservoirs properties and to make faster and better decisions on the drilling, exploitation and production of resources from reservoirs.

Before receiving the images, oilfield service companies perform seismic surveys. Seismic data acquisition can be done in different environments. This study reviews the principles of the seismic surveys for the onshore and offshore environments. The R&D projects, described in the Chapter 3 will also refer to the innovations aimed to perform seismic data acquisition and analysis in land and in marine environments.

Offshore seismic acquisition: To perform seismic surveys in the marine environment, service companies use a seismic vessel with a source that produces the waves and the streamers that receive and collect the data (see Figure 1.1). Seismic streamers are the cables attached to the seismic vessel. They connect seismic sources and hydrophones (receivers) and create one system. Using compressed air, the seismic source produces acoustic energy. Highly sensitive sensors (hydrophones) capture the sound and echoes of the returning waves. The process of recording the waves and sounds provides information about rock types and about characteristics of reservoirs.

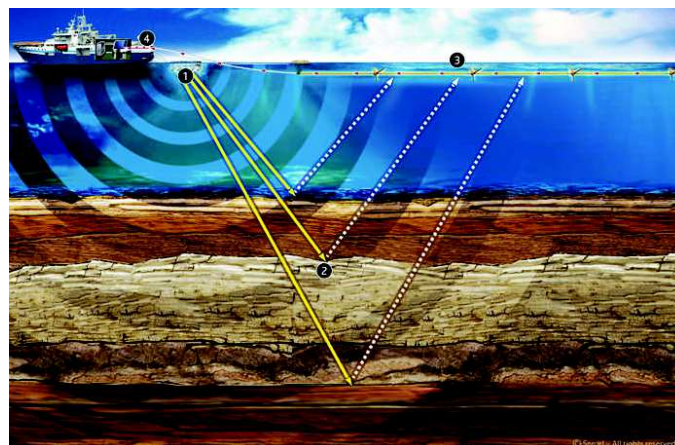


Figure 1.1 Offshore seismic acquisition surveys*

Where 1 is a compressed air gun; 2 – reflected seismic energy; 3 – sensors – hydrophones;
4 – tools for recording and processing the data

During the offshore seismic acquisition surveys, the sensors capture the signals and transfer them to the data stations on the vessel. Then, with the help of powerful computers

* Source of illustration: <http://www.sercel.com/about/Pages/what-is-geophysics.aspx>; accessed September 15th, 2015

and specific software programs, seismic specialists (geologists, geophysicists, reservoir engineers, etc.) translate and interpret the collected seismic data into the maps and images with structures and characteristics of the reservoirs. Then, a service company sends the results of the surveys to the clients-petroleum companies, who will use the maps and images to take decisions on the drilling of the reservoirs in a marine zone.

Modern technologies make seismic surveys possible not only in deep water, but also in the shallow and remote places. To perform seismic surveys in seabed zones, specialists place the cables with sensors on the seabed and use the separate source vessel to capture the seismic data. Another technology, named ocean bottom cables allows oilfield service companies to make surveys in shallow water and in transition zones such as areas between the river and the marine environment.

Onshore seismic acquisition: Similarly to marine acquisition, the land acquisition process lies in the creation and recoding of sound waves (see Figure 1.2). Onshore seismic surveys require huge and heavy equipment that must be served by land crews. To explore new areas with natural resources, service companies send equipment such as machines and trucks and crews of specialists to collect and to analyze the seismic data at the zones of the surveys.

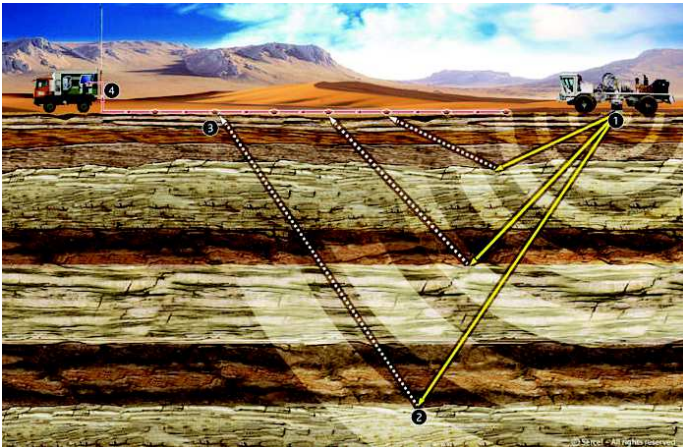


Figure 1.2 Onshore seismic acquisition surveys*

Where 1 is a seismic source; 2 – reflected seismic energy; 3 – sensors (geophones);
4 - tools for recording and processing the data

The onshore seismic surveys are performed by several large machineries, which are named as truck. To carry out the surveys, crews use two types of equipment: a truck with energy source to create vibrations and a “recording” truck to collect and store the received data.

* Source of illustration: <http://www.sercel.com/about/Pages/what-is-geophysics.aspx>; accessed September 15th, 2015

The process of surveys is based on creation of sound and collection of reflected waves. The machine with the seismic source has vibrating plates. The source creates the sound waves; it sends and receives the signals from the ground. Highly sensitive sensors, called geophones, capture the reflected signals from the land rocks. The signals are transformed into images and pictures in the “recording” truck. Specialists use the images to analyze the localization and characteristics of the natural resources in the land layers and rocks. The results from onshore seismic surveys are the images of land structures. They are the important elements for decision-making on exploitation (e.g. drilling) in the new zones that contain natural resources.

Although the seismic surveys in offshore and onshore environments are complex technological processes, these are only the first steps to search for and to discover a new energy fields. After acquisition surveys, the seismic data must be processed and interpreted. In other words, the collected data must be analyzed and “prepared” before sending them to the clients. This part of the exploration process forms the seismic processing and interpretation activities.

Seismic processing and interpretation: The function of the processing and interpretation is the detailed analysis of the seismic data, received during the surveys. The purpose of these activities is to transform the data into images that will be further used to take decisions on how to produce resources from new reservoirs. To receive the detailed description of the rocks and zones with natural resources, the geophysicists use powerful computers and advanced software programs. The processing and interpretation software programs allow specialists to get the detailed analysis of the geological data and subsurface structures.

Seismic interpretation and processing are a complex set of activities done by the skilled professionals at the specific workstations with the help of the advanced computer programs and software solutions. The results of the processes are the images, maps and models that are used to describe geological properties of the layers. The data serve for detection and detailed description of areas with natural resources and can be used to calculate their volume.

By and large, the oilfield exploration of natural resources consist of the acquisition of seismic data in different environments, such as offshore and onshore and of processing and interpretation services. In marine environments, the seismic data are collected by the seismic vessel, in land environments by the specific trucks for seismic surveys. For both types of environments, the main principle of seismic surveys is to create sound waves and to record the reflected sound by the sensitive sensors.

The differentiation lies in the advancement of the technologies that enable seismic surveys in harsh environments (e.g. shallow water, seabed, transition zones for marine seismic surveys; deserts, forest, jungles, urban areas for land seismic surveys); also in the type of source that is used to create the sound waves (e.g. dynamite, air gun, vibrator, etc.); in the numbers of streamers and sensitivity of sensors that increase the accuracy and efficiency of operations; in the quality and resolution of images and maps (e.g. 2D, 3D, 4D modeling). The competitiveness of an oilfield service company would be determined by the novelty of the proposed technologies to perform seismic acquisition, processing and interpretations surveys and by the ability to identify and to reply to the industry challenges.

1.1.2 Industry challenges and innovation

In the oilfield service sector, the two main industry challenges are *data accuracy* and the *environmental impact* from operations. High quality resolution of images and maps is challenging because of the presence of horizontal and vertical picks that represent the layers. They are reflected in the pictures and decrease the accuracy of the data. When such pictures are used to make drilling decisions, there is always a degree of uncertainty and risk because the interpretation of seismic data is not highly accurate.

One of the solutions to the existing problem is to repeat seismic surveys several times and to compare the results. However, because of the cost of services, most companies search to minimize the number of data acquisitions. The improvements in the operational efficiency of the surveys and advancement of the existing programs for processing and interpretation are the alternatives approaches to solve the data accuracy challenge.

While interpretation and processing specialists deal with the problem of accuracy, people at the land and marine seismic surveys search for solutions than can decrease the environmental footprint from operations. For seismic acquisition, the existing challenge is the minimization of the generative impact that can be caused to the environment during discovery and field analysis of natural resources in land and in marine areas.

Like many operations in the energy industry, the acquisition of seismic data in diverse zones has a negative impact on the surroundings. In fact, for the petroleum industry and particularly for oilfield service companies, the sustainability of the environment is a central topic. The reason is that during operations, both service and petroleum companies impact the environment. Some of the activities may cause significant damage to nature and to humans. For example, during onshore seismic surveys, heavy equipment and trucks can harm the

infrastructure, such as buildings, roads or cause the destruction of areas (e.g. deforesting of trees and plants, emaciation of water resources, deterioration of soil).

Similarly, the offshore seismic acquisition influences negatively the marine ecosystems. During the surveys the seismic vessel and the seismic source affect the marine species, particularly by producing sound. Studies show that seismic surveys can have diverse impacts on marine species (Gausland, 2000). Some operations can cause serious damage and dysfunctions in animal life (e.g. behavioral disorders, partial or complete hearing loss among animals that use sound for communication and navigation such as whales, dolphins etc.). High-level sound can cause hearing loss among marine mammals, whereas low-level sound may lead to shifts in the ability to hear, communicate and navigate.

With a purpose to protect nature, research agencies influence the activity of the energy companies by developing reports, standards and regulations to decrease the environmental footprint. As a response, service providers and petroleum companies must fulfill requirements, perform studies and prove that their existing operations do not cause serious damage. Environmental impact is also a concern for the R&D activity of the energy companies, which should be taken into account at the early stages of the development for any new or refined technology. Energy companies search for new and alternative methods, technologies and techniques that can significantly decrease the impact from their surveys and operations.

To decrease the negative impact from operations, energy companies must follow strict rules, standards and fulfill the requirements from the health, safety and environment (HSE) programs. For oilfield service companies, being environment friendly and providing services with decreased impact on nature (such as e.g. new offshore seismic services that do not harm marine species) is an approach to position themselves as innovative companies and an approach to attract and engage with old and new partners and clients.

The technology-based service company from our research promotes the environmental protection program and takes actions to decrease the impact from the seismic acquisition. The technologies used for marine seismic acquisition are tested and controlled to prevent the negative effect on marine mammals. Control and execution of the environmental protection programs are carried out by a specific department. The role of the department is to manage systems related to security, safety, health and environment. The department helps managers at different levels perform tests and make decisions related to environmental safety issues for existing operations, during development of new technologies and controls also the operations in the fields.

According to the internal documentation*, the company takes specific actions to reduce the impact from the seismic acquisition. For marine surveys, some examples include such activities as measuring and controlling fuel waste and optimization of the energy consumption in vessels, usage of the standard warning mechanisms for animals before the surveys; for land surveys, minimization of vegetation clearance and responsible usage of water (in deserts) during execution of subsurface imaging activities according to the requirements of the environmental management system (ISO 14001).

In more general terms, for energy companies, one of the existing industry challenges is the operations and their impact on the environment in particular. Building a responsible organization and performing operations with minimum environmental damage is the task of oilfield service and petroleum companies. Sustainability issues and protection of the ecosystems should be maintained at all stages of the oil and gas exploration and production cycle.

For oilfield service companies, the environmental concern may be seen as new opportunities to improve existing technologies. Alternatively, it may open new horizons for technologies of the future with the decreased negative influence on land and marine ecosystems. Such an approach to target the existing industry challenges may encourage service companies to rethink the old ways of doing operations and performing seismic surveys, and thus to create new environmentally sustainable technologies.

1.1.3 Competitiveness in the oilfield sector

In the energy industry, the environmental footprint is not the only crucial factor. Another important issue is the technological solutions and operations provided by service companies. When a petroleum company subcontracts seismic acquisition surveys, processing and interpretations, important items are the services and the technologies that can be offered by a service firm. Intensive R&D capabilities, rapid evolution of the technologies and high prices of products and services are some of the factors that make this sector a very attractive one to all types of organizations e.g. small and specialized as well as large and integrated companies. The business in this sector is efficient, but highly competitive one.

Oilfield service companies operate in a science-intensive sector. To get an expensive contract from a client, companies should provide a better service at a competitive price. An alternative, but more expensive option is when a service company proposes a client to

* Company's report on sustainable development, 2013 (public document)

perform an operation, by using an innovative technology. In that case, a client is early adopters of an innovation, and, as a rule, has the right to be the first one to test and to use a new technology.

While small and medium sized companies find their added value by proposing a small range of specialized products and services, large organizations are forced to compete in the existing business domains and to create innovative technologies to compete in future. In other words, organizations need to improve operational efficiency of the current technologies, and at the same time, search for, discover and develop innovative approaches, technologies and tools for future operations.

For the large oilfield service companies, one of the options to deal with the duality of today's and tomorrow's businesses is merger and acquisition strategies. Very often, small and medium sized organizations have knowledge, competences and technologies in innovative or highly specialized business domains. This makes them particularly attractive for the large organizations that do not have time to develop such alternative capabilities within their own structures. Contrary to small firms, large organizations have the ability to acquire and to exploit the missing competences within the old structures. The advantage is the new skills and competencies that can be integrated rapidly. But at the same time, the success from integration and exploitation of new knowledge is not always guaranteed.

Merger and acquisition strategies are one of the approaches how large oilfield service providers build and acquire their knowledge, competences and technologies. It is also the way large organizations become fully integrated companies and propose to their clients the full spectrum of equipment, operations, products and services for energy resources exploration in diverse environments. One of these companies is the technology-based service company analyzed in our research.

1.2 The scope of the company's activity

As an integrated organization, the technology-based service company produces and provides technologies, engineering products and software services for seismic acquisition, processing and interpretation. The firm develops technologies, perform studies on the subsurface and analyses the seismic data to reach a complete analysis of structures and characteristics of reservoirs with oil and gas. Products and services provided by the company can be grouped under three main *domains of activities*:

1. **Equipment design and build:** design and production of the engineering, technological solutions and instruments for seismic acquisition and reservoir

monitoring applied in different environments (land, marine, transition zones, downhole environments);

2. **Performance of the data acquisition:** development and execution of the technological solutions and geophysical expertise necessary for seismic data gathering (seismic surveys), reservoir analysis and monitoring in marine, land and airborne zones;
3. **Geology, geophysics and reservoir analysis (consultancy):** offer of cross-disciplinary technical services, consultancy and products that are applied for exploration of natural resources and optimization of assets, including:
 - Imaging software for subsurface;
 - Software tools for multidisciplinary processes (e.g. analysis of reservoir, seismic interpretation, modeling etc.);
 - Geological consulting and interpretation of reservoir features, mapping solutions;
 - Well data on key locations worldwide;
 - Data management (interpretation, consultancy, training).

The technology-based service company is a science-based organization, with a particular focus on R&D. The science-based organizations search for, create, develop, exploit and commercialize technological innovations (Abernathy, Utterback, 1978; Le Masson et al., 2010). They prioritize the process of transferring scientific findings into feasible technologies and place them on the markets. Often, science-based organizations have high R&D investments; they manage significant portfolios of patents and IP rights and often launch innovation.

The company consists of diverse organizational structures, business units, departments and groups. Structures are different in size and functionality. Some of them form divisional business lines, others represent specific working groups or teams. Each organizational structure has its own specialization and function. In general, the products, services and solutions proposed by the company are produced by a specific organizational unit and might be consumed in the production process of another entity. Hence, diverse solutions and services are developed and proposed by different business entities (divisions, business lines, functional groups, expert groups). The variety of technological and software solutions and services is presented in Table 1.1.

Table 1.1 Specialization of company's structures and portfolio of solutions

(This table includes the original data built from the company's public information and serves specifically for the purpose of our research)

	Organizational structures (Div. business lines, specialized functions, groups, teams)	Solutions (Technologies, products and services)
1	Business unit on reservoir software and services	Geophysical software; seismic interpretation and reservoir characterization services; training seminars and (private/group) courses on software and applications; consultancy
2	Expert team on interpretation	3D software solution; service and consultancy in interpretation, well path planning, velocity model building
3	Business unit on reservoir modeling software	Seismic to stimulation integrated software tool: petrophysics and rock physicist software; analysis and interpretation software; model building; seismic inversion; geostatistical inversion; geosoftware training; consultancy
4	Satellite mapping provider (expert group)	Satellite images for various market sectors (oil and gas, civil engineering, mining etc); satellite radar monitoring and data processing; offshore remote sensing service (ex. shallow water mapping, ice monitoring, oceanographic services); onshore exploration (ex. geological, mineral mapping); remote sensing
5	Business unit on oil and gas exploration and production consultancy	Products, including tools, multiclient reports and digital datasets for petroleum geology and analysis; geological data analysis services and consultancy (data analysis, wellsite services, training, petroleum reservoir service, integrated geology analysis, advisory services, unconventional and geochemistry analysis and studies)
6	Seabed geological solutions provider	Seabed solutions for exploration, developmental and production of oil and gas fields, including: acquisition services (in shallow water, transit zone, intermediate depth, deepwater, permanent reservoir monitoring); acquisition solutions (4D, carbon capture and storage, arctic and multiclient solutions); post-acquisition services (processing and interpretation, reservoir analysis)
7	Business unit on seismic acquisition equipment for various environments	Design, manufacturing, production of highly technological equipment for seismic acquisition (petroleum exploration) in land, dowlhole, marine and seabed environments; customer support services (repair, shipping, training)

8	Airborne geophysics service provider	Airplane and helicopter data collection; processing and interpretation services
9	Data management service provider	Organization and management of client's data (ex. physical or digital storage, data sorting, etc.); data transformation; well data library; consultancy and training
10	Geological consulting service provider	Consulting services on geology, geophysics, geospatial, petroleum economics, petrophysics, reservoir engineering; training courses
11	Geosciences software provider	Software solution for exploration, development and oil production management; interpretation and seismic reservoir analysis
12	Gravity and magnetic solution provider	Software for data acquisition, processing and interpretation and services based on gravity and electromagnetic techniques applied in marine, land and airborne environments
13	Business unit on land acquisition	Geophysical solutions (equipment and services) for onshore environment, including: design and execution of programs for land seismic studies; geophysics studies of surface and seismic imaging; reservoir monitoring
14	Business unit on marine acquisition	Complete range of solutions and techniques for marine acquisition service; broadband solutions to record frequencies for high resolution imaging; arctic exploration
15	Multi-client data provider	Data library information on key reservoir locations presented in the 2D and 3D format for land seismic, marine seismic surveys; aeromagnetic data; geological reports, interactive maps
16	Provider of subsurface imaging solutions	Advanced imaging technologies; solutions for subsurface processing, depth imaging, software for 4D processing and reservoir analysis; systems for data recording and interpretation in land, marine
17	Broadband technology provider	Technology for high resolution imaging and ghost elimination, can be applied in marine, land acquisition and imaging processes
18	Provider of solutions for unconventional resources	Integrated seismic solutions for reservoirs with unconventional resources (ex. tight gas, shale gas and oil, heavy oil etc); services on search, acquisition, processing, studies and monitoring; optimization of client's decision on drilling and fracturing

Table 1.1 shows that the technology-based service company has a vast number of products and services. The portfolio includes a range of geological, geophysical equipment, solutions and services for seismic acquisition, processing and interpretation of data. As a science-based organization, the company supports intensive R&D on the development of the innovative technologies and as a fully integrated company it covers the whole cycle and processes necessary for exploration of oil and gas resources in diverse environments. The products and services are accessible to different types of clients and on the local and global markets.

To perform operations and to develop new technologies, the company organizes the processes in different structures, specialized entities, functional units and groups. Our research, gives a particular attention to three important and large organizational structures. These entities are the onshore divisional business lines, the offshore divisional business lines and the innovation specialized unit. The following section will cover different aspects of these organizational entities including a description of their structures, functions, roles, processes, linkages, differentiation and integration activities and the overall positioning within the technology-based service company.

1.3 Organizational structure and structuring of the company

The technology-based service company is a large organization that uses a matrix type organizational structure (see Figure 1.3) to organize its activities. Multiple business processes are organized and managed in divisions, divisional business lines and cross-functional structures. Such a type of organization allows the company to execute diverse activities and to coordinate several structures and processes that differ in terms of market orientation.

The organizational structure consists of three divisions, nine divisional business lines and ten different cross-divisional functions and departments and one cross-divisional innovation specialized unit. Divisions and divisional business lines are organized according to their market specializations. These entities search for, develop and produce products and services for particular markets. Some products and services can be “consumed” internally (e.g. supplement materials for other divisional business lines), or could be sold to final clients (e.g. onshore seismic surveys).

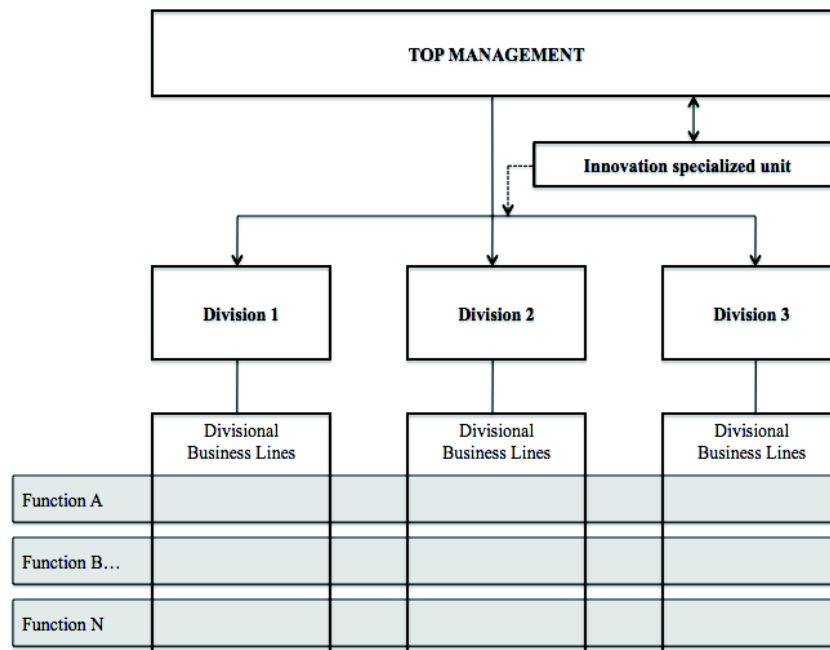


Figure 1.3 Organizational structure of the company
 (Constructed from the public data, 2013-2014)

Cross-divisional functions and departments are the entities that provide support to the divisions and divisional business lines according to their competences. Their role in the company includes: general management function, strategy, policy and guidance, internal audit and risk, operational support, policy and guidance, human resources management, etc.). The innovation unit is another part of the company that performs a specific function on innovation and has the mission to act across diverse divisions and their business lines.

Matrix structure is a common form of organization and structuring of the business processes, particularly for large organizations. But at the same time, companies with matrix type of organization face with difficulties such as the complexity and lack of flexibility, insufficient linkage between diverse processes, bureaucracy, internal politics, etc. Another problem is the alignment and coordination of different structures, functions and activities in order to assure the achievement of the corporate strategy,

In the existing studies, **strategy** is an individual or more often a collective emergent process of learning and adaptation in complex and unpredictable environment (Mintzberg et al., 1998). In strategic management, this definition of strategy belongs to the stream of the learning school. The primary goal of the learning school is to define what *actually* is occurring in organizations and answer the questions on who is responsible for formation of strategy and where does it take place.

The learning school suggests to set up clear boundaries between the processes of creation and implementation of the strategy. In fact, the strategy can only anticipate a small

amount of what a company can execute. Very often, “when a strategy fails, the thinkers blame the doers” (Mintzberg et al., 1998, p. 177). In contrast to this very traditional approach, the learning school proposes to see a strategy as a collective process of learning and change. Little actions and decisions made by different people can significantly shift the direction of a strategy and individuals from diverse parts of the company “can contribute to the strategy process” (p. 178).

In the world of large companies, the learning strategy can take a format of a corporate *venturing*. An organization creates a new structure or a firm where the employees have a freedom to develop and to promote new ideas and act as dynamic internal entrepreneurs. In this context, top management has a critical role on the integration and promotion of strategic intents, similarly as ensuring interaction and coordination between managers at higher and lower levels (see e.g. Burgelman, 1988; Mintzberg et al., 1998).

A practical illustration of theory of the learning school and corporate venturing is the innovation specialized unit of the technology-based service company. As a part of the organizational structure (see Figure 1.3.), the unit aims to create the link between the top management of the company and divisional structures. Another important function of the unit is to select new ideas and incubate innovations by acting as the corporate entrepreneurs. Further in our research we provide description of the innovation unit and examine this form of a corporate venturing in the company.

Studies show that very often, corporate ventures exist and act as the autonomous entities. “They break away from the rest of the organization rather than blend into it” (Mintzberg et al., 1998, p. 189). The separation occurs because the innovative processes and ideas of a venture cannot compete with the organizational routines, market and efficiency oriented functions and structures.

Moreover, a success or a failure of a corporate venture depends much on the ability of “doers” (or middle level managers) to convince “investors” (top managers) in the necessary change (see e.g. Burgelman, 1988; Mintzberg et al., 1998). It is purely political process, because managers at the operational levels are the initiators of the strategic initiatives and creators of innovation, whereas the top managers are responsible for assessment and decision-making. Their role is limited, as they do not always have necessary technical or economical knowledge and information to execute strategic intents.

In addition, the decision regarding the activities of the venture, either individual or collective can be controversial. Often they are based on past experience of managers and tend to rely on rational choices (Mintzberg et al., 1998). Likewise, in the corporate venture,

decisions can be used to promote the interests and intents of an individual or a specific group of people.

Those organizations who continually learn, have the ability to combine efficiency and flexibility (Mintzberg et al., 1998). They learn both from a success and a failure, they relocate relevant internal knowledge and search for new one outside of their own domain. But as any stream, the learning school has the limitations. Learning is hard in rapidly changing, uncertain and complex environments. Long-term planning is particularly difficult for organizations, because industries are not stable and change can occur unexpectedly. To avoid failures, a learning organization should foresee the short term patterns and to develop guidance to deal with uncertainty and complexity.

Our research is crossing theory and practice and suggests reviewing the learning school and a corporate venture from the study of Mintzberg et al., (1998) by using a case of the technology-based service company. To describe the structuring of the company, configuration and relation between diverse organizational elements, we rely on the concept of organizational structuring, proposed by Mintzberg, (1979). Based on this theory, we describe three main structures: first, the organization of the whole company; second, the structuring of the divisional business lines which represent the operational entities; third, the structuring of the innovation unit that, in our case, is a form of the corporate venturing. We intend to define the actual organization of the company and find out how different business structures implement the critical intents and achieve corporate strategy which, as a rule, is defined by the top management. Further sections include the descriptions of the structures, their functions and exact activities.

1.3.1 Structuring of the technology-based service company: The Divisionalized Form

As a fully integrated service company, the firm covers all the stages of the search for, discovery and analysis of new fields with natural resources, including source rock studies, basin analysis for future drilling, exploration-seismic studies, geochemical and geophysical analysis, production and reservoir analysis. According to study of Mintzberg (1979), the technology-based service company can be characterized as an organization with the Divisionalized configuration (see Figure 1.4). **Divisionalized form** is defined as a “market-based structure, with a central headquarters overseeing a set of divisions, each charged with serving its own markets” (Mintzberg, 1980, p. 335). The headquarters serve as a controlling and coordinating body for the autonomous and independent operational divisions. They set performance standards to the divisions, monitor and measure the results from the activity.

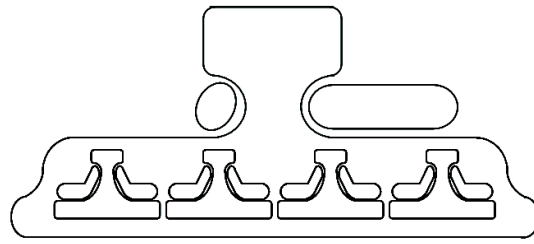


Figure 1.4 Structuring of the company: The Divisionalized Form
(Adapted from Mintzberg, 1979)

In the case of our company, the core activities are organized in the specialized and autonomous divisions: 1) equipment, 2) data acquisition, data processing and 3) interpretation. The Divisionalized form is justified by the market diversity of the company. Each of the divisions has particular function and serves for the needs of the specific market segments.

The first is the *equipment division*, which delivers advanced seismic acquisition solutions and instruments for reservoir monitoring. The goal of this division is to produce equipment that provides imaging to detect natural resources (oil, gas, other minerals). In general, the equipment serves for discovering the areas with natural resources and for reservoir monitoring in diverse environments (including land, marine, hostile zones, down hole zones, ocean bottom).

The business lines of this division provide not only final products for markets, but also the equipment that can be consumed by other divisions of the company. These are for example spare parts or equipment for technologies in operations. The product of the equipment division can be applied in multiple environments that help expand the targeted groups of customers and areas of operations. In addition to the main activity, the division also develops new to the market technologies (e.g. based on acoustic waves, customer–designed cables, etc.).

The second division develops technologies, engineering products and services for the *seismic acquisition* in onshore and offshore environments. After the recent integration of a new structure (M&A, in September 2012) this division expanded its activity and is now able to cover the full range of operational phases for oil and gas exploration in diverse zones (discovering, development and production processes). This division works on seismic surveys, particularly on the process of optimization and solving of imaging difficulties during the exploration surveys in challenging environments. The seismic acquisition division is a unique provider of technology that can be applied for acquisition surveys in 3000 meter water depths.

The third division specializes on *data analysis - the processing and imaging*. It develops software products and services to study the reservoir characteristics, for modeling

and interpretations during and after seismic surveys. Within the division, there are three business lines. Each of them fulfills a specific function: business line A delivers unique technology and expertise on reservoir characterization and seismic interpretations; business line B focuses on reservoir modeling for different types of reservoirs such as new, existing, thin, complex, etc. (models are used to improve performance and profitability during oil and gas production phases); business line C provides consultancy services on the overall exploration process, including different types of analysis of geological data, reservoir engineering services, consultancy and advisory services for petroleum companies.

The three divisions are the autonomous structures of the technology-based service company. The general control of the company is the responsibility of the top management (board of directors) from headquarters located in Paris. All divisions consist of several divisional business lines, which are different in terms of size, functions and market segments. These structures also have R&D functions, and perform research and development activities to create products and services for their existing markets.

All divisions are independent entities and have the power to organize, to perform their operations and to take decisions within the scope of their activity and targeted markets. They have financial, operational and decision making freedom to choose how to allocate their resources. In divisional R&D departments, the heads and leaders of the divisions are able to decide how and what kind of technologies they develop. At the same time, the headquarters control the results from the activity of the divisions and their business lines. The top management sets the goals for divisions, maintains and controls their performances.

Thus, each division consists of several business lines. Divisional business lines are the market-specialized structures. They perform specific sets of activities and functions to fulfill the needs of the divisions. This study will review in details the structure and organization of two business lines from the division responsible for seismic acquisition.

1.3.2 Structuring of the divisional business lines: The Professional Bureaucracies

The seismic acquisition division includes two structures – onshore and offshore business lines. These two entities perform similar activities but have different market orientation. The onshore business line develops products, services and technologies for seismic surveys in a land environment. The offshore business line performs similar activities in the marine environment. Hence, these entities are similar in operations, but different in the fields of surveys.

The structuring of the divisional business lines is similar to the Professional Bureaucracy (see Figure 1.5.) because the entities perform the main organizational work and form the core of the firm. The **Professional Bureaucracy** is the structure which “hires highly trained specialists – called professionals - in its operating core and then gives them considerable autonomy in their work” (Mintzberg, 1980, p. 333). The professions are grouped based on the function or market bases. They have the ability to work freely and to control their own work. The stability is ensured by the standard set of skills and procedures, necessary for operations. For the collective results, the controlling and coordinating body is present at the administrative level.

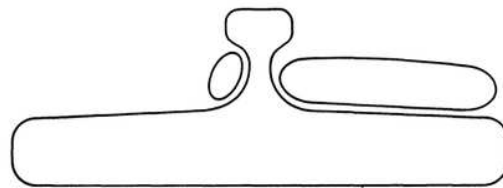


Figure 1.5 Structuring of the divisional business lines: The Professional Bureaucracies
(Adapted from Mintzberg, 1979)

In the company, divisional business lines have two main functions. Their first and main objective is to ensure the effective performance of the current business operations. Their second objective is to perform the necessary R&D activities to ensure the company’s competitiveness on the existing markets (in this case – on the offshore and onshore seismic acquisition). In other words, the mission of the business lines is to increase the efficiency of the existing technological operations and to ensure the company’s positioning in the specific market segments.

In fact, divisional business lines are more exploitation-oriented types of structures. They can be described as large in size, old and well established, effective entities. The divisional management controls the activity of the business lines. Together with the top management of the company, divisional leaders set the goals and control the performances of these entities. Business lines have quarterly targets and short term orientation. On a regular basis, divisional business lines should demonstrate their operational effectiveness to the top management of the company.

To improve the effectiveness from the current operations and to increase the competitiveness on the existing markets, these entities rely on the highly skilled professionals in divisional R&D structures. The onshore and offshore divisional business lines have their independent R&D departments.

As already mentioned, the company is a science-based organization, where research and the creation of new products and services is a primary factor. According to the corporate

data (2013) in the R&D structures of the onshore and offshore business lines there were approximately 80 highly skilled professionals who worked on the creation of new products. In comparison, the number of employees who work in R&D at Division 1 and Division 2 amount to around 350 and 300. The differences in numbers of people are justified by organizational specificities such as history, size and effectiveness of the divisions, as well as by the nature of activities, operations and processes, performed at the divisional R&D structures.

In the technology-based service company, divisional business lines act as Professional Bureaucracies (see Figure 1.5.). In such entities, individuals are highly skilled specialists and professionals. Individuals have the ability to work independently, but at the same time, they are supposed to stay in close contact with their managers at different levels – heads of business lines and divisional leaders. These structures are “essentially bureaucratic” (Mintzberg, 1979, p. 351), the coordination is “achieved by design and by standards that predetermine what is to be done”. They have the professional authority and rely on “the power of expertise” (p. 351).

Although, divisional business lines are independent and hire highly skilled professionals and experts, the activity of these entities is standardized. In these structures, the employees have two main tasks: first, to identify the clients’ needs and second, to perform actions in order to satisfy the needs of the markets. The professionals have limited freedom to be creative and to perform activities that are out of the scope of their routine tasks. They have to serve the needs of the structures.

Such a structural configuration, as in the business lines, creates an environment that is both complex and stable: “complex enough to require the use of difficult procedures... and stable enough to enable these skills to become well-defined and standardized” (Mintzberg, 1979, p. 366). The creation of innovation in the R&D departments within these structures is also tricky. In a sense, this structure is inflexible, but to control the performance, it always searches for stability. This structural configuration is suitable for stable environments where it can predict and produce standard outputs. But it is less appropriate to create new products.

Professional Bureaucracy structures resist changes. Their purpose is to control and standardize existing products, processes and activities. They are not suitable for breaking the rules and creating innovation. In bureaucracy type of organizations, the structures and individuals who have power and control will resist and prevent innovative (or divergent) thinking and behaviors. They are “*conservative* bodies, hesitate to change their well established way” (Mintzberg, 1979, p. 375). And even if an individual proposes an

innovation, “great political clashes inevitably ensue” (p. 375). Usually, in these bureaucratic structures changes are slow and painful.

Thus, in the company, the divisional business lines have the configuration of the Professional Bureaucracies. These entities have a high specialization in terms of skills, knowledge, operations, technologies, services and markets. They do perform innovative activities in their R&D departments, but they are more of an incremental nature. In general, their work is exploitative: they perform standardized research and development processes and activities to improve operations and technological effectiveness of the existing products and services. Their goal is to be effective and profitable and to deliver short term results on a regular basis.

In spite of the fact that divisional business lines are the predominant structures, the technology-based service company creates innovations. The company has a specific organizational structure that is responsible for creative, non-routine and non-standardized types of development. This structure is the innovation specialized unit. It is aimed to create radically new and breakthrough technologies that change the existing processes and operations in the oilfield exploration business.

1.3.3 Structuring of the innovation unit: The Adhocracy

The innovation specialized unit is a form of a corporate venturing as describe previously by the theory of by the learning school (see Mintzberg et al., 1998). Created in 2010, the innovation unit was aimed to perform new, complex and non-standardized product development activities that were not supported by the structures of the divisional business lines. Its mission was to create technological innovations and the employees were able to act as internal entrepreneurs.

It is driven by the entrepreneurial spirit and has the purpose to create radically new products and services.

The structuring of the innovation specialized unit is similar to the Adhocracy (see Figure 1.6.). The Adhocracy form is the most appropriate structure for “sophisticated innovation and which is able to fuse experts drawn from different specialties into smoothly functioning projects” (Mintzberg, 1980, p. 337). It is a highly organic, decentralized and an innovative structure with limited formalization of behavior. This structure focuses on the expertise, gives priority to the advanced technical systems and exists in young and dynamic environments.

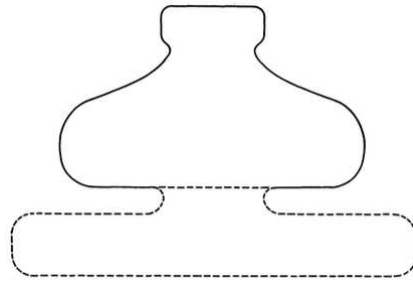


Figure 1.6 Structuring of the innovation unit: The Adhocracy
(Adapted from Mintzberg, 1979)

In the case of the technology-based service company, the innovation unit is a cross-divisional department that performs the innovation function across three divisions and their business lines. To act transversally, the innovation unit uses its legitimacy and a power to create innovations, delegated by the top management of the company. The activities and functions of the unit are recognized, protected and supported by the executives.

The direct link between the unit and executives works in both directions. On the one hand, the innovation unit is an “executor” for the top–down strategic innovations. On the other hand, the unit is the “guardian” of the innovations from the divisional structures. In other words, the innovation unit is an integrating structure between the leaders and the executors, and in between the diverse organizational structures (see Figure 1.7). It is a place where executives can explore their visionary ideas of future business, and similarly, where divisional structures can propose to explore their own innovative ideas and technologies.

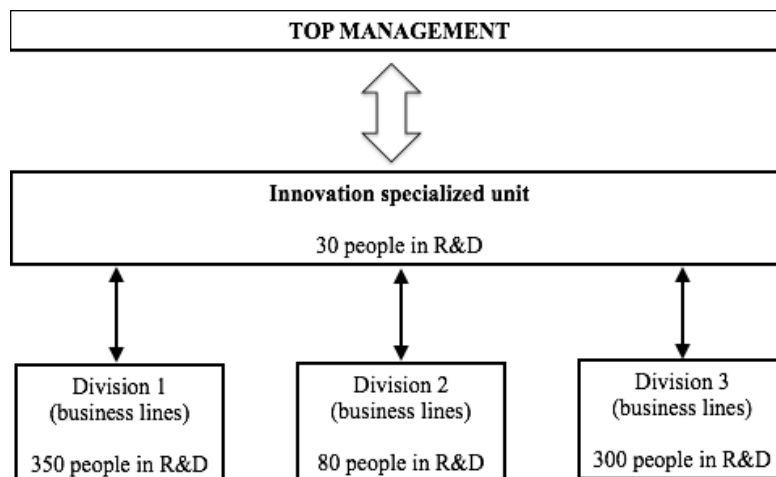


Figure 1.7 The integrating role of the innovation unit
(Constructed from the corporate data, 2013)

Except ties with the top management, the innovation unit has a links with the divisional structures. The unit owns the advisory role and consultancy function on the co-

creation of complex technological projects, performed by multiple divisional business lines. This advisory activity covers the topics related to the maturing of new ideas and development of innovative technologies during the process of joint development. In complex divisional projects and in shared, cross-divisional projects, the innovation unit performs early exploration stages as well as the assessment, evaluation and decision making functions. As the rule, the unit takes a lead on the development of the strategically important projects of innovation. It sponsors, manages and governs the development processes.

Thus, in the technology-based service company, the innovation unit performs the function of an “integrator” between the diverse organizational structures. For the management of an organization, such an integrating role entrusted to a specific entity is both important and complex. Lawrence and Lorsch (1967, p. 2) define **integration** as the achievement of unity of efforts among the major functional specialists in a business. This function includes answering unexpected problems that emerge at the traditional entities (in our case the divisional business lines), performing non-routine activities, resolving conflicts between departments and taking important and smaller decisions.

In an organization, the role of the integrator is to ensure the smooth coordination between explorative and exploitative types of ideas, processes, activities, structures etc. and to manage these interrelations effectively. This function is the responsibility of the innovation unit. It establishes the links between the top management and divisional business lines, it creates a space to select and mature new ideas of the technological innovations, coming from all structures of the company, top-down and from bottom-up.

1.4 The actual job of the innovation unit

In addition to the function of integration, another objective of the innovation unit is exploration of new ideas, concepts and technologies. The *mission* of the specialized unit is to drive innovation and to ensure creation and delivery of highly innovative technological solutions in the company. To execute its exploratory mission, the innovation unit takes an active role in the creation and formalization of the culture and facilities dedicated to the development of innovation. In particular, the main directions of unit’s work are the following:

- Culture of innovation;
- Environment for innovation;
- Development of R&D talents and experts;
- Intellectual property management;

- Maturation and incubation of radically new technological ideas and concepts;
- Advisory and technological planning;
- Coordination of divisional R&D;
- Partnerships;
- Recognition, promotion and communication of technological innovation.

The activity of the innovation specialized unit is aimed on the creation and improvement of the culture of innovation. In general, the energy exploration sector and the energy industry are very traditional and conservative, because of the high risks and costs from unverified operations. In this sector, organizations have an efficiency-oriented culture. Individuals and decision-makers have exploitative-focused mindsets. In this sector, uncertainty and risk of failure are rather high and costly. Sometimes failures may cause significant damage to equipment, humans and nature. More often, individuals rely on the problem solving, rather than on the using of the creative approaches to address a need.

The innovation unit is aimed to break the old rules and to introduce and reinforce the culture of exploration, learning and experimentation with new ideas. To foster the culture of innovation and to create the exploration-oriented environment, the unit applies several specific actions. First, the innovation unit manages the *innovative projects*. Usually, these are the projects developing complex, radically new technological and software solutions that cannot be developed in the divisional R&D departments. As divisional business lines are highly specialized entities, with standardized and routine processes and activities, they do not develop such research-intensive projects. As a rule, they perform only an incremental type of R&D.

The development of radically new products and services needs the opposite processes. This activity requires specific competences and expertise, high investments into research at the initial phases and acceptance of possible failures. As in business lines the costs of failures are very high, they try to avoid such high-risk activities. The innovation unit creates the space where new projects with innovative ideas can mature and be transformed into the feasible products. To develop innovative projects, the unit allocates its own resources (people, funding, partners, etc.) and gets sponsorship and support from the top management of the company.

Within the company, the innovation unit has an R&D *coordination* role. Very often, the development of complex innovative projects requires the creation of multidisciplinary teams with experts and professionals in specific domains. In some cases, the complex development may need involvement of partners. The unit fulfills this function. It ensures

coordination between divisional structures, leaders, processes and resources in complex, cross-divisional projects.

Similarly, the unit establishes new *partnerships* with external organizations and supports existing ones. The partnerships have diverse natures: exploratory research, applied studies and pre-commercialization trials. The unit works with universities and research laboratories on the scientifically applied projects that are aimed to create new knowledge, to support research, to test and to make experiments with the unknown process operations or technologies.

Equally, the unit does more applied studies with small and medium sized companies. Those are organizations with specific competences, technologies and tools that can be outsourced by the project team. Very often, in science-based organizations, project teams acquire knowledge and competences from the outside. In the innovation unit, it takes the form of a specific study, research and test activities, performed by the external organizations on behalf of the project team. Usually, these are only small parts of the new product development (NPD) phases that could be outsourced.

Another type of partnership is with end consumers. Clients are large organizations, often, global petroleum giants that will use a solution for exploration of natural resources. This type of collaboration occurs at the final phases of the new product development process, particularly when a technology is available and ready to be launched on the market.

As the innovation unit works on NPD of radically new technologies, it also involves clients into the process of development. When a new technology is at the pre-commercialization stage, the innovation unit suggests a client who could cover the costs of experimentation and final tests of the new technology in the real environment. Usually, petroleum companies are interested in new technologies. The interest of the clients is to be granted the exclusive rights to perform operations and a competitive performance on their own markets. For the innovation unit, this type of collaboration is a regular one, as it helps cover the costs of experimentation and get the first purchasing constructs.

Oilfield service companies do not only involve clients at the final stage of the NPD. Sometimes petroleum companies can co-develop radically new technologies together with the service provides and join new project at the initial phases of development. Often, these are strategically important, high risk and billion investment projects that are aimed to develop breakthrough technologies that will change the industry. As a rule, the development of such projects is shared between more than two partners and, very often involves state and governmental organizations. However, this is another type of collaboration between partners, characterized by intensive exploration in co-creation and co-development processes.

Apart from partnerships and collaborations, the innovation unit has also an *innovation advisory* role. It prepares the recommendations to the divisional structure on new technologies, products and services that should be developed in the divisional business lines. These suggestions and recommendations are focused on existing and new business domains: they define alternatives that open new markets, and also refinement of the existing technologies that would help to compete on the existing ones. With advisory function, the unit monitors the current business to ensure a competitive positioning in the different markets, and at the same time, develops proposals to the business lines on exploration of the alternative markets.

The exploratory function of the unit is supported by a set of organizational activities. In particular, the innovation unit provides support and training of the professionals and experts involved in the R&D activities. The unit organizes conferences on innovation management topics, especially in geosciences and in the energy sector for employees at all levels and structures. The company has an internal structure called “the university” that provides educational facilities, training and courses on multiple topics to the professionals in the R&D departments. In addition to those trainings, the innovation unit provides expertise and courses on complex project management. If necessary, the unit assists and advises project teams that face problems during NPD in R&D departments of divisional business lines.

In the company, the innovation unit *communicates* and promotes the culture of innovation. For internal communication, the unit develops “letters” dedicated to the topics on innovation. These are specific messages (newsletters) to employees in R&D departments of divisional business lines and also in all functional structures, that tell the success stories on innovations. These stories are examples of technological development from diverse industries. These letters also contain personal success stories from company’s champions and innovators. Very often, they describe the difficult and uncertain process of creation of an innovation. These messages from the innovation unit are aimed to inspire employees and to stimulate and to promote the culture of innovation and risk taking.

Communication also occurs with external partners. The members of the innovation unit are the regular participants at the international and national conferences, exhibitions and industrial fairs in the domain of oil and gas exploration and production. During the conferences and workshops (e.g. organized by EAGE - European Association of Geoscientists and Engineers), the innovation unit makes presentations of its technological innovations. It communicates to partners and clients and shows the recent results from its exploratory R&D development.

To increase the employees' motivation and interest in the exploratory type of activities, the unit creates incentive systems and *recognition* for individuals and teams who perform exploratory activities. Among all employees of the company, the unit organizes an internal competition dedicated to R&D activity. It grants the innovation award to individuals and teams from diverse organizational structures who proposed and initiated, developed and/or implemented innovative technologies, processes, products and services.

The internal award has three different categories. The innovation award is given first to a project that demonstrates radical advancement of technology (similar to a radically new solution); second to a project that shows outstanding operational improvements in the existing technology (similar to an incrementally improved solution); finally to a potentially possible technology that will bring a revolutionary industry change in the future.

For the company, the internal innovation award is an approach to demonstrate the effectiveness of the exploratory activity, to promote and to foster the culture of technological innovation. For the innovation unit, this activity is one of the approaches to assess and to measure the impact from the exploratory types of R&D. It is also a way to demonstrate the returns from the activity of the unit to the top management of the company.

The team of the innovation unit

The innovation unit is represented by the individuals, who have a freedom to act as the internal entrepreneurs. The head of the unit is an innovation-driven manager with an entrepreneurial mindset. Being passionate about new technologies, his personal and professional goal is to drive radical innovations across the divisional structures and in the whole company. He manages a team of highly skilled professionals and experts. The team is represented by the individuals with the innovation-oriented mindsets. They have knowledge, skills, competencies and experience in the development of radically new technological innovations.

In particular, the innovation unit consists of 30 individuals, who have educational backgrounds in fields of electrical, mechanical engineering, mathematics and modeling, physics, geophysics, geosciences, business etc. They have the skills and capabilities necessary for the creative problem solving, non-routine and non-standardized approaches to development. They are the innovation-driven people, who have professional experience in R&D and in product development of the complex technological innovations. The team consists of employees who previously worked at the divisional business lines or functions,

and also of newcomers, who joined the company recently. Their daily job is to create new knowledge and to apply them to the development of innovations.

In terms of functions, the individuals from the innovation unit do not have specializations. They can be engaged in diverse projects and perform different roles. This group is more homogenous, where individuals are able to “wear multiple hats” at the same time. They can be involved in brainstorming to define new concepts or business cases, or in the actual execution of experiments and tests of the first prototypes that have emerged from a new concept.

As part of the team, the innovation unit has an intellectual property group. It is composed of specialists who work on the IP issues. Their role is to ensure that all the property rights emerging at the company from an R&D activity, such as new ideas, concepts, technologies, are protected independently of the stage of their development. The IP team controls the property rights and serves the needs of the innovation unit and divisional structures. The team participates in diverse projects meant to create radically new or incrementally improved technologies, and takes part in the development process at different stages - in early conceptualization and pre-industrialization phases. The group and the innovation unit ensure the creation, management and execution of the technological innovations in the whole company.

Overview and conclusion

The aim of this chapter was to introduce the context of the in-depth case research and to describe the organizational and environmental characteristics of the company. The study uses the case of the technology-based service company that operates in the oil and gas industry. This company is an oilfield service provider of the oilfield exploration equipment, technologies and services for large petroleum companies. It produces technological, engineering, hardware and software solutions for exploration of natural resources in diverse environments (e.g. land, marine, etc.) that contain oil and gas reservoirs.

The *technology-based service firm* is a large company with over an 80 years’ old history. It is a leading organization in the field of onshore and offshore seismic data acquisition and interpretation that provides surveys to clients worldwide. It is a fully integrated and a science-based company. The company has significant R&D capabilities such as resources, people and organizational structures specifically dedicated to the creation,

research, experimentation, development and implementation of new technologies for the existing markets and future business domains.

Also the company is an innovation-oriented organization that promotes the culture of innovation among its organizational structures and employees at diverse levels. It has the innovation specialized unit with a mission to create and to develop radical innovation. The unit develops complex innovative projects that are aimed to introduce new technologies, to change markets and the existing approaches to perform operations in the oilfield sector.

This company is an oilfield service provider and its core-activity includes: seismic data acquisition surveys mainly in onshore and offshore environments and seismic data processing and interpretation services. To be a leading provider of services of oil and gas exploration, the company's processes and activities focus on *three main domains*:

- 1) Equipment design and build;
- 2) Execution of seismic data acquisition surveys;
- 3) Data interpretation, reservoir analysis and consultancy.

In addition, the company manages the vast product portfolio that consists of multiple technological solutions, services and consultancy in the field of oil and gas exploration. By and large, the company's processes are built around two activities: a) R&D and new product development (NPD) of equipment, hardware and software technologies and services for oilfield exploration; b) field operations and services provided to major clients – often, global and large petroleum companies.

The *organizational structure* of the technology-based service company has a matrix type. It has three divisions with functional specializations. They are differentiated according to three domains of activities: 1) equipment; 2) seismic data acquisition; 3) seismic data processing and analysis. Each division includes several business lines that are specialized on a particular market segment. This study (including the following chapters) will refer only to the onshore and offshore divisions business lines.

The company also has specific cross-divisional functions that perform specific services across divisions (e.g. finance, HR, strategy and integration, partnerships, communication, risk management, audit etc.). The role of these functions is to ensure coordination of activities and processes between the various structures of the company. In addition, the company has a specific structure – the innovation specialized unit - responsible for the management of technological innovations across divisions and the creation of radically new market solutions.

To deepen the understanding of the organization of the company and its different organizational elements, our research applied a theoretical framework on the structuring of organizations (Mintzberg, 1979). According to the configurations proposed by Henry Mintzberg, the service company has a *Divisionalized* form. Three divisions are differentiated according to their types of activity and market specializations. They are independent and autonomous entities with financial, operational and decision-making freedom. The top management of the company sets objectives and plans as well as controls the efficiency and performance of the divisions. Hence, the *divisions* of the company are:

- Differentiated according to the type of activity and market;
- Autonomous in the organization of their own processes and activities;
- Financially and operationally free;
- Independent in decision-making on allocation of resources;
- Controlled by the top management (performance and plan execution).

Furthermore, divisions consist of business lines. These are structural elements of the divisions with specialization on the market segments. This study includes the analysis of the onshore and offshore divisional business lines that produce solutions for seismic acquisition surveys for operation in land and in marine environments.

Divisional business lines are structured as *Professional Bureaucracies*. These are large, well-established and efficient entities. The objective of the business lines is to ensure competitiveness on the existing markets and the effective performance of the current business operations. Business lines have the R&D departments that perform exploitative types of activities: they improve existing technologies, products and services and refine current operations. Business lines have a conservative approach to perform business: they have standardized processes, routine activities and resistance to change. The divisional management sets the market targets and plans for the business lines and then controls their performances. Thus, the *divisional business lines*:

- Have divisional structures, specialized in particular market segments;
- Are large, well-established, efficient entities;
- Are conservative, highly specialized, standardized and routine-oriented;
- Are executive and short term oriented;
- Have highly skilled and competent professions;
- Carry out incrementally-focused R&D;

- Have performances controlled by divisional management.

Lastly, the technology-based service company has the innovation specialized unit. It is a separate, autonomous and independent organizational structure. The activity of the unit is protected and controlled directly by the top management of the company.

The innovation unit receives sponsorship and executive support for new projects that are aimed to develop radically new and strategically important technologies

The unit is structured according to the *Adhocracy* form. In contrast to the divisional business lines, the innovation unit is a young, innovation-focused and entrepreneurially driven structure. Its activity is unstructured and not well defined. Particularly, the unit collects radically new ideas and selects the best ones for development. Through research and experimentation, the unit acquires new knowledge. It incubates new ideas, makes them mature and then takes go-no go decisions (together with top management teams). For radically new product development projects, the unit looks for resources: individuals and teams in divisions and in business lines, funding and sponsorship support from executives, partners for co-development. It provides training, and advisory support on the range of topics for project teams and for R&D people in divisional structures.

The innovation unit consists of a group of highly skilled individuals who have innovation-oriented mindsets. All members of the unit have knowledge, skills and expertise in complex product development, creation and management of engineering and software innovative products and services. On the whole, the innovation unit has two main functions: 1) to create radically new technological innovations; 2) to establish links between top management and divisional structures. Therefore, the *innovation specialized unit* is:

- Young, entrepreneurial, innovation-focused;
- Separate, independent and autonomous;
- Supported, protected and sponsored by top management;
- Develops radically new technological solutions for the distant future;
- Has an uncertain, high risky, sometimes “gambling” activity;
- Explorative and research-driven.

After reviewing the characteristics of the technology-based service company and its environment, we switch to the questions on methodology and includes the study of the existing theory and the design of the specific research method. The next chapter addresses three large areas. First is the theoretical background on topics of exploration and exploitation

and second, on the organizational ambidexterity and its different approaches. Third part is dedicated to the detailed description of the multilayer methodology. The synthesis between these parts will demonstrate the necessity to apply a new method to study the complex phenomena of organizational ambidexterity. Likewise, it will justify the chosen method to our research question.

CHAPTER 2.

ORGANIZATIONAL AMBIDEXTERITY: CONCEPTUAL FRAMEWORK AND ANALYTICS

This chapter reviews the existing literature on exploration and exploitation activities and on the organizational ambidexterity concept. It also observes the multilayer methodology that is used in this study to address the research question.

The concept of ambidexterity proposes that ambidextrous companies have the ability to explore and exploit simultaneously. They can incrementally improve existing products and services and, at the same time, develop new ones. To achieve ambidexterity, the literature proposes three organizational solutions: sequential, structural (simultaneous) and contextual. However, none of these different approaches represents a well-defined and sustainable organizational solution both to explore and exploit. This chapter makes the analysis of the concept of organizational ambidexterity and its current stage of the development in the existing literature. Its purpose is to answer the following questions:

How to set up exploration and exploitation in an organization?

Does the ambidexterity concept provide a sustainable solution to explore and exploit?

How to identify and analyze exploration and exploitation in an organization?

In this chapter, our research uses diverse streams of literature, including the existing studies on organizational learning, knowledge management, strategic management, innovation management, new product development and project management. It also has a structure that consists of three main parts dedicated first, to exploration and exploitation, second, to the organizational ambidexterity and third, to our multilayer methodology. These parts can be seen as independent sections on specific topics. Nevertheless, they are interrelated elements that are essential for answering the research question. Figure 2.0 outlines the logic of this chapter and clarifies its different sections. It can also be used as the guidelines to navigate from one part to another.



Figure 2.0. Guidelines on Chapter 2

2.1. General introduction to exploration, exploitation and ambidexterity

To survive in the long term, an organization needs to exploit existing capabilities and to explore alternative opportunities. The ability to do both activities simultaneously is called organizational ambidexterity. It is the ability to combine contrasting, inconsistent and sometimes incompatible organizational elements as explorative and exploitative activities, strategies, structures, processes, mindsets, behaviors, etc.

In the essence of ambidexterity there are two different activities – exploration and exploitation. The purpose of exploitation is to improve and increase the performance. The goal of exploration, in contrast, is to search for new opportunities and to experiment. Both exploration and exploitation are essential if a company wants to remain sustainable and to survive in the long term. But at the same time, many organizations struggle to achieve the balance between exploration and exploitation.

It is hard to simultaneously exploit and explore because of the contradictory nature of these activities. They have different characteristics and different needs. Very often, they compete for organizational resources whereas managers need to select and make choices how to allocate resources between them. In general, these are competing and contradictory activities. But, if an organization wants to survive in the long-term, it must combine and to co-organize both exploration and exploitation. Paradoxically, these activities are contrasting, but at the same time, they are complementary to each other (Chen and Katila, 2008). In combination, they lead to prosperity and organizational survival (March, 1991).

The concept of ambidexterity is aimed to find the answer to the question of balance identifies in the organizational learning and discussed in strategic management studies. To sustain and to survive over time, an organization needs to ensure that it is performing enough exploitation and at the same time, is doing enough exploration (e.g. Levinthal and March, 1993; March, 1991; O'Reilly and Tushman, 2013). Although it is hard to identify what would be the enough amounts of exploration and exploitation, the concept of ambidexterity proposes several solutions how these activities can be organized within a single organizational context. These approaches are the structural, sequential and contextual forms of ambidexterity. Further in this research, we will describe and review each of these modes.

Except the type of co-organization (sequential, structural, contextual), another emerging question for the ambidexterity is the sustainability of the proposed approaches. Existing studies do not show the evidence that these solutions to achieve organizational ambidexterity can sustain over time. In other words, even if a company will succeed to

explore and exploit by using one of these approaches, there is no guarantees that its ambidexterity will sustain in the long term.

To understand how a company can achieve and continually explore and exploit, our research will deep dive into the examination to understand the essence of exploration, exploitation and ambidexterity concepts. Before going into the details, we suggest to give attention to the alternative streams of literature, which observe a similar question on the combination of contrasting agendas and on the organizational duality.

The question of balance in “non-ambidexterity” literature

The question of balancing exploration and exploitation received some attention from scholars in ambidexterity. However, it is not the unique source of literature that observes how an organization can balance and combine incompatible logics, strategies and activities. Several streams of literature in management studies refer to the question of combination and alignment of diverse activities and structures that are necessary for organizational sustainability and success. Particularly, a successful organization that has a bipolar structure is found in studies on dual organizations (e.g. Abell, 1999, 1993), in the literature on organizational strategy (e.g. Porter, 1996) and research on dual business models (e.g. Markides, 2013). Similarly to ambidexterity, these concepts (see Table 2.1.) reflect the alternative vision on the duality and the bipolar characteristics of an organization (see also Cohendet and Llerena, 2005). They demonstrate the alternative approach to understand the question of balancing between exploration and exploitation.

Table 2.1. Exploration and exploitation in non – ambidexterity literature

Stream of literature	References	Component associated with exploitation	Component associated with exploration	Combination/ balance
<i>Dual organizations</i>	Abell, 1993; Abell, 1999	“Mastering the present” agenda / strategy	“Preparing for the future” agenda / strategy	Sustainability, longevity
<i>Strategy</i>	Porter, 1996	Operational effectiveness	Strategic positioning	Superior performance
<i>Dual business model</i>	Markides and Charitou, 2004; Markides, 2013	Old business model	New business model	Successful performance

The concept of dual organizations has a similar logic as the concept of ambidexterity. It argues, that because of the rapid changes on markets and industries, a single strategy is no longer effective to compete successfully (Abell, 1999, 1993). *Dual organizations* have dual strategies that enable effective management of the business of the present and at the same time, anticipation of change for business of the future (Abell, 1993).

The need to have two different strategies is determined by the increasing complexity and the speed of change occurring inside and outside of an organization. The old fashion of operating - using a single strategy - is not sufficient, because a single strategy can “provide the basis neither for running the existing business, nor the basis for managing change” (Abell, 1993, p. 4). In order to succeed in changing environment, a successful organization should combine two different agendas. Dual strategies fulfill two needs: a company is “planning for today” to perform current activities with excellence and at the same time, it is “planning for the future” to anticipate and manage coming changes.

Dual strategies, described as “mastering the present” and “preparing for the future” have contrasting logics, need different structures and have diverse implications. The goal of the “present” agenda is to be efficient on the markets and among competitors (Abell, 1993). The goal of the “future” agenda is to identify the future and a possibility for changes. The “future” has a high degree of uncertainty. To decrease it, a company can start from the definition of possible markets, strategic choices, competitive moves, identification of necessary knowledge and resources (Abell, 1999). This agenda has an exploratory nature. It must be initiated by the vision, and further transformed into multiple alternative scenarios.

Effective dual organizations should searches for the balance between two strategies. Organizations can be preoccupied with mastering the present (similar to exploitation) and fail to anticipate change (similar to exploration). Companies become “the victims of their current strategic focus and fail to prepare themselves for the future” (Abell, 1999, p. 5). The opposite is also dangerous. Organizations can “devote most of the attention to the future, overlooking the needs of excellent performance today” (p. 5). The appropriate balance between two agendas will depend on the organizational situation and its environment. In dynamic environment with rapid changes organizations can devote more attention to the “future” agenda; in stable environment to prioritize the “present” (Abell, 1993).

Both agendas are different but interrelated. Decisions in the past can influence current organizational performance; the decisions of the present can also shape the future of the organization. Their mutual presence and “in parallel” existence would be essential for organizational survival (Abell, 1999, 1993).

A similar vision on the organizational success and sustainable performance is described by another study from strategic literature. Porter (1996) defines *strategy* as the creation of a unique and valuable position through involvement and combination of two different sets of activities - operational effectiveness and strategic positioning - followed by choice and selection between them. Superior organizational performance requires operations with both elements. On the one hand, operational effectiveness is necessary to achieve growth and profit; on the other hand, strategic positioning allows a company to create value and to differentiate from competitors (Porter, 1996).

Combination of operational effectiveness and strategic positioning is challenging for organizations. Organizations should distinguish both essential but different agendas. The goal of operational effectiveness is the continuous improvement and refinement of activities (as in exploitation); the goal of strategic positioning is the selection among alternatives (as in exploration) and decision-making on the allocation of resources. Operational effectiveness means to perform similar activities better than competitors, whereas strategic positioning means performing different activities or performing similar activities differently (Porter, 1996).

To respond to technological and market shifts and to remain sustainable a company should ensure the presence of both agendas. Improvement of “operational effectiveness is necessary part of management, but it is not strategy” (Porter, 1996, p. 20). Prioritization of effectiveness and disbalance with strategy may be troublesome. Porter (1996) argues, the increase in operational efficiency may lead to superior profitability in the fixed period, but result in a failure in the long term. Rapid diffusion of organizational knowledge, management techniques, technologies and product and service improvements will stimulate competitors to imitate and benchmark the best and effective practices. Hence competition, based on operational effectiveness, is mutually destructive and ineffective for the long term performance; it results in decreasing time returns and static or declining with time performance.

For sustainability, organizations must combine operational effectiveness and strategic positioning as well as search for higher integration between different activities and create links across the company (Porter, 1996). Organizations should integrate and balance these different agendas. Imitation by the rivals will be less possible if a company builds a system of interrelated and linked organizational activities. Hence, sustainable organization must be seen as a “*nest of a tightly linked activities*” (Porter, 1996, p. 15), where the selection and choice between certainties and alternatives would have a positive effect on the system.

Finally, the literature on business model innovation describes the likewise dual organizational logic. *Business model* is a system of linked elements (customer value proposition, profit formula, key resources and processes) that together create and deliver value (Johnson et al., 2008). Because of the shifts in the environment, a company might need to change the existing business model and adopt a new one. The reasons why a company does need to have both old and new business models may be explained as follows: a need to address radical innovation (e.g. democratization of the product on the emerging markets); a need to capitalize on a new technology, a need to bring certainty to unexplored areas, and to protect business from the disrupters, to respond to the market shifts and others (Johnson et al., 2008, p. 65).

While some of the scholars suggest a transition from the old to the new business model to capitalize on the new opportunities (Johnson et al., 2008), others propose to address old and new models simultaneously. The logic of *dual business model* is in “adapting a new business model next to the existing one” (Markides, 2013, p. 313). The benefit from the model is in a combination of the old and the new models and the ability to address existing and emerging needs, to respond to the rapid growth and market shifts (Markides, 2013; Markides and Charitou, 2004).

The dual business model is challenging because “a new business model requires different and incompatible activities” (Markides, 2013, p. 313). In other words, a company will need to operate with two different and contrasting sets of activities, to build and coordinate different structures. To cope with differences between old and new business models an organization will need to separate them at different structures (e.g. units). Those structures will be responsible for new and old domains, have independent roles and functions. Separation can be achieved by e.g. giving autonomy to the units, hiring new people, ability to build own capabilities, cultures, strategies etc. But at the same time, in order to benefit from synergies, the company will need to search for integration and linkage between the different structures. Structures with old and new models can be linked by integrating mechanisms (Markides, 2013): such as common senior manager, shared vision, encourage cooperation, credible integrator, culture of openness, central strategic control, etc.

The concept of dual business model has a similar logic as the one described for ambidexterity. To combine old (exploitation) and new (exploration) business models a company should build dual structures and acquire different capabilities to perform incompatible activities. To achieve successful performance, an organization will need to separate old and new business models in different units to cope with conflicts. At the same time, an organization will search for integration between the activities of the different units to

benefit from their synergies (Markides, 2013). However, for the concept of dual business model it is still unclear what an organization needs to separate and what to integrate.

In spite of the growing interest for the question of management of both old and new models, the theory of dual business model remains to be explored. In the existing literature, it is a relatively new topic. In particular, Markides (2013, p. 313) argues that the concept “lacks of theoretical foundation”. To expand the knowledge on the dual business model, he proposes to learn from the ambidexterity literature and to use the principles of coordination and management of exploration and exploitation from the literature on organizational ambidexterity. The author’s view is that “the ambidexterity literature can guide the discussion on how to manage two conflicting business models and firm’s duality... and to provide new insights to researchers on exploring business model innovation” (p. 315).

Therefore, three concepts from the literature on “non-ambidexterity” topics (see Table 2.1) refer to the question of organizational duality and show an organizational need to balance two contrasting activities and agendas. These concepts represent the alternative framework to understand the nature of ambidexterity, which is in combination of contrasting activities. Three different concepts describe the necessity of having both competing activities and processes that can be organized, for example in different separated structures. But at the same time, these studies suggest that diverse activities and structures must be integrated in order to get the benefit from their synergies. The concept of ambidextrous organizations can use some insights from three different theories to find out how to co-organize both exploration and exploitation in a way that leads to a synergy from their combination.

Although a lot of similarities can be found between the described theories and the concept of ambidexterity, the important difference is that exploration and exploitation are the processes. To explore and to exploit means to perform specific sequences of actions in time. To balance them, an organization needs to find out how to co-organize both activities and how to perform the actions to achieve the common goal. Whereas, the analyzed theories focuses more on the financial and operational long term effectiveness of an organization. For ambidextrous companies, finding an organizational balance will mean to learn how to make inconsistent activities complementary.

2.1.1. The essence of exploration and exploitation

A central concern in the organizational literature is how to balance exploration and exploitation. To sustain successful performance, an organization needs to exploit existing certainties and at the same time, to explore new opportunities (e.g. Gibson and Birkinshaw,

2004; Levinthal and March, 1993; March, 1991; O'Reilly and Tushman, 2013; Raisch and Birkinshaw, 2008; Tushman and O'Reilly, 1996). For an organization, these are two different and competing activities. In some cases, mutual presence of exploration and exploitation might be painful for organizations, as the activities need different resources, processes and structures and have different returns. But, paradoxically, no matter what the context is, the combination of both would be essential for organizational survival and sustainability (e.g. Levitt and March, 1988; March, 1991; Raisch et al., 2009; Tushman and O'Reilly, 1996).

March's view on exploration and exploitation

Initially, the question of balancing between exploration and exploitation and its importance for organizational performance was identified by James G. March. In his work (March, 1991, p. 71), he studies the “relation between the exploration of new possibilities and the exploitation of the old certainties” and its relation with organizational sustainability. He observes two different activities and provides arguments on the allocation of resources, the distribution of costs and benefits in time and space. His main argument is that if a company wants to achieve “survival and prosperity”, it must find the appropriate balance between exploration and exploitation (March, 1991, p. 71). However, he also argues that the balance is hard to find and even more, is hard to sustain. The reasons are the trade-off, conflicts and tensions that emerge between exploration and exploitation.

March observes the activities in the context of organizational learning and creation of organizational knowledge. His view is that the decisions on the allocation of resources between the activities are based on the theory of rational search, which can be interpreted as the analysis of several investment opportunities with a probability of unknown returns (March, 1991). In fact, when a company allocates resources for exploration and exploitation, it makes the decisions based on the available information and selects between both activities. At that stage, the choice is made between the investments into exploration, which is a high-risk activity with unknown future returns and between the investments in exploitation, which is a certain activity with proximate results.

For organizations, the exploration – related decisions are particularly hard because of high degree of uncertainty, unpredictability of environment and returns, which are distant in future. Of course, with time, an organization can accumulate knowledge on unknown returns and increase the probability of success from exploration-focused decisions. But in reality, companies should make rapid decisions because of the speed of change in the environment. Thus, an organization should “select between making the investments in to uncertain alternatives (to search for future returns) and investments in the best and evident option” (to

improve its present returns) (March, 1991, p. 72). The drawbacks of such decisions, particularly on future alternatives, can lay in the instability of future returns and their dependence on the present decisions.

Decision on allocation of resources between exploration and exploitation is only one part of the game. The second part is the appropriate balance between both activities. March (1991), in his work “Exploration and exploitation and organizational learning” raises several important topics that make the balance between the activities particularly difficult. This study suggest to review these topics as they can clarify the emerging trade-offs and tensions between exploration and exploitation and help to expand the existing knowledge on the question of balance and organizational ambidexterity.

According to March’s organizational learning, the balance between exploration and exploitation is difficult because of the following issues:

1. Speed of innovation;
2. Change in the environment;
3. Ambiguity of choice;
4. Organizational memory;
5. Nested system

First, the balance is hard to achieve because of the *speed* to acquire knowledge and to produce different types of innovations. Exploration and exploitation may result in different innovations, e.g. radically new and incrementally improved. March (1991, p. 72), in particular, argues on the “distinction between refinement of the existing technology and invention of a new one”. Different types of innovations need different skills and competencies. The time and speed to acquire new skills and to improve the existing ones are also different (Levitt and March, 1988; March, 1991). March explains (1991, p. 72):

“It is clear that the exploration of the new alternatives reduces the speed with which skills at existing ones improved. It is also clear that improvements in competence at existing procedures make experimentation with others less attractive”

Second, the balance is hard to find because of the *change in the environment*. In March’s studies, an organizational development has the evolutionary format. The evolution of a company happens because of the environmental turbulence. To achieve success,

organizations should devote attention to the change in the environment and be able responding quickly to the turbulence. He argues (March, 1991, p. 72):

“Effective selection among forms, routines, or practices is essential to survival, but so also is the generation of new alternative practices, particularly in a changing environment. Because of the links among environmental turbulence, organizational diversity, and competitive advantage, the evolutionary dominance of an organizational practice is sensitive to the relation between the rate of exploratory variation reflected by the practice and the rate of change in the environment”

Third, the scholar refers to the ***ambiguity of choice***. Vulnerability of the exploration is another factor that makes the balance between exploration and exploitation hard. Because of the uncertainty and complexity of the organizational behavior and its environment, the selection and allocation of resources between both activities is difficult (March, 1991). He states (p. 73):

“What is good in the long run is not always good in the short run. What is good at a particular historical moment is not always good at another time. What is good for one organization is not always good for a larger social system of which it is a part”

Similarly, Levitt and March, (1988) explain that success can be ambiguous. “Learning and experimentation depend on the evaluation of outcomes as successes or failures” (Levitt and March, 1988, p. 325). In that context, organizational success is the relation between targets and outcomes. Targets can change over time, as well as the outcomes. With new targets, an organization will need to evaluate the results. From the individual point of view, decision-makers are able to interpret their outcomes as successful, even in case of shortfall (Levitt and March, 1988). Organizations have different metric to assess the results of the activities. From the organizational standpoint, the evaluation of the outcomes from learning and experimentation tend to be more negative or mixed.

Forth, March refers to the ***organizational memory*** that makes the balance hard to achieve. Experimentation and past experience can influence the organizational decisions on how to allocate resources between exploration and exploitation. In the same way, (Levitt and March, 1988) propose that organizational learning depends not only on the individual, but also on the organizational memories. Socialization and control are the means to conserve and

preserve the procedures, rules, cultures and technologies. Equally, they record the history of the organization and shape its future. March argues (1991, p.73):

“Organizations learn from experience how to divide their resources between exploration and exploitation, this distribution of consequences across time and space affects the lessons learned”

Finally, the scholar observes an organization as a ***nested system***, which consists of different levels. The balance is hard to achieve because of the trade-off between the activities that emerge at multiple levels. The choice and selection occur at each level of a system, and make the balance between exploration and exploitation particularly difficult. He describes (1991, p. 72).

“Finding an appropriate balance is made particularly difficult by the fact that same issue occurs at levels of a nested system – at the individual level, the organizational level, and the social system level”

The idea to observe an organization as a system of levels is justified by the learning process. Levinthal and March (1993) propose that learning is nested because it occurs simultaneously at different levels. In such a system that consists of different levels, exploration and exploitation become substitute activities. Improving an existing technology substitutes for searching for a new one, and vice versa (Levinthal and March, 1993).

March, in his studies (Levinthal and March, 1993; Levitt and March, 1988; March, 1991) provided significant insights into the trade-off between exploration and exploitation and balancing between them. For an organization, achieving the balance between the activities is particularly difficult due to the existence of the differences in times and in space that are necessary to acquire new skills and knowledge and to improve the existing ones. It is also difficult because the future is uncertain and because of the ambiguity of choices made by the rationally based approach to make decisions. The balance is also difficult because of the nested structure of any organization and the interdependence that exists between the levels. Finally, like the living species, an organization operates within the environment. March's view is that to survive, an organization should be sensitive to the industry shifts and environmental turbulence.

2.1.2. Differences and complementarities of exploration and exploitation

Exploration and exploitation differ in terms of characteristics and have contradictory logics. However, their mutual presence of exploration and exploration is essential for organizational long term survival (see Levitt and March, 1988; March, 1991). This means that even if the activities are contradictory by their nature, for an organization, they are complementary (see also Chen and Katila, 2008). Before clarifying how exploration and exploitation are different and how they can be complementary, our research will outline the meaning and definitions of the activities.

The essence of exploration and exploitation is organizational learning and the process of knowledge creation. March (1991) does not provide the exact term of exploration and exploitation, but he describes them as a set of different activities (p. 71):

*“**Exploration** includes things captured by terms such as search, variation, risk taking, experimentation, play, flexibility, discovery, innovation. **Exploitation** includes such things as refinement, choice, production, efficiency, selection, implementation and execution”*

The essence of exploitation is the improvement, refinement and extension of the existing features, such as competences, paradigms and technologies. In contrast, the essence of exploration is the search and experimentation with new alternatives (March, 1991). Similarly, Chen and Katila (2008) propose that the goal of exploration is to increase variation, to test the environment and select a main design. Exploitation, in contrary, is the improvement of the selected design.

Although, these definitions describe exploration and exploitation as different and independent, these activities are somehow coupled. In fact, exploration and exploitation are interdependent activities. Improvement and selection is not possible without previously made search and experimentation activities and vice-versa. Hence, in the organizational context, both activities can create a cycle of exploration and the exploitation.

In the organizational and management literature, the activities of exploration and exploitation always refer to different types of innovation. Similarly, this study observes the activities in the context of organizational innovation to describe the differences and complementarities between the two. The aim is to understand where, how and when exploration and exploitation can emerge. This study characterizes the activities and defines organizational areas where they emerge: in different types of technological innovations, during phases of the development process and in different R&D structures.

The question of balance between exploration and exploitation emerges when a company wants to develop different types of innovation. Literature on organizational learning suggests that exploration and exploitation have different objectives and returns. March (1991) describes exploration as “innovation” and exploitation – as improvement of “the existing...” e.g. skills, product or technology. Let us assume that the purpose of exploration is to produce new knowledge, competences, technologies etc., whereas the goal of exploitation is to improve the existing ones.

However, the idea to identify exploration with something new and innovative (e.g. radically new product) and exploitation with the improvement of the existing (e.g. incrementally improved product) faced with criticism. In fact, exploration does not always lead to radically new product, same way, as exploitation does not guarantee incremental improvements of the existing ones. The literature on ambidexterity do not differentiate the activities and types of innovations, but argues, that by doing exploration and exploitation simultaneously, a company can produce different types of innovation, as radical and incremental innovations (O’Reilly and Tushman, 2004), or as reframed in other sources, incremental and discontinued innovations (see O’Reilly and Tushman, 2013; Tushman and O’Reilly, 1996). This study will observe the typology of innovations with a purpose to identify whether exploration means and will (or not) lead to radical (discontinued) innovations and exploitation means and will lead to incremental innovation.

2.1.3. Innovation and innovation process

In existing studies, exploration and exploitation are the activities of creation of different types of innovations. (e.g. March, 1991; O’Reilly and Tushman, 2004, 2013; Tushman and O’Reilly, 1996). J. Schumpeter, known as “the godfather of innovation studies”, (Tidd et al., 2005, p. 7) defines **innovation** as the “*new combination*” of methods, materials, forces etc. Over time, innovation (new combination) can “grow from the old by continued adjustment in small steps” (Schumpeter, 1934, p. 66). This process is *continuous*, as new combinations appear discontinuously through change and growth (Schumpeter, 1934). New combinations emerge in the “new firms” and not in the old ones. Schumpeter defines innovations that can have five possible combinations (p. 66):

- New good or a new quality of a good;
- New untested method of production;
- New unexplored market;
- New supply chain; new organization

The idea of innovation as a combination of different categories, that emerge in a company as a response to change is also present in the literature on innovation management (e.g. Christensen, 2000; Tidd et al., 2005). Tidd et al. (2005) define four types of innovation that can take different forms in the company (p.10):

- Product innovation (changes in the company's product or service);
- Process innovation (changes in the creation process);
- Position innovation (changes in the user context);
- Paradigm innovation (changes in the existing model)

Additionally, innovations can be distinguished by a degree of novelty. They can be radical and incremental. Incremental innovations produce minor improvements, whereas radical innovation change the way products can be used (Tidd et al., 2005). Innovation can emerge in companies and can bring revolutionary changes to industries: "sometimes these changes are common to a particular sector or activity, but sometimes they are so radical and far-reaching that they change the basis of society" (Tidd et al., 2005, p. 12). However, another stream of literature suggest that traditional typology of radical and incremental innovation "is incomplete, potentially misleading and does not account the disastrous effects on industry of minor improvements in technological products" (Henderson and Clark, 1990, p. 9). Particularly, in technological innovation, a new component can be incorporated into the existing system and become an innovation in a particular industry. Further our research will review specificity of creation of the technological innovation.

The categorization of the innovation is a way to distinguish one type of innovation from another. It is also an approach to demonstrate the diversity of forms and formats that innovation and activities can take in an organizational context. At the same time, it would be difficult to differentiate and separate the activities and different types of innovations, because in a company they emerge and evolve as a continuous process of creation and improvement.

Development is a continuous process of creation and refinement. Both exploration and exploitation emerge during the development of an innovation. This process might result not only in the creation of new and improved products and services, but also in creation or improvement of the processes. As discussed above, innovation can take different forms. It can arrive as a response to a dramatic shift and bring radical change. But in most cases, innovation is the result of incremental improvements (Tidd et al., 2005). "Products are rarely new to the world" (Tidd et al., 2005, p. 13), but more often, innovation is the result of continued improvements, stretch and optimization, enhance of the performance.

Technological innovation

In the context of technological innovation, the typology is defined according to reconfiguration of the concepts, components, elements, design etc. The technical innovation literature distinguishes among technologies those refining existing and those creating a new one. Burgelman et al. (2004, p. 441) define *incremental* as innovation that “introduces relatively minor change to the existing product, exploits the potential of the established design and often reinforces the dominance of the established firms. The development of the innovation requires considerable skills and has significant returns, but does not create dramatically new knowledge (Henderson and Clark, 1990). *Radical* innovation is “based on a different set of engineering and scientific principles and often opens up whole new markets and potential applications” (Henderson and Clark, 1990, p. 10). On a larger scale, innovation can redefine the industry or create an entry for new firms (Burgelman et al., 2004; Henderson and Clark, 1990).

In terms of development process, incremental innovation requires considerable skills and can bring significant value for companies. Radical technological innovation can drive important change and create shifts in the industry (Burgelman et al., 2004). The technological innovation literature suggests that organizations, particularly the established firms, need different sets of capabilities to develop innovation (Burgelman et al., 2004). Incremental innovation strengthens the existing organizational capabilities, radical innovation forces them to search for “new problem solving approach” and to acquire new commercial and technical skills (p. 441).

In one of the studies, C. Christensen defines the difference between incremental and radical technological innovation. In his work “The Innovator’s dilemma” (2000) he describes two types of innovation - sustained and disruptive, that emerge as a response to technological change. His innovation is presented as a continuing development process, with a mix of different terms, used in the literature.

Christensen (2000, p. 19) defines *sustaining technologies* as new technologies that improve established product performance for mainstream markets and clients. Such technologies can be discontinued, radical or incremental in nature. *Disruptive technologies*, on the contrary, are the innovations that brings a different value proposition and creates new customer value (Christensen, 2000). This innovation is difficult for organizations. In the short term, disruptive technologies have worse product performance. In most cases, they are undervalued by the clients and by mainstream markets. The author suggests that most

technological advances are sustained by their nature, and only occasionally does innovation bring disruptive technological change (Christensen, 2000).

Literature on innovation and technological innovation management outlines the typology and defines what should be considered as radical and incremental, sustained and discontinued innovation. Our research suggest that whatever the term chosen, innovation must be seen as a continuing process of development, where radical and incremental types would demonstrate the *degree of novelty* of a new product or service in a specific context. Solely exploration does not guarantee the development of radical innovation. It may lead to the creation of new knowledge, radically new products, services and technology. Equally well, exploration may result in solving the current problem or in improving the existing product, service or technology. “Doing innovation” does not always result in the actual creation of the innovation. The returns from the development process “may or may not lead to an innovation” (Le Masson et al., 2010, p. 164).

Our research, in particular, refers to management of different types of technological innovation on a case of a technology-based service organization. It observes the process of creation of different innovative projects and their precise definitions (Chapter 3). For simplification, innovation is distinguished as incremental and radical innovation. At this stage, our research, defines innovations as the following:

Incremental innovation – a new technological solution (a product, a service or a combination of both) with the improvement of the existing features (e.g. technological component, configuration of the system, operational model) for the existing markets and/or clients.

Radical innovation – a new technological solution (a product, a service or a combination of both) with new features (e.g. new technological component, configuration of the system, operational model) that creates new markets and/or a new client.

In management literature, development of innovation always refers to creation of new knowledge and re-combination of the existing one with a purpose of search for new opportunities (Le Masson et al., 2010; Tidd et al., 2005). Knowledge itself is different: it can be based on the existing or future opportunities; it may internally exist in an organization or be acquired from the outside (e.g. market, industry, technology research); it can be explicit and transferable or tacit and difficult to transfer (Tidd et al., 2005).

Studies propose, creation of new knowledge is a highly uncertain process (Tidd et al., 2005). When an organization is “doing innovation” it cannot pre-define the exact configuration of the end product or service, particularly at the earlier stages of the process. In most cases, the development of incremental innovation is risk – free or has limited and low degree of uncertainties. Contrary, radical (discontinued) innovation is rare, because during the development phases a company has to deal with high degree of uncertainty and risk. It is a role of the innovation management and managers to reduce the level of uncertainty during the development of innovation (Tidd et al., 2005). The location and to deal with uncertainty and to develop innovations is the organizational R&D structures.

R&D – the place for innovation

In many organizations, the R&D structures are the place for creation of innovation. These are the departments where new ideas get selected, matured and finally transformed into real market products and services. A company can organize and coordinate R&D structures and activities in different forms, depending on the factors, such as the core activity, size, age, history and culture etc. Sometimes, the creation and development process can be homogeneous, when a group or several teams perform both research of ideas and actual development of a product. Alternatively, a company may separate these activities by giving a specific research function to one structure (e.g. a research business unit or a team) and a function of development and implementation to another structure (e.g. design, engineering, operational departments, teams).

By and large, the aim of the R&D structures, departments and teams is to produce innovations and to create new products and service. However, the activity of these structures does not always result in the actual creation of radical innovation that would change the industries. It is more likely to result in unpredicted returns. To understand the link between research and development activities inside the R&D structures, let us observe the meaning of each of them.

Research and development (R&D) is defined as a creative work to increase the stock of knowledge and to use this knowledge to build new applications (Le Masson et al., 2010). It includes such categories as basic research to receive new knowledge, applied research to get new knowledge with specific requirements, and experimentation to produce or improve products or services. This definition shows that the core of R&D is the creation and application of new knowledge. The term is similar to the definition of innovation, which is also based on the creation and utilization of the new knowledge.

Although there is a close link between innovation and R&D, scholars (Le Masson et al., 2010) consider that this link is imprecise. There are a few reasons for that. Firstly, because the R&D may not always result in the actual innovation (Le Masson et al., 2010). One of the possible returns from this activity can be a solution to a specific problem, and not a product with a particular degree of novelty. Second reason is the nature of R&D departments. Particularly, the engineering and design teams ground their work on the existing knowledge rather than on the creation of new one. “They naturally tend to use existing knowledge as far as this is possible” (p. 164).

Le Masson et al. (2010) argue that from the managerial perspectives, research and development are different functions. They need different structures and different activities for execution. **Development** can be defined as a controlled process that activates existing competences and knowledge to specify a system (organization, product, process, etc), which must meet well-defined criteria (costs, time, quality) and those values were clearly conceptualized and sometimes evaluated (Le Masson et al., 2010, p. 165). **Research** is a controlled process of production of new, valid and robust knowledge (p. 171). Research activity search for answers to a specific question and may lead to new unexpected knowledge.

Research and development differ in the processes they use. Development is the autonomous function, that needs a clear definition of the competences, specification and value at earlier stages of the process (Le Masson et al., 2010). Research, in contrast, searches for value but does not define it. In development, the main approach is a problem solving one. This function tries to do as little research as possible, and moreover, it prefers to avoid to go into unexplored areas (Le Masson et al., 2010).

The research and development functions are different, but not exclusive. On the contrary, they are compatible. When developers face a problem during the development process, they must work with researchers to find a solution to it (Le Masson et al., 2010). This is a period when research and development work together.

Several similarities can be found between the terms and descriptions of research and development and exploration and exploitation activities. The definition of development describes it as a structured and defined function. Such words as controlled, existing knowledge and competences, well-defined and evaluated are similar to the description of the exploitation activity. Research is a controlled process with a goal to create new knowledge. This description is similar to the exploration activity.

Also, the terms of research and development were found in the literature on organizational learning. In his study on exploration and exploitation March (1991) argues that just as exploration and exploitation, research and development differ in returns and timing (p. 73):

“Basic research has less certain outcomes, longer time horizons, and more diffuse effects than does product development. The search for new ideas, markets, or relation has less certain outcomes, longer time horizon, and more diffuse effects than does further development of existing ones”

Although, research and development have different logics, they work together and become R&D. Similarly, exploration and exploitation are linked and dependent activities that create new knowledge and improve the existing one. Mutual presence, combination and synergy of both would be vital to sustain successful performance (Levinthal and March, 1993; March, 1991). The R&D of innovation is a continuing process of knowledge creation from both exploration and exploitation.

Diverse streams of literature on innovation management show that both exploration and exploitation are necessary for creation and development of innovation. Depending on the context, these activities may take different format and have different returns. Exploration and exploitation can take a form of the processes and be organized as research and development activities. Similarly, they can take a form of a product or a service with diverse degrees of novelty and be defined as radical and incremental innovation in a company. At this stage and based on the existing literature, it is rather difficult to distinguish what is exactly exploration and exploitation.

2.1.4. Characterization of exploration and exploitation

After reviewing the different forms and formats of exploration and exploitation in the context of innovations, in the process of creation of technological innovation and in R&D structures, this study is now able to identify the meaning of these activities. Table 2.2. provides the characterization of exploration and exploitation in an organizational context. The table demonstrates a contrasting and contradictory nature of exploration and exploitation and justifies the conflicts that can emerge between the both.

Table 2.2. Characterization of exploration and exploitation activities

(Adapted, Dymyd L., Llerena P., 2013)

	EXPLORATION	EXPLOITATION
Rationality	Unstructured, opportunity seeking	Structured, deterministic
Search Spaces	Open, fuzzy and not a priori defined, endogenously defined	Closed, pre-defined and limited
Search Processes	Open search, opportunity driven, option creating	Focused search, goal-oriented, option selection
Environment	High uncertainty and unpredictability	Risky and rational construction of expectations
Returns	New knowledge that results e.g. in the new market, product, technology etc. with a significant degree of novelty	Refinement of the existing knowledge that results e.g. in the improvement of the existing market, products and technologies etc. with incremental types of improvements
Time frames	Long-term, distant	Short-term, proximate

According to Table 2.2, exploration and exploitation have different types of *rationality*. Exploitation is a structured and deterministic activity that aims to create value and fulfill specifications. Exploitation is aimed to answer the pre-defined questions. It applies a problem-solving approach and searches for solutions in a limited and closed area. Exploration, in contrast, looks for new opportunities. It is an unstructured activity that is based on divergent thinking and types of behavior. It uses non-standardized and non-routine approaches and processes to create new knowledge and solutions.

For exploration and exploitation, the *search spaces* is also different. In exploration, the space to search new opportunities is fuzzy and initially undefined. At the basis of exploration is experimentation, creation and testing of new knowledge creation (Levitt and March, 1988; March, 1991; Nonaka, 1991). Exploitation, in contrast, is the activity driven by opportunity. It is aimed to create new options. As a pre-defined activity, exploitation selects the best option from the possible ones. The selection process is focused and goal-oriented. In exploitation, the motivation is driven by improvement of value and execution of the pre-defined objectives.

The activities operate in *different environments*. Although, risk is present in both, the degree is different depending on the activity. Exploration is more uncertain and has a higher level of risk. The chances to fail are higher in exploration than in exploitation. When an organization explores, it needs to perform activities and make decisions in highly uncertain and unpredictable conditions and in the vulnerable environments that might change in the future. When a company exploits, it executes the defined activities and takes decisions in certain conditions. It can predict the behavior of the environment and shorten the chances to fail.

Exploration and exploitation have different *returns*. Exploration creates new knowledge, competences, technologies and products (March, 1991). Its objective is to experiment with new opportunities and to select among alternatives. The activity results in the creation of new markets or a new category of clients, in the creation of a new technology with a significant degree of novelty, in the production of a new type of product or service, etc. However, the returns from exploration are uncertain and hard to predict. The returns from exploitation have the opposite characteristics. They are more predictable and proximate. Exploitation results in the improvement of the existing knowledge, competences, technologies and products (March, 1991). It may result in improvement of the market positioning, in the refinement and production of the incrementally improved technology, in the creation of better versions of the existing products and services, etc.

Finally, the activities have different *time frames*. The time factor is also linked with the speed necessary to acquire and to create new knowledge. As exploitation is a certain activity, its time horizons are well defined. The returns are proximate and can be assessed in the short term. The opposite is the period necessary for exploration. This activity is a time consuming one. The time horizons are distant and unclear. The results from exploration are not visible immediately. It is an activity with long-term orientations. An organization, that explores, can harvest the returns only in a distant future.

Hence, characterization and description of exploration and exploitation according to the applied factors as rationality, search space and process, environment, returns and time show that these are contrasting, contradictory and opposite activities. They differ in their nature and in processes they apply.

Paradoxically, the combination of exploration and exploitation is crucial for organizational survival. This means that they must be complementary and their presence is mutually beneficial for a company. In other words, an organization should learn to combine and benefit from both. Then, the question would be “how”?

Some scholars argue that together exploration and exploitation are able to create synergies and to achieve benefits in the long term. For an organization this means a sustainable performance (e.g. March, 1991; O Reilly and Tushman, 2004; Raisch et al., 2009). Indeed, many companies try different models to simultaneously explore and exploit. Some create explorative teams within existing structures, others separate exploration and exploitation in different business units or switch between periods of exploration and periods of exploitation. Even if an organization can achieve the balance by applying one of the existing solutions, many of them fail to sustain the appropriate degree of exploration and to keep the balance through time. This means that scholars still need to find out how to co-organize effectively two contradictory activities of exploration and exploitation in order to make them complementary and their balance sustainable in the long term. The following section clarifies why companies fail to balance exploration and exploitation over time.

2.1.5. Balance: Why is it hard to achieve?

Previous sections explained, that a combination of contrasting and competing exploration and exploration activities would be essential for sustainable performance. However, despite the long-term benefits that it might bring to a company, such a desired state is hard to achieve. It is an organizational challenge to co-organize exploration and exploitation and to ensure their effective performance over time.

There are multiple reasons why companies fail to sustain the balance. What happens, in fact, is that an organization makes choices on how to allocate and divide resources between exploration and exploitation. Similarly an individual makes decisions when to explore and when to exploit. Both organizations and individuals make their decisions based on available information. Then, they select and divide resources between exploration and exploitation.

These decisions, selection and allocation of resources between exploration and exploitation are hard to make, at least because of the 6 reasons, drawn from the existing literature on organizational learning (e.g. Levinthal and March, 1993; Levitt and March, 1988):

1. Contradictory logics;
2. Competition for organizational resources;
3. Decision-making: past experience and avoidance of failure;
4. Ambiguity;
5. Rational behavior;
6. Lack of vision

The first reason is the *contradicting logic* of exploration and exploitation. The contrasting nature and characteristics of exploration and exploitation make their co-existence almost impossible (e.g. Birkinshaw and Gibson, 2004; Chen and Katila, 2008). To combine both, an organization should find approaches to co-organize and to manage different structures, processes and activities related to exploration and exploitation.

Second reason is the *competition for resources*. Both exploration and exploitation compete for organizational resources (March, 1991). As resources are scarce and limited, organizations must take decisions on how to allocate resources between the two activities. Often, such decisions are rational and based on the assessment of a payback and returns from the activities. As described previously, exploration and exploitation differs in results. This means that an organization should use different metrics to assess their performance.

The competition for organizational resources leads to the third reason - the organizational *decision – making, past experience and avoidance of failure*. An organization should select and make choices on the distribution of resources between two activities (March, 1991). However, future expectations and past experiences influence this process. When making these decisions, an organization takes into account the success and failures from the past (Levinthal and March, 1993; March, 1991). In fact, organizations learn from results of the past. If there were more failures, an organization would try to secure the future (see also March, 1991). It will search for optimization of decisions and invest in activities that guarantee the success.

For an organization, choice, selection and decision-making create a situation of *ambiguity*, lack of clarity and stability. When exploration and exploitation are in competition, they are expected to perform equally well and to demonstrate the results from their execution. Selection is based on the performance and values that activities can bring to an organization. But the comparison as such between exploration and exploitation is hardly possible. The attempts to use identical measurements and assessment metrics to evaluate the performance of exploration and exploitation are useless. The activities and their results are too different. The exploitation has certain and proximate outcomes, while exploration experiments with the opportunities for the distant future (March, 1991). Because of the differences between exploration and exploitation, an organization and individuals should apply different metrics to evaluate the performance of each of the activities.

Moreover, the activities themselves are ambiguous. As been discussed above, it is hard to define the exact meaning of exploration and exploitation and in different contexts, these activities can have multiple shades and take different formats. During the research activities, particularly, sometimes it is impossible to identify the exact borders, the scopes and

the time frames for each of the activities. The ambiguity of exploration and exploitation is well illustrated by several examples of the innovative projects that we describe and analyze in Chapter 3.

The balancing process between exploration and exploitation is also complicated because of the *rationality*. Organizations and individuals are rational decision-makers. Intelligence, in terms of organizations, means that the actions taken by an organization must fulfill the defined objectives (Levinthal and March, 1993). Organizations collect the information to estimate the possible future returns and to make decisions (Levinthal and March, 1993). Such a rational approach allows companies to choose the best possible option from the alternative one (Levinthal and March, 1993).

However, even within organizational intelligence, rational decision-making faces problems. Levinthal and March (1993, p. 109) identify three problems that complicate the decision-making process:

- *Problem of ignorance* - uncertainty about the future and the past and the causal structure of the world;
- *Problem of conflict* – multiple nested actors confronting multiple nested time perspectives with preferences and identities that are inconsistent across individuals and across time;
- *Problem of ambiguity* – lack of clarity, instability and endogeneity in preference and identities

Scholars in organizational learning suggest that studies in strategic management can try to solve these problems (Levinthal and March, 1993). If so, the solution to the problems of decision-making would have led to the balance between exploration and exploitation.

Finding the balance between exploitation of existing knowledge and exploration of new knowledge is difficult because of the *lack of a vision*. In most cases, organizations and managers have short term orientation and prioritize rapid returns. In the organizational learning literature this phenomenon is explained as the “myopia of learning” (Levinthal and March, 1993).

The study from Levinthal and March (1993) explains that the first limitation to achieve the balance is the priority of the short term to the long term (that is called a “temporal myopia”). Effective performance requires both exploration and exploitation. Often, companies tend to prioritize exploitation and devote little attention to exploration. But, it is also true that an organization cannot survive in the future without surviving in the present

(Levinthal and March, 1993). Then, for companies the biggest challenge is to keep the appropriate proportion of exploration.

The second limitation is the focus on the success of the component rather than on the success of the system (names as “spatial myopia”) (Levinthal and March, 1993). The conflict emerges when individuals put more efforts to promote and to support the success of their own unit or department, rather than to consolidate the common efforts to achieve a success for the whole organization (Levinthal and March, 1993). At the same time, different organizational groups have different interests and different assessments of the same activities and events (Levitt and March, 1988). Each group and every individual would rather give a priority to their own interest, than to the interests of the whole company. Organizations should wisely define the term of their success, because it might result in creation of internal competition among different business units, teams and individuals.

The third limitation is the avoidance of failure (“failure myopia”). Often, organizations promote success and underestimate failures (Levinthal and March, 1993; Levitt and March, 1988). Companies tend to support and to promote successful individuals and avoid failures. Levitt and March (1988, p. 335) argue “individuals, who have been successful in the past are systematically more likely to reach top level positions in the organizations than are the individuals who have not”. The conflict of interest will force organizations and people to choose between individual and collective success at the unit and at the organizational level.

Moreover, with such an approach, an organization will encourage successful performance and avoid risk taking. It will focus its attention on exploitation of certainties. However, if an organization satisfies only the needs of the short-term and protects the interests of small groups instead of a company in whole, in the long term, it will inevitably suffer from a lack of exploration.

Studies shows that promotion of success complicates the maintenance of balance (Levinthal and March, 1993). Particularly, organizations struggle to maintain the appropriate degree of exploration (Levinthal and March, 1993) which is the activity associated with risk-taking and high uncertainty. An organization may decide to stop exploration as an unprofitable and ineffective activity because of unmeasurable results, high experimentation costs and low performance. A solution to continue exploration could be found in specific assessment metrics and the adequate expectations of its returns (Levinthal and March, 1993). Absence of exploration or exploitation is dangerous for the long term sustainable performance as it will results in a large disproportion of activities.

Misbalance of activities and the “illusion of success”

Often, organizations give priority to exploitation of existing certainties and devote little attention to exploration of alternatives (e.g. Benner and Tushman, 2003; Chen and Katila, 2008; Levinthal and March, 1993; March, 1991). The main reason is the different returns from these activities. In the short term, the results from exploration have poor performances, as an organization invest resources and time to acquire new knowledge and capabilities. The results from exploitation, in contrary, have a greater impact in the short term and can be assessed immediately (Levinthal and March, 1993; March, 1991).

Another explanation why organizations devote more attention to exploitation is the rapid speed of learning (e.g. Benner and Tushman, 2003; Chen and Katila, 2008; March, 1991). By doing exploitation, a company improves specific competences and is able to perform a particular activity better and faster (Levinthal and March, 1993). The more a company engages in exploitation, the bigger is the gap and costs to engage in exploration of new alternatives and competencies.

Although, in the short term focus on exploitation can demonstrate increase in organizational performance, in the long term, in contrary, such exploratory – centered activity will be self-destructive (Levinthal and March, 1993; March, 1991). A company that concentrates the activity exclusively on exploitation of existing capabilities and excludes exploration of new domains will be trapped in stable equilibrium (March, 1991). In other words, it will be incapable to evolve, to adapt and to change according to the evolving environment and to survive among competitors.

The contrasting situation is when a company solely focuses on exploration, may also lead to failure. An organization that devotes all resources and efforts to exploration and excludes exploitation will suffer from high experimentation costs and little benefits (March, 1991). Though exploration can exist without exploitation and result in creation of new ideas, knowledge, products, technologies etc., with time, the solely exploration will lead to undeveloped competences (March, 1991).

Scholars argue, in the short term, high intensity of exploitation will results in the increasing efficiency from the current business operations, but in the long term, it will lead to organizational failure (Levinthal and March, 1993; March, 1991; Tushman and O’Reilly, 1996). The balance can be achieved only temporally because very often, organizations tend to decrease the level of exploration with time. With declining exploration, exploitation becomes a central activity in a company. Levinthal and March (1993) describe it as the problem of maintaining a balance. The literature on ambidextrous organizations describes similar effect

from the superiority of exploitation. Tushman and O'Reilly (1996) use the term a “*success syndrome*” to describe how organizations tend to lower their attention and decrease the resources devoted to exploration after a period of time.

The main idea of the “syndrome of success” is that incumbent companies lose their flexibility. Large organizations have high resistance to internal and external change and in general, tend to reduce exploration. Tushman and O'Reilly (1996) explain that when a company grows, becomes larger and older, the complexity between organizational elements (such as structures, systems, processes, activities etc.) increases and creates resistance to change. As a result, it leads to structural inertia and inability to change because of the complexity, size and high interdependence between organizational elements.

Studies on organizational learning and strategic management shows that with time, companies tend to increase in exploitation and to decrease the level of exploration (e.g. Benner and Tushman, 2003; Chen and Katila, 2008; Levinthal and March, 1993; March, 1991). Though, very often a priority is given to exploitation of existing certainties, for sustainable and successful long term performances, an organization should pursue both activities (Levinthal and March, 1993; March, 1991; O'Reilly and Tushman, 2013; Tushman and O'Reilly, 1996). To do so, companies should learn how to achieve and to sustain the balance between exploration and exploitation.

A critical question in balancing between two activities is how to maintain the appropriate proportion of exploration. Taking into account the problems of decision-making and constraints towards limitation of exploration, Levinthal and March (1993, p. 107) suggest that the “primary challenge to sustain the optimal mix of exploration and exploitation is the tendency of rapid learners and successful organizations to reduce the resources allocated to exploitation”. In other words, this means that *to achieve a balance, organization should continuously maintain the appropriate degree of exploration* in parallel to exploitation.

To sustain exploration Levinthal and March (1993) propose solutions based on the incentives, beliefs, organizational structures and selection processes. Studies suggest, the following steps can help an organization sustain an appropriate degree of *exploration* over time (Levinthal and March, 1993):

1. Encourage and reward exploration;
2. Create a new structure with function on exploration;
3. Encourage risk-taking;
4. Change existing selection practices

To sustain exploration, organizations should first, encourage and reward exploration activity, for example by the assessment systems and incentive schemes. Second, exploration can be reinforced by a new structure, created in the current organization. However, Levinthal and March (1993) mention that a new venture unit with the assignment to perform exploration might be dangerous. Its activity will result in modest returns, no exploratory behavior and uncoordinated exploration (Levinthal and March, 1993). Third, exploration can be strengthened by encouraging risk-taking in a company and among individuals. The fourth solution to sustain exploration is to change organizational selection practices (Levinthal and March, 1993). This solution requires clarifications as it also deals with behavior of individuals.

In general terms, the organizational selection practices are based on the estimation of successes and failures that were described at the beginning of this section on decision-making. Organizations and individuals promote success and systematically undervalue failures. Behavior or activity that may lead to a failure is undesired. From the behavioral point of view, this process has the following consequences. Levinthal and March (1993) explain that successful people are promoted to executive positions; employees who have been unsuccessful are shifted to lower positions or leave a company. On the one hand, those successful, confident and empowered senior and executive managers do not recognize the role of luck in their past achievements (Levinthal and March, 1993). They have the illusion of control and a belief that they can handle events even in the uncertain future.

On the other hand, organizational processes also influence the behavior of individuals, particularly those who have the power of decision-making. From the point of view of behavioral psychology, such strong beliefs in managers and their decisions put pressure on the individuals. The reason is that in present, as in the past, those empowered managers must continually demonstrate results, achievements and successful execution of plans, tasks and objectives. In such context, a manager or a group of managers would prefer to avoid undesired performance that may lead to a failure. In an organization, empowered individuals would search for a rational choice and avoid taking high risks. They will try to ensure the success of their actions and decisions, in order to demonstrate effective performance and to be able to “climb higher” on the organizational hierarchy.

Managerial decision-making, the conflicts and tensions between exploitation and exploration, the illusion of success are the factors, that were analyzed not only by scholars in organizational learning, but also in strategic management and technological innovation literature. For example, Porter (1996) refers to managerial pressure that exists in organizations. To demonstrate performance, managers should deliver tangible, concrete and

measurable results from their activities. Willing to perform better and to increase their benefits, managers are trapped in the competition for operational effectiveness; they ignore the need to do things differently - to explore new alternatives.

Undoubtedly, the short term success can be achieved by doing solely exploitation. But in the long term, exploitation without exploration will result in decreased performance (March, 1991; Porter, 1996). A managerial willingness to increase in growth and to avoid failures leads to the growth trap. To achieve the desired performance, managers might intend to explore new domains, but they would still choose to invest into the incremental types of development and change, which are able to demonstrate rapid returns. Porter (1996, p. 18) argues, that a “pressure to grow or apparent situation of the target market lead managers to broaden the positioning by extending product lines, adding new features, imitating competitors’ popular services, matching processes, and even making acquisitions”. Such activity results in the short term success, but ignores the needs of the future.

In addition to strategic management, the literature on technological innovation may shed a light on the problem of selection between exploration and exploitation. In this literature, the question of exploration – exploitation is defined as the innovator’s dilemma (Christensen, 2000). For managers, the dilemma is “how they can simultaneously do what is right for the near term health of their established business, while focusing adequate resources on the disruptive technologies that ultimately could lead to their downfall” (p. 16). Similarly to the organizational learning literature, the innovator’s dilemma identified by Christensen, deals with managerial and organizational decisions on the allocation of resources between two different activities.

From the evolutionary perspectives, even the established and successful companies can fail. Established companies tend to invest in the technology that their best clients want. Organizations do not invest aggressively in innovation (or disruptive technologies) because they see this activity as “not a rational financial decision” (Christensen, 2000 p.20). It happens because innovation cannot generate high margins, significant market shares and often serves for a small group of customers. Very often, companies “rarely are able to identify and invest into a new technology until it’s too late” (p.20). Because, exploratory activity, and particularly at its earlier stages, has significant degree of uncertainty and risks.

Therefore, this section devoted to exploration and exploitation identified the meaning of exploration and exploitation activities in the organizational context. The exploration and exploitation activities were observed through organizational learning, strategic and innovation management literatures. It is essential to understand that exploration and exploitation are

inconsistent activities with different and contradictory nature. They have contrasting characteristics and competing needs.

At the same time, these are complementary activities and their mutual presence is necessary for long term successful organizational performance. It is true that the balance between the both is hard to achieve because of the competition for scarce organizational resources, conflicts and tensions that emerge between the activities. Next section is devoted to organizational ambidexterity and its different approaches. It aims to clarify how an organization can pursue exploration and at the same time perform exploitation and what are the possible solutions to achieve them simultaneously.

2.2. Organizational ambidexterity – an integrated and interrelated phenomenon

In addition to the question on how to divide organizational resources and select between competing exploration and exploitation (Levinthal and March, 1993; Levitt and March, 1988; March, 1991), literature devotes attention to another important concern: how an organization can co-organize both activities at the same time? (e.g. Birkinshaw and Gibson, 2004; Chen and Katila, 2008; Gibson and Birkinshaw, 2004; O'Reilly and Tushman, 2013; Raisch et al., 2009; Tushman and O'Reilly, 1996). The importance of this question is justified by the organizational need to exploit existing certainties and at the same time, to explore into new domains of knowledge.

Even though in the long term, both activities would be critical for organizational survival (Levitt and March, 1988; March, 1991), it is uncertain how they can be co-organized in a single organizational context. Activities are so different, that they could hardly co-exist together (Birkinshaw and Gibson, 2004). As analyzed in the previous section, the contradicting logics, differences in characteristics and returns are the factors that put exploration and exploitation in competition and make them incompatible. A solution was found in the ambidextrous companies that are able both to explore and exploit.

In broad terms, *organizational ambidexterity* means the ability of a company to simultaneously address exploration and exploitation activities (see e.g. Chen and Katila, 2008; Gibson and Birkinshaw, 2004; O'Reilly and Tushman, 2004; Tushman and O'Reilly, 1996). The original definition of ambidextrous organizations, proposed by Duncan (1976), defines it as the organizational ability to shift structures in order to develop radical and incremental innovation. Since then, the concept of ambidexterity has received decent attention from academics in organizational and management studies.

Organizational ambidexterity: meaning and definitions

The question of what is the exact definition of organizational ambidexterity has no clear answer. There are a variety of definitions from different streams of literature. The symposium on ambidexterity (see *The Academy of Management Perspective*, 2013 Vol.27, No. 4) aimed to summarize more than 20 years of studies on ambidexterity, define current state of the concept and outline the future research directions. But even after years of studies, scholars argue “the term organizational ambidexterity continues to be used to describe highly desperate phenomena...” (O’Reilly and Tushman, 2013, p. 331) and has no clear definition.

The good news is that the existing literature provides diverse and alternative visions on what could be perceived as organizational ambidexterity. Some of these definitions from scholars, who devoted much of their attention to the topic of organizational ambidexterity, are presented in the Table 2.3.

Table 2.3. Definitions of organisational ambidexterity

<i>Reference</i>	<i>Definition of organizational ambidexterity</i>
Tushman and O’Reilly, 1996	“The ability to simultaneously pursue both incremental and discontinued innovation and change results from hosting multiple contradictory structures, processes, and cultures within the same firm”
O’Reilly and Tushman, 2004	“... Segregate exploratory units from their traditional units, encouraging them to develop their own unique process, structures and cultures. But also tightly coordinate these new units with existing organizations at the senior management level”
Gibson and Birkinshaw, 2004	“Successful organizations aligned and efficient in their management of today’s business demands, while also adaptive enough to changes in the environment that they still be around tomorrow”
Birkinshaw and Gupta, 2013	“... A useful way of framing the challenges organizations face in managing two competing objectives at the same time”

Tushman and O’Reilly (1996, p. 24) define ambidexterity as “the ability to simultaneously pursue both incremental and discontinued innovation and change results from hosting multiple contradictory structures, processes, and cultures within the same firm”. This

definition is drawn from the study on evolutionary and revolutionary change and their influence on organizational performance. The study shows (Tushman and O'Reilly, 1996) that to survive, an organization should reconfigure and shift its organizational elements (e.g. organizational structure, process, cultures, technologies, etc.) in order to be able to adapt to market and industry change.

In later studies (O'Reilly and Tushman, 2004), scholars propose that to address both exploration and exploitation, an organization should separate the exploration-driven unit from the traditional business and empower them with independent structures and activities. An ambidextrous organization “segregates exploratory units from their traditional units, encouraging them to develop own unique processes, structures, and cultures. But companies should also tightly coordinate these new units with existing organizations at the senior management level” (O'Reilly and Tushman, 2004, p. 74). By using separated organizational structures, the ambidextrous organizations fulfill two functions: they separate new and existing units on the structural level and integrate their activity at the executive level.

Alternatively to separation and integration of different structures, few scholars link ambidexterity with organizational adaptability and alignment (Birkinshaw and Gibson, 2004). Ambidextrous are organizations that are “aligned and efficient in their management of today’s business demands, while also adaptive enough to change in the environment that will still be around tomorrow” (Gibson and Birkinshaw, 2004, p. 209). Birkinshaw and Gibson (2004) suggest that “adaptability” is necessary to explore quickly new opportunities, while “alignment” helps exploit the existing assets (Birkinshaw and Gibson, 2004).

Scholars proposed diverse definitions of organizational ambidexterity, however, the agreement was not found. Confusion on what is the exact meaning of ambidexterity resulted in re-focusing of the attention from the main problem and in proposing even more vague and undetermined interpretations of ambidexterity. As the result, in a recent study ambidexterity is defined as “a useful way of framing the challenges organizations face in managing two competing objectives at the same time” (Birkinshaw and Gupta, 2013, p. 296).

Despite the fact that there is no clear and unique definition of ambidexterity in the literature, it is certain that ambidexterity has a positive influence on the organizational performance (see e.g. Andriopoulos and Lewis, 2009; He and Wong, 2004; O'Reilly and Tushman, 2004; Tushman and O'Reilly, 1996). Studies show that having the ability to explore and to exploit, organizations perform better and produce more innovations (Chen and Katila, 2008; Raisch et al., 2009; Tushman and O'Reilly, 1996). Ambidextrous organizations are “more likely to create breakthrough products and processes while sustaining or even improving their existing business” (O'Reilly and Tushman, 2004, p. 74). Ambidextrous

organization are more stable and successful, they have higher chances for profitable growth and able to create more radical innovation (Birkinshaw and Gibson, 2004; O'Reilly and Tushman, 2004; Raisch and Birkinshaw, 2008).

Our research suggests that the concept of ambidexterity refers to the philosophy of organizational duality and includes a state when a company needs to combine two incompatible and contrasting activities. However, these are not only the activities of exploration and exploitation as such, but also the diverse forms and formant of their representation. Particularly, those are exploration and exploitation organizational structures, processes, cultures, results, types of innovations (e.g. radical and incremental), R&D actions and behaviors etc.

In one of the recent studies, the *essence of ambidexterity* is described as “the ability to leverage existing assets and capabilities from the mature side of the business to gain competitive advantage in new areas” (O'Reilly and Tushman, 2013, p. 332). Following this logic, our research uses the definition proposed by O'Reilly and Tushman (2004) and discussed by other scholars (e.g. Birkinshaw and Gupta, 2013; Chen and Katila, 2008) where **organizational ambidexterity** is the ability to simultaneously manage incremental and radical (discontinued) innovation. By using a case of a company, we analyze the organizational ability to co-organize and to manage structures, processes and activities, necessary for development of these innovations.

For the selected case, which is the technology-based service company and for the purpose of simplification, our research differentiate innovations as radical and incremental. In this case study, radical innovation is similar to the meaning of discontinuous innovation, which is a term, more often used in the existing literature (see e.g. Birkinshaw and Gibson, 2004; Christensen, 2000; Tushman and O'Reilly, 2002, 1996). The term radical also deals with the higher degree of technological advancement, rather than those that are present in the incremental types of development. Further we present several solutions how an ambidextrous company can pursue exploration and exploitation and develop different innovations.

2.2.1. Approaches to ambidexterity: Sequential, structural and contextual

Ambidextrous organizations are able to exploit and at the same time to explore. To do so, the existing literature defines three organizational approaches: sequential, structural and contextual ambidexterity. These are the different types of ambidexterity, associated with diverse coordination modes between exploration and exploitation.

The approaches to achieve ambidexterity differ in the way they organize and execute exploration and exploitation. For example, in the sequential approach, ambidexterity can be achieved if a company shifts structures between periods of exploration and periods of exploitation (Chen and Katila, 2008; O'Reilly and Tushman, 2013). The same idea was proposed by the original concept of ambidexterity (Duncan, 1976) when an organization shifted structures to develop incremental and radical innovation. Structural ambidexterity, in contrast, proposes a simultaneous mode to pursue both activities. To explore and exploit simultaneously, a company should separate explorative units from the exploitative ones (O'Reilly and Tushman, 2004).

An alternative view to achieve ambidexterity is proposed by the contextual approach. This concept suggests to create a specific organizational context where individuals are able to make their own choices on how to divide their time between exploration and exploitation (Gibson and Birkinshaw, 2004). The following section provides a detailed review of three different modes of ambidexterity.

Sequential ambidexterity

This approach to achieve ambidexterity is based on the assumption that exploration and exploitation could not be addressed at the same time (e.g. Chen and Katila, 2008; Kauppila, 2010). In *sequential ambidexterity*, an organization should switch between periods of exploration and periods of exploitation (Chen and Katila, 2008). Scholars suggest that an organization should focus either on innovation or on efficiency, rather than try to simultaneously address both. Because the nature of activities is so different that it is impossible to do both at the same time. The balance is in a temporal solution where “periods of exploration should be moderated with periods of exploitation, and vice versa” (Chen and Katila, 2008, p. 200).

The sequential type of ambidexterity is similar to the logic of organizational adaptation, evolution of scientific paradigm and trajectories of technologies (Chen and Katila, 2008). For example, the development of a new technology can demonstrate temporal separation between periods of exploration and exploitation. During the development process, the investments into the research of new a technology represent an exploration activity. When the design of a new technology is established, a company can switch to the production and diffusion of a new technology that would represent the period of exploitation (Chen and Katila, 2008).

Sequential ambidexterity can also take the form of selection and retention (Chen and Katila, 2008). When a company is doing research to find the proper design (exploration), and when the appropriate one is found, a company starts to improve and refine it (exploitation).

Alternatively, the shifts from exploration to exploitation can be presented in the format of replication. In case of replication, the exploration occurs when a firm searches for a new component, and exploitation arrives when the chosen component can be replicated on a larger scale. Literature suggest, the film production of the Pixelar Studio is an example of sequential ambidexterity: at the beginning, new ideas are tested in the format of short videos (the exploration period). Then, the best ideas are selected and transformed into full-length films (the exploitation period) (see Chen and Katila, 2008). In a similar way, another study (Winter and Szulanski, 2001) describes the approach to organizational strategy based on replication. This phenomenon of creation and replication of successful strategies is also known in the literature as the “McDonald approach” to do business.

The main idea of the replication is to explore a successful concept and then shift to its exploitation on a large scale. Winter and Szulanski (2001, p. 735) describe the core of the replication strategy is in “exploration to discover the main idea and exploitation by implementing the replication of its concepts”. One of the advantages of the replication strategy is the creation of a model that can be applied on a large geographical scale with little modifications (Winter and Szulanski, 2001). Another advantage is the routinization of knowledge and the diffusion of this knowledge to larger groups. Finally, an organization can maintain and improve the model, selected for the replication, till the end of its life cycle.

In sequential ambidexterity my means of replication, exploration is linked to organizational flexibility. In other words, to explore means to search for new ideas, to identify and to test possible scenarios (Winter and Szulanski, 2001). In contrast, exploitation relies on structured procedures. To explore means to “follow the working example as a point of reference” (p. 736). The success and the profitability from the replication strategy emerge when the appropriate idea has been explored and extensively exploited. Studies propose that MacDonal’s and Starbucks successfully use the strategy of replication. These companies explore new opportunity and apply a successful one on a large scale (Winter and Szulanski, 2001).

However, the replication strategy that shifts between periods of exploration and periods of exploitation has some drawbacks. The risk of exploitation of the wrong idea can be very high. Winter and Szulanski (2001, 736) argue that the replication strategy “entails costly replication of what may turn out to be irrelevant”. It means that the chances of failure should be minimized at the early exploration phases and the results from exploration must guarantee

a success in the period of exploitation. Another disadvantage of the replication strategy is in neglecting the incremental steps towards innovation. Replication decreases the pace of incremental improvements, innovation and learning.

For a company, the sequential solution to ambidexterity can take different forms. It can emerge as an evolutionary approach and as a response to technological development when a company will explore in one period and exploit in another (see Chen and Katila, 2008). Alternatively, it can be adapted as the replication strategy, when an organization will explore new domain and then, exploit it extensively (e.g. Chen and Katila, 2008; Winter and Szulanski, 2001).

Except switching between the different periods, few scholars propose that temporal separation of exploration and exploitation is also possible by means of structural shifts (e.g. Boumgarden et al., 2012; Burgelman, 2002). Structural shifts are necessary to remain focused either on one or another activity at different periods of time. The case studies on temporal structural shifts include: e.g. the longitudinal study of Intel (Burgelman, 2002), the case of HP (Nickerson and Zenger, 2002), the theory of “vacillation” and a longitudinal study of HP (Boumgarden et al., 2012).

Though sequential ambidexterity cannot provide a clear answer to the problem of balance, it can be a good approach to study organizational history and experience to switch between exploration and exploitation over a long period of time. O’Reilly and Tushman (2013, p. 327) argues, “studies on sequential ambidexterity often focus on a large scale examples with changes taking place over long period”. This stream of literature refers to the topic of organizational centralization and decentralization to achieve sustainability. Scholars also propose that sequential approach may be more appropriate for stable, environments and small in size firms and be used as an alternative view to the question of balance.

The literature on sequential ambidexterity undoubtedly contributes to studies on exploration and exploitation; but the main question on balancing between the both remains open. Particularly, for sequential ambidexterity the two important topics are still unclear (O’Reilly and Tushman, 2013): how organizations switch between exploration and exploitation over time and how these transitions look like.

Structural (simultaneous) ambidexterity

Structural approach proposes a simultaneous fashion of exploration and exploitation. In this mode, exploration and exploitation occurs simultaneously in different and structurally separated units. Studies argues that shifting between periods of exploration and periods of

exploitation could be inefficient for organizations, because of the inability to adapt to rapid change in the environment (O'Reilly and Tushman, 2013; Tushman and O'Reilly, 1996). In *structural ambidexterity*, a company is able to simultaneously perform exploration and exploitation in separated organizational structures or business units (e.g. O'Reilly and Tushman, 2004, 2013; Tushman and O'Reilly, 2002, 1996).

The reasoning why do companies must address both activities simultaneously is described in the study on ambidextrous organizations and change management (see Tushman and O'Reilly, 1996). Organizational evolution occurs as a result of change, when periods of small, incremental change switch to more radical type of change. In fact, an organization faces with a great variety of change that occur at the same time. The changes are driven by different forces: some changes are driven by technological advancement, market and competition, others by strategies and value creation (Tushman and O'Reilly, 1996).

The argument in favour of simultaneous exploration and exploitation is the complexity of an organization and the speed of change. Because of the variety of change that happens at the same time and the need to operate with diverse interrelated elements (as structures, processes, cultures, etc.) an organization should engage in exploration and exploitation in a simultaneous fashion. (Tushman and O'Reilly, 1996). Moreover, in contrast to sequential approach where the activities are incompatible, in structural ambidexterity exploration and exploitation are seen as the complementary activities (Chen and Katila, 2008). In a company, they can and should occur at the same time. But how to organize their co-existence is still an open question.

This type of ambidexterity has a close relation with innovation and change. The literature on structural (simultaneous) approach describes ambidexterity in the context of three main organizational elements (e.g. O'Reilly and Tushman, 2004; Tushman and O'Reilly, 1996) :

- Different types of activities (exploration – exploitation);
- Different types of innovations (incremental and radical/discontinued);
- Different types of change (evolutionary and revolutionary)

In general terms, innovation and change are the tightly linked activities. Innovation brings change to the existing approach of doing things. The same way, as different types of change entails innovation. Exploration helps organizations to discover new opportunities that could be implemented on the markets and in industries. Exploitation serves for improvement and refinement of the existing knowledge and capabilities.

By monitoring the environment, a company is able to capture change that occurs in the markets and in the industries. Studies shows that the indicators for coming change could be diverse, such as technological advancement, market shifts due to a competition or a client, change in regulation, etc (Tushman and O'Reilly, 1996). The case of the Apple company shows how the organization has changed because of the shifts in technologies and markets. In the past it was a product-based company with a core-business in the production of computers. Today, it is also a service and an application company (see also Tushman and O'Reilly, 1996). The organization owns a range of products and services that are continually passing through incremental improvements.

Another indicator of weak response to the market change and the industry dynamics is the decreasing organizational performance. A company can experience decreased returns if it fails to recognize on time the critical market and industry change (Tushman and O'Reilly (1996). For managers it is critical to capture the moment and to understand when an organization should shift structures in order to be able to respond to the industry dynamics.

Change management is a frequently discussed topic among the studies on structural ambidexterity (e.g. Chen and Katila, 2008; O'Reilly and Tushman, 2004; Tushman and O'Reilly, 2002; Tushman and O'Reilly, 1996). However, this approach is not about managing change, but more about the ability to explore and exploit in a simultaneous fashion. Firstly, the structural solution creates structures, architecture processes and procedures where these two activities can co-exist (see e.g. O'Reilly and Tushman, 2004; Tushman and O'Reilly, 1996). Second, organizations that apply this type of ambidexterity can produce different innovation. They can develop both incremental and discontinued innovation (O'Reilly and Tushman, 2004; Tushman and O'Reilly, 1996), produce incrementally improved products and services and create radically new ones. Third, in structural ambidexterity an organization is able to capture radical (revolutionary) and incremental (evolutionary) changes (Tushman and O'Reilly, 1996). By applying this approach, a company develops the ability to transform and to reconfigure its strategies, structures, capabilities and cultures to adapt to a changing environment.

The existing literature describes the example of how structural ambidexterity can serve organizational needs with regards to its different structures, change and innovation. O'Reilly and Tushman (2004) study the implementation of structural ambidexterity in the newspaper company - the USA Today. The scholars describe how an organization made a transformation from being a traditional newspaper company to a new internet-based organization. This shift occurred during the rise of a radically new Internet technology in 1990

To become an ambidextrous company, the USA Today used two different approaches. The first attempt took place in 1995 when the executives launched a new independent online service, that was separated from the traditional business and empowered with operational freedom (O'Reilly and Tushman, 2004). New unit was completely independent and separated from the rest of the company. However, such a complete separation led to a failure. The new unit has become isolated from the core business and had low performance.

In fact, to support a new service the company allocated a significant amount of resources, but in return the new unit was able to bring little impact to the overall business (O'Reilly and Tushman, 2004). With little support from executives, the innovative unit turned into the internal competitor for the traditional printing business entities. Having almost no executive support, and facing a lack of resources it started to lose talents and steadily disappeared (O'Reilly and Tushman, 2004).

Another attempt to achieve ambidexterity through structural separation was taken a few years later. In 1999 the company started to experience decreased returns. To improve performance, the USA Today developed a strategy with three objectives: first, to support the traditional printing business; second, to innovate into online and third, to innovate into the television businesses (O'Reilly and Tushman, 2004). A strategic decision was to separate three entities and to allow them to have autonomous processes, procedures and cultures.

Previous experience of the company showed that separation would lead to isolation of a new unit. Then, a goal of the management team was to find a solution that would allow them to integrate and link different units. Being structurally separated, printing, online and television entities were tightly integrated on the leadership level. The role of the leaders was to search for synergies between different businesses, to share and communicate the commitments, to encourage and to support cross-unit transfers and put in place the recognition programs. The executive incentive program was changed for a common bonus program that linked growth rates over the three entities (O'Reilly and Tushman, 2004). This means that in case of USA Today, everybody was responsible for the common success.

This example of structural ambidexterity illustrates how a firm was able to co-organize structures for exploration and exploitation both through separation and integration. Three different entities were separated in autonomous structures. But at the same time, they were tightly integrated at the executive level - "even as sharing and synergy were being promoted, the organization integrity of the units was carefully maintained" (O'Reilly and Tushman, 2004, p. 7). The study by O'Reilly and Tushman (2004) shows that structural separation allowed a company to protect the traditional newspaper printing business and simultaneously to innovate into new business domains, such as internet and televisions.

These practices can be applied to other organizations to achieve ambidexterity or to avoid solutions that may lead to failure as isolation of a new unit. At the same time, the example of the USA Today shows no evidence that the model of structural ambidexterity which was suggested in the study (O'Reilly and Tushman, 2004) would be suitable for other businesses and moreover, can be a long term sustainable solution to explore and to exploit.

To build an ambidextrous organization through structural approach, an organization should separate exploration and exploitation in different organizational units. The separation is necessary to overcome the conflicts and tensions between different activities. This approach allows a firm to separate not only activities, but also different competences, systems, incentives, processes and cultures related to exploration and exploitation (O'Reilly and Tushman, 2008).

In addition to structural separation in different entities, another important issue is the achievement of alignment (coordination of the activities). The separated exploration and exploitation entities should have a common strategic orientation. Scholars suggest, "established companies can develop radical innovations and protect their traditional business by creating organizationally distinct units that are tightly integrated at the senior executive level" (O'Reilly and Tushman, 2004, p. 2). This means that one of the solutions for coordination is to link the structures at the executive (leadership) level.

The literature on structural ambidexterity (e.g. Chen and Katila, 2008; O'Reilly and Tushman, 2004; O'Reilly and Tushman, 2008, 2013) argues that separation is necessary to cope with contradictions between exploration and exploitation. However, it does not provide a clear distinction between different entities, their characteristics and type of activity. It would be vitally important to know what are those explorative and exploitative units, what type of structures and activities do they have, how they are different or similar, how they can work together to execute a common strategy and what are the alternatives to engage in common work and to achieve synergies. These are the questions to answer for further studies on structural ambidexterity. The good news is that there is some evidence why activities must be separated in different units and integrated at the top level, and what are the characteristics of these explorative and exploitative units. We provide the answers to these questions further in our research.

Additional attention should be given to the research method in the existing studies on structural ambidexterity. In fact, scholars apply diverse methodologies to the questions of ambidexterity through structural separation of units. Table 2.4. presents several examples of studies from the existing literature. Some scholars apply an in-depth case study method (e.g. O'Reilly and Tushman, 2004), others use large-scale data collection (Katila and Ahuja, 2002)

and longitudinal studies (He and Wong, 2004). In spite of the diversity of methods, scholars agree that structural separation has a positive influence on firm's performance (e.g. Chen and Katila, 2008; He and Wong, 2004; Katila and Ahuja, 2002; O'Reilly and Tushman, 2004; Raisch et al., 2009; Tushman and O'Reilly, 2002).

Studies show that simultaneous exploration and exploitation have a positive impact on the organizational performance (Katila and Ahuja, 2002). For example, the research on the product development in 124 technological firms demonstrates that simultaneous pursuit of exploration and exploitation allows companies to be more innovative. In structural ambidexterity, firms combined existing and new knowledge, technologies and resources and therefore, were able to develop more innovations (Katila and Ahuja, 2002).

Table. 2.4 Structural ambidexterity in existing studies

Reference	Research method	Results from structural ambidexterity
Tushman and O'Reilly, 1996	Empirical study	Rapid adaptation to environmental changes; faster innovation
He and Wong, 2004	Longitudinal study	Positive influence on organizational performance; increase in sales growth rate
Katila and Ahuja, 2002	Multiple case study	Positive impact on organizational performance; faster innovation; Increased productivity
O'Reilly and Tushman, 2004	Single case study	Positive influence on organizational performance; adaptation; faster innovation
Rothaermel and Deeds, 2004	Multiple cases and longitudinal study	Innovativeness; improvement of product development in partnerships (alliances)
Chen and Katila, 2008	Empirical study	Positive impact on organizational performance, rapid adaptation to change; innovativeness
Kauppila, 2010	In-depth embedded case study	Positive impact on organizational performance, innovativeness, inter-organizational partnerships

The positive effect from structurally separated, but simultaneous exploration and exploitation is also to be found in the rapid adaptation to change in the environment. The existing literature demonstrates that firms that simultaneously explore and exploit, can adapt

rapidly to the turbulent environment (Chen and Katila, 2008; Tushman and O'Reilly, 1996), they can introduce new products and services on the market faster (Katila and Ahuja, 2002; O'Reilly and Tushman, 2004), and also create value and enhance exploration and exploitation through partnerships and acquisition (Kauppila, 2010; Rothaermel and Deeds, 2004) .

In spite of the increasing attention devoted to structural ambidexterity in the existing literature, it is still unclear how organizations and managers can cope with conflicts between the multiple and diverse needs and activities from explorative and exploitative units. Another open question is what organizations should do to link and to coordinate a separate explorative unit with the rest of the organization and what is the exact role of management teams. Finally, it is important to understand what happens with structural ambidexterity over time and how change in the environment influences its behavior. One more open question is about the sustainability of the structural (simultaneous) approach to achieve ambidexterity.

Contextual ambidexterity

The contextual approach supports the idea that exploration and exploitation are completely different activities and cannot simultaneously co-exist in a company. Birkinshaw and Gibson (2004) propose to apply a specific organizational context to achieve ambidexterity. The tensions and conflicts between exploration and exploitation can be managed by behavioral solutions. The literature defines *contextual ambidexterity* as “a behavioral capacity to simultaneously demonstrate alignment and adaptability across the entire business unit” (Gibson and Birkinshaw, 2004, p. 209). The *alignment* is the ability of all business units to work on the same goal, and *adaptability* is “the capacity to reconfigure activities in the business unit quickly to meet changing demands in the environment” (p. 209). Scholars propose that in such an organizational context, individuals are able to make their own decisions, how to allocate time between exploration and exploitation (Birkinshaw and Gibson, 2004, 2004).

The alignment and adaptability should occur in a simultaneous fashion (Birkinshaw and Gibson, 2004; Gibson and Birkinshaw, 2004) and can be achieved by building an organizational context where employees would be able to “make their own judgments how best to divide their time between the conflicting demands for alignment and adaptability” (p. 211). This approach to ambidexterity is focused on the whole organization, and not on the specific organizational units. The ability to balance exploration and exploitation is based on the “organizational context characterized by an interaction of stretch, discipline, support and trust” (Gibson and Birkinshaw, 2004, p. 213).

The research shows that contextual ambidexterity has a positive influence on organizational performance (Gibson and Birkinshaw, 2004). The study of 41 business units in different industries demonstrates the increase of organizational effectiveness when alignment and adaptability are organized simultaneously. Moreover, behavioral context is a flexible solution that can be created by means of multiple options, “depending on the administrative heritage of a given business and the values of its leaders” (Gibson and Birkinshaw, 2004, p. 223).

In the literature, one of the examples of contextual ambidexterity is the case of an automobile company. The research on Toyota Production systems makes the analysis on how the firm can manage the conflicts between efficiency and flexibility (Adler et al., 1999). To cope with the tensions, the company used a specific mechanism. The firm applied “metaroutines” (routines for changing other routines) to facilitate the efficient performance of non-routine tasks (Adler et al., 1999, p.43). Workers and suppliers were involved in routine and non-routine tasks. The different tasks had a temporal separation, while workers were able to switch sequentially between both (Adler et al., 1999). This process enabled the execution of different tasks in parallel. This example shows that individuals were involved in exploitation when they were performing the routine tasks and also in exploration activity, when they were switching to a new task. In addition, contextual ambidexterity and individual engagement in different activities were fostered by organizational culture, encouraged and promoted by the top management team.

The contextual mode of ambidexterity is different from the sequential and structural approaches as it uses behavioral contexts. This mode is based on individual’s decisions, rather than on shifting structures as in the sequential and simultaneous approaches. The focus is given to the individual level, and not to the organizational one. It is the main reason that makes contextual ambidexterity different from the two previous types of ambidexterity.

As in sequential and structural ambidexterity, the literature on contextual ambidexterity does not provide the answers to the important question on balance between exploration and exploitation. Particularly, for studies on contextual ambidexterity it is essential to define what are the processes and systems that can create this type of ambidexterity, how individuals should explore and exploit simultaneously and who are those ambidextrous individuals.

Alternative solutions

As none of the proposed approaches to ambidexterity provides the answer to the question on balance, scholars propose alternative views how an organization can both explore and exploit. Studies suggest that companies should take into account the speed of change in the environment when they make decisions about exploration and exploitation. In particular, simultaneous ambidexterity could be an appropriate solution for an organization in dynamic environment (Chen and Katila, 2008). As changes occur rapidly, a company has no time to shift between periods of exploration and periods of exploitation. In contrast, in stable environment an organization can use temporal separation, and focus either on exploration or on exploitation. Because in such an environment, it is possible to predict future conditions, production and technological change (Chen and Katila, 2008).

Alternatively, several scholars argue that companies should not choose between sequential or structural ambidexterity and propose to use the *integrated model*. This model suggest to integrate both sequential and structural ambidexterity (Chen and Katila, 2008; Laursen and Salter, 2006). The study of Laursen and Salter (2006) proposes to pursue exploration and exploitation simultaneously by outsourcing exploration. Another study demonstrates how exploration and exploitation can occur simultaneously at the level of product development process (Katila, 2002).

The concept of dynamic capability is another framework to address the question of balancing between exploration and exploitation. **Dynamic capabilities** can be defined as “the ability to integrate, build and reconfigure internal and external competencies to address rapidly changing environment” (Teece et al., 1997, p. 516). The framework is used to analyze the resources and methods of value creation for companies in dynamic environment.

In fact, the concept of dynamic capabilities can be a useful tool for managers to make decisions on allocation of resources between exploration and exploitation (O’Reilly and Tushman, 2008, 2013). However, it is important to understand that dynamic capability and organizational ambidexterity are different concepts. If the studies in ambidextrous organizations would apply the logic of dynamic capabilities to solve the question of balance, then the ambidexterity concept would have been based around the question on allocation of resources. O’Reilly and Tushman (2013, p. 332) argue, that in the context of dynamic capabilities “organizational ambidexterity (sequential, structural, contextual) is reflected in a complex set of decisions and routines that enable the organization to sense and seize new opportunities through reallocation of organizational assets”. Our research suggests that the

concept of organizational ambidexterity currently is in the middle of its development, because it has multiple views, yet unexplored approaches and numerous open questions.

2.2.2. Ambidexterity concept: Complexity and its intermediate stage of development

An organization is ambidextrous when it has the ability to pursue both activities at the same time. It also means that a company can deal with the paradox or the dichotomy of exploration and exploitation, as described in the existing literature. The “paradox” lays in the ability to address equally well two different activities which are, in fact, contradictory (e.g. Andriopoulos and Lewis, 2009). The *paradox* itself is an idea with two opposite but equally necessary propositions (Andriopoulos and Lewis, 2009). Ambidextrous companies need to combine paradoxical logics, competences, strategies, activities (Smith et al., 2010). The paradox is in the necessity to perform *equally well* contrasting activities of exploration and exploitation to achieve a sustainable performance.

This makes an organizational ambidexterity to be a complex phenomenon. The complexity lies in the tensions that emerge between exploration and exploitation. Moreover, as the concept is in the intermediate stage of its development, it has multiple open questions. The following subsection reviews the conflicts and the stage of the development in details.

Complexity of the phenomena and emerging organizational tensions

The exploration – exploitation and organizational ambidexterity literature refers to several conflicts that emerge when an organization tries to address both activities simultaneously. Based on the existing studies on organizational ambidexterity Raisch et al. (2009) define four tensions that emerge in the concept of ambidexterity:

1. Differentiation and integration;
2. Organizational and individual;
3. Static and dynamic;
4. Internal and external knowledge

In the literature on ambidexterity, the first organizational tension that emerges between exploration and exploitation is *differentiation and integration*. Lawrence and Lorsch (1967) define **differentiation** as segmentation of the organizational system into subsystems, each of which develops particular attributes (p. 3). **Integration** is the process of achieving

unity of efforts among the various subsystems in the accomplishment of the organizational task (p. 4). To achieve ambidexterity those mechanisms must be interpreted not as alternative, but as complementary for an organization (Andriopoulos and Lewis, 2009; Raisch et al., 2009). As neither differentiation nor integration on its own leads to maximization of the exploration and exploitation, managers willing to achieve ambidexterity should define the right degree of both differentiation and integration (Raisch et al., 2009).

The second tension deals with the *organizational and individual* approaches to find the balance. The existing literature reviews both organizational mechanisms as structural separation (e.g. O'Reilly and Tushman, 2004) and individual capacities to explore and exploit, as in contextual ambidexterity (Gibson and Birkinshaw, 2004). Alternatively, some scholars propose to mix them, as they are closely linked factors that build ambidexterity (Chen and Katila, 2008).

Both streams of the literature that uses either the organizational or the individual approach have room for further studies. For example, in structural ambidexterity it is still undefined how companies become ambidextrous by having the separate units (O'Reilly and Tushman, 2013), what are the mechanisms to achieve synergies (Markides, 2013) and what their dynamics and evolution are (Raisch et al., 2009).

Similarly, in the literature on contextual ambidexterity the open question is whether all individuals can engage in both exploration and exploitation and how they can perform these activities. Researchers suggest that individuals, who can manage both exploration and exploitation are those who have personal characteristics and ability to act ambidextrously (Raisch et al., 2009). Then the question would be how to train individuals to become ambidextrous. Describing the organizational and individual paradox, Raisch et al. (2009) argue that these factors are linked and the managerial ability to pursue both activities depends on the organizational context.

The third tension is associated with *static and dynamic* characteristics of ambidexterity. This tension is formed on the idea that to survive in the long term, organizations must reconfigure their assets and activities in order to adapt to change in the environment (Chen and Katila, 2008; O'Reilly and Tushman, 2008; Teece et al., 1997; Tushman and O'Reilly, 1996). The reconfiguration and restructuring bring a notion that ambidexterity itself is *dynamic* and can change over time. Several researchers describe the main role of a sustainable organization that lies in the adaptation, reorganization, integration and allocation of resources to respond to change and turbulence of the environment (O'Reilly and Tushman, 2008).

Moreover, dynamic factor can be found in the literature on different types of ambidexterity. The study on tensions suggests that both structural and contextual ambidexterity use dynamic processes (Raisch et al., 2009). In the theory on structural ambidexterity, the question about the evolution of ambidexterity and its different units remains open. To shed the light, some scholars suggest a hybrid forms of ambidexterity, where companies can have different structures and at the same time shift between periods of separation and integration (Chen and Katila, 2008).

The dynamic factor is also present in contextual ambidexterity. Dynamic occurs when individuals separate their time between exploration and exploitation (Birkinshaw and Gibson, 2004). This means that individuals need to switch between two different tasks to avoid confusion, rather than to do both simultaneously (Raisch et al., 2009). Another argument is that both simultaneous and sequential approaches may lead to ambidexterity, and for sustainability, organizations can switch between different solutions over time (Chen and Katila, 2008; Raisch et al., 2009). Our research tends to define ambidexterity as rather a *dynamic* than a static organizational phenomenon and the arguments why will be discussed further.

Finally, the exploration and exploitation tension refers to utilization of *internal and external* knowledge. This tension is to be found in the combination and integration of different types of knowledge. Studies show that both internal and external knowledge, as their integration into the company, are the necessary factors to build ambidexterity (Raisch et al., 2009). The knowledge management literature argues that to benefit from the potential of new knowledge, they at first must be absorbed and integrated and then utilized (Cohen and Levinthal, 1990). To be ambidextrous, an organization needs to have the ability to explore new knowledge, to exploit existing knowledge and also to benefit from their synergies (Raisch et al., 2009).

The four fundamental tensions from the study of Raisch et al. (2009) show the various dimensions of exploration and exploitation and the complexity of achieving a balance between two activities. It also demonstrates that ambidexterity is a complex phenomenon. The study from Raisch et al., (2009) enhances the main idea from the literature on ambidexterity that lies in the importance of combination and integration of competing and contradictory activities of exploration and exploitation. Those companies, willing to achieve ambidexterity, should combine diverse and often contradictory organizational elements as well as find ways to benefit from their synergies.

The study from Andriopoulos and Lewis (2009) proposes an alternative view on the tensions between exploration and exploitation. The research on five ambidextrous companies

from the design industry, describes several conflicts that emerge between the activities. Scholars argue that the exploration – exploitation paradox has a nested structure and defines three main tensions (Andriopoulos and Lewis, 2009):

1. Strategic orientation: profits and breakthrough innovation
2. Customer orientation: weak and tight relation with customers
3. Individual behavior: discipline (to exploit) and passion (to explore)

The first constraint lies in the *strategic orientation*, where ambidextrous organizations want to have both profits and breakthroughs. Ambidextrous organizations are willing to fulfill two opposite goals: they want to be both efficient and innovative. Andriopoulos and Lewis (2009) explain that to be efficient managers carefully select projects and allocate resources for their development. At the same time, firms tend to enhance their reputation and adaptability by searching for new opportunities and creating breakthroughs. An ambidextrous organization, willing to be both profitable and innovative needs to mix integration and differentiation practices, while managers should engage in supportive communication of company's goals. Another option for companies is to “diversify project portfolio with routines, profitable, incremental projects that pay the bill and high-risk breakthrough projects that build new capabilities” (Andriopoulos and Lewis, 2009, p. 704).

The second constraint is the *customer orientation* that refers to a weak or tight relation with clients. With tight customer relation a company can better fulfill the market needs and enhance client's loyalty (Andriopoulos and Lewis, 2009). However, for an organization it might have a negative effect. Scholars explain that strong ties with customers narrow the search for new unknown opportunities and increase the intensity of exploitation. Weak ties, in contrast, would lead to experimentation with new possibilities and enhance exploration. By using only weak ties, a company may extend the organizational knowledge, but it could also lead to the ignorance of market demands. The wise and effective management approach would be to benefit from both weak and tight relations with customers (Andriopoulos and Lewis, 2009).

The third constraint is the *individual behavior* and the ability to both explore and exploit, that Andriopoulos and Lewis (2009) define as drivers for “discipline and passion”. This trade-off refers to the human ability to be creative and executive, to bring innovative ideas and the ability to implement them. The ability to exploit is defined as discipline and includes explicit roles, targets and deliverables, enables focus and development process. The ability to explore refers to passion that is empowered by personal expression, challenge and

pride. In the study from Andriopoulos and Lewis (2009), individuals in the ambidextrous companies were involved in different types of activities. Describing discipline (exploitation) individuals refer to “explicit roles, project execution and short time frames”; they describe passion (exploration) as a challenging work that “opens new opportunities for unexpected inspiration and artistic expression” (Andriopoulos and Lewis, 2009, p. 706).

The individual trade-off between “discipline and passion”, or, in other words, the ability to both explore and exploit, is similar to the problem identified in contextual ambidexterity (Gibson and Birkinshaw, 2004). The conflict lies in the necessity to combine different activities: individuals must be able to create new ideas and at the same time, be able to implement them.

The search for new ideas and their implementation are two different activities. The problem is not to create new ideas, but to implement them. Levitt (2002) argues that what is often in shortage, is not the creativity itself, but actions and putting ideas in to work. The individual ability to both explore and exploit might have behavioral and physiological constraints. Many people with ideas do not understand how to operate to implement those ideas. Those who have skills and knowledge, energy and power to get things done, may not have creative ideas. Levitt (2002) argues that ideas without execution are useless, only implementation can prove their value.

To cope with tensions at the individual level, the study of five ambidextrous firms (Andriopoulos and Lewis, 2009) proposes to use the integration and differentiation practices depending on the specific organizational context. Scholars suggest that to achieve ambidexterity, a company can use a sequential, structural, or a hybrid structure in different projects and in different project phases. Another solution to ambidexterity is to differentiate tasks at the organizational level: e.g. as in the study of five different companies, larger organizations used division of labor, whereas in smaller firms, employees were wearing multiple hats simultaneously (Andriopoulos and Lewis, 2009).

Two studies on tensions between exploration and exploitation (Andriopoulos and Lewis, 2009; Raisch et al., 2009) show that organizational ambidexterity is a complex phenomenon with the essential notion of duality and a combination of inconsistent components (e.g. structures, processes, activities, etc.). The ambidextrous organizations should build and support two different structures for both activities, and at the same time, to facilitate the tensions that emerge at each level. Moreover for a long term sustainability, ambidextrous organizations should search for synergies between different components. Otherwise, exploration and exploitation will remain to be present as if they are two independent and disconnected organizational activities.

In a similar way as in the literature on organizational learning, these studies about the tensions inside the ambidextrous companies describe the evident conflicts that can emerge between exploration and exploitation. The basic reasons why it is hard to achieve organizational ambidexterity are similar to the ones on balancing exploration and exploitation from the organizational learning literature. Our research observed these conflicts between the activities in the previous section (see §2.2.2).

Complications occur because of the ambiguity of the present and the uncertainty of the future situation, rational choices and managerial decision-making that often rely on past experience. Moreover, as described by scholars from the organizational learning, and confirmed by studies on ambidexterity, an organization is a *nested system*, that has to deal with conflicts and tensions that emerge at multiple levels. The balance is hard to achieve because an organization needs to search for a balance at every level of a nested system. For a company, it is an extremely difficult task. And even if a balance is found, the dynamic features of ambidexterity and the change in the environment will force organizations to search for a new balance again. For this reason, future studies should find out how to sustain the balance in the long term. In the present moment, when the ambidexterity concept is at its intermediate stage of the development, it is unable to give this answer.

Intermediate stage of development

In recent years, the concept of organizational ambidexterity has received attention from scholars in different streams of organizational studies. Ambidexterity and the question of balance between exploration and exploitation has been observed from different angles such as organizational learning (e.g. Levinthal and March, 1993; Levitt and March, 1988; March, 1991), strategic management (e.g. Birkinshaw and Gibson, 2004; Chen and Katila, 2008; Raisch, 2008; Tushman and O'Reilly, 2002; Tushman and O'Reilly, 1996) business model innovation (Markides, 2013) and dynamic capabilities (Shuen et al., 2014; Teece et al., 1997).

Still, the existing literature has multiple open questions. It is becoming critical to answer some of those questions if researchers want to continue studies on ambidexterity. Similar is proposed by the scholar at the Symposium on ambidexterity (e.g. Birkinshaw and Gupta, 2013; Junni et al., 2013; Markides, 2013; O'Reilly and Tushman, 2013). These critical for the ambidexterity concept questions are formed around the following topics:

- Exact meaning of organizational ambidexterity;
- Organizational transitions between old and new capabilities;

- Dynamics of ambidexterity (influence of time and environment);
- Role of leadership (senior and executive managers)

Studies from the Symposium on ambidexterity (see The Academy of Management Perspective 2013, Vol. 27, No 4) summarize more than twenty years of research in the field of organizational ambidexterity. The primary factor why the concept of organizational ambidexterity is so popular among scholars is its versatility (Birkinshaw and Gupta, 2013). Even after years of studies, ambidexterity is still a universal, vast, ambiguous and undetermined concept to explain a range of organizational problems.

Regarding the past 15 years of studies on ambidextrous organizations the researchers argue: “while progress has been made, there remains much to do. The risk, however, is that scholars use the term to apply to more and more *desperate phenomena*, the construct itself loses its meaning” (O’Reilly and Tushman, 2013, p. 333). Similarly, Birkinshaw and Gupta (2013, p. 287) propose that the ambidexterity concept “has reached a point where it needs some *refocusing* and *rethinking* to ensure that its boom in popularity does not quickly lead to an equally spectacular bust”.

The original term of ambidexterity refers to the ability of an individual to use both hands equally well. The term ambidexterity has been used in organizational studies to show that a company can address different components and activities at the same time (Birkinshaw and Gupta, 2013), e.g. the ability to combine exploration and exploitation and to pursue different types of innovations (Junni et al., 2013; O’Reilly and Tushman, 2004). Birkinshaw and Gupta (2013) argue that the concept has been used to explain different types of dualities: exploration and exploitation, alignment and adaptability, flexibility and efficiency etc. But what is really organizational ambidexterity still unclear.

The literature suggests to define ambidexterity as the ability to manage simultaneously explorative (discontinued) and exploitative (incremental) innovation (Junni et al., 2013; O’Reilly and Tushman, 2004, 2013; Tushman and O’Reilly, 2002). The recent study of Birkinshaw and Gupta (2013, p. 291) proposes more general views and defines ambidexterity as “an organizational capacity to address two organizationally incompatible objectives equally well”. Another study suggests that the term ambidexterity is applied to explain “highly desperate phenomena” (O’Reilly and Tushman, 2013, p. 331). Hence, we can conclude that the definition of ambidexterity is vague. To progress further in studies on ambidexterity, the term itself must be narrowed. (Birkinshaw and Gupta, 2013).

The loss of focus, precession and confusion in the understanding of the phenomenon is the current danger for studies on ambidexterity (O’Reilly and Tushman, 2013). That is why

the first challenge for the ambidexterity literature is to define *what is the exact meaning of organizational ambidexterity* and determine the research scope.

The essence of ambidexterity is to orchestrate the allocation of resources for old and new capabilities (O'Reilly and Tushman, 2013). It is the ability to use the full capacity of the existing business and to innovate into new areas. To solve these problems, scholars propose several solutions, such as sequential ambidexterity with temporal separation of activities (Boumgarden et al., 2012; Chen and Katila, 2008; Kauppila, 2010; Nickerson and Zenger, 2002); structural ambidexterity with exploration and exploitation separated in different units (O'Reilly and Tushman, 2004; Tushman and O'Reilly, 2002), and contextual ambidexterity with a particular organizational context for alignment and adaptability (Birkinshaw and Gibson, 2004; Gibson and Birkinshaw, 2004). For further studies on ambidexterity, it is important to know *how ambidextrous organizations perform these transitions* from one state to another (see also Birkinshaw and Gupta, 2013; O'Reilly and Tushman, 2013) and whether the chosen solution is a sustainable one.

Literature knows little on the time when ambidexterity could be appropriate (O'Reilly and Tushman, 2013). Ambidexterity is linked with environmental and technological change (Chen and Katila, 2008; Tushman and O'Reilly, 1996). Scholars suggest that further studies must investigate the influence of the environmental dynamics and the industry context on the organizational ambidexterity (Junni et al., 2013). It is the reason why industry dynamics and time should be taken into account to understand *when ambidexterity takes place* (see also Junni et al., 2013; O'Reilly and Tushman, 2013).

Lastly, studies on ambidexterity should not ignore the role of the decision-makers. Few scholars raised this question in the existing literature. The contextual approach refers to ambidextrous employees that can both explore and exploit (Birkinshaw and Gibson, 2004; Gibson and Birkinshaw, 2004). Other studies demonstrate evidence on the ambidextrous senior and executive managers (O'Reilly and Tushman, 2004) and ambidextrous leaders (Tushman and O'Reilly, 2002). However, the role and contribution of senior managers and leaders to organizational ambidexterity remain unclear. O'Reilly and Tushman (2013) argue that ambidexterity is a leadership challenge. Birkinshaw and Gupta (2013) propose that managerial capability is a key to organizational ambidexterity. Therefore, it is crucial to discover *who are those managers and leaders that make the decisions* and help to sustain organizational ambidexterity.

2.2.3. Unexplored role of leadership in the concept of organizational ambidexterity

In the innovation management literature, leaders have a critical function on building the innovative organization. Scholars describe leadership as an important ability to create a company where individuals would be able to innovate, make contributions and solve problems (Hill et al., 2014). Leaders are responsible for providing an organizational environment that supports and encourages innovation.

In the study on the evolutionary perspectives of a firm, Cohendet et al. (2000) state that an entrepreneur (or a leader) “plays the central role as an agent of change” (p. 111). The essence of conflicts and trade-off between exploration and exploitation is described as a specific organizational need to “allocate the intensity of learning within the firm to the learning process that is strategic” (p. 106). In this process, the leadership performs a critical function, as it controls the learning process and takes decision on the allocation of resources “according to the vision” (p. 106). Internal entrepreneurs (or leaders) have the decision-making power and can define the intensity of learning depending on the company’s objectives.

Similarly, a leader can modify the learning process by changing routines at different organizational levels or only its specific characteristics (Cohendet et al., 2000). These modifications can be done, for example, by rewarding exploration, by developing common knowledge and beliefs and by creating a company’s culture. However, in all cases, the leadership will have to deal with the ambiguity of the organization, that is also associated with “the firm’s potential for creativity” (p.110). The effectiveness of the leadership will result in the coordination between common knowledge and ambiguity.

Studies shows that the effective entrepreneurial (leadership) function should have three characteristics (Cohendet et al., 2000):

- Dynamic capabilities;
- Vision;
- Organization

First, the leadership should be able to envision change in the environment and reconfigure existing structures. It should have *dynamic capabilities* (see Teece et al., 1997), which is the ability to manage strategically the adaptation, integration and re-configuration of internal and external organizational assets, skills and competences. Second, effective leadership defines and communicates the company’s vision. The *vision* is the set of beliefs

that represent the internal and external environment of an organization. Finally, effective leadership can influence the way a company is *organized*, as well as its evolution, hierarchy and managerial components (Cohendet et al., 2000).

In the literature on knowledge-based organizations, leaders are able to shape the present and the future of the company. To influence the intensity of learning and to achieve the exploration and exploitation balance, entrepreneurs, leaders and managers can use diverse mechanisms, such as incentive systems, culture and vision (see Cohendet et al., 2000). In contrast to the theory on learning organizations, the concept of the ambidextrous organizations does not provide a clear statement regarding the roles and the functions of leaders and managers.

In fact, there is another ambiguity that emerges in theory on the ambidextrous organizations. Scholars propose that creation and maintenance of ambidexterity is a leadership challenge (O'Reilly and Tuchman, 2004, 2013). At the same time, other studies show that little attention is devoted to the topics of managerial capabilities in the context of ambidextrous organizations (see also Birkinshaw and Gupta, 2013; O'Reilly and Tuchman, 2013). In other words, there is no clear evidence on the role of leaders, executives and senior management in building and sustaining organizational ambidexterity. If the balance between exploration and exploitation is based on selection and resources allocation decisions between exploration and exploitation (Levinthal and March, 1993; March, 1991), then, it will be essential to understand who makes the decisions on ambidexterity, who are those key individuals that can build and maintain the ambidexterity, and how do they make these decisions.

Similarly to the organizational learning literature, the studies in strategic management give attention to the important role of leadership in making the selection between conflicting components. Porter, (1996) describes that in many organizations, leadership has been engaged in constant improvements of operational efficiency and the increase of company's profits. The main role of leadership is not to generate values, but to take decisions, to define and to communicate strategy and organizational values. Porter (1996, p. 20) argues, the role of the leadership is "to provide the discipline to decide which industry change and customer needs the company will respond to, while avoiding organizational distractions and maintaining the company's distinctiveness". To respond to the environmental change, leadership must define what to do and how to react. Leadership must engage both in extending the operational efficiency and in maintaining the organizational uniqueness and values (Porter, 1996)

The same idea is present in other streams of literature. The studies on dual organizations suggest that the managerial role is crucial in achieving the balance between the

present and the future agendas (Abell, 1999, 1993). The reason why companies fail to balance between two different goals is “usually the inability of individual managers to wear two hats simultaneously” (Abell (1999, p. 5). In complement to the literature on strategic management, that describes the important role of leadership (Porter, 1996), the concept of organizational duality (Abell, 1999) refers to the functions of managers at diverse levels – executive and senior level managers.

Abell (1999) provides an explicit explanation why all managers should stay focused on present and at the same time on tomorrow’s goals. In an organization, the conventional wisdom is that middle management focuses on current operational needs of the business, while top management addresses more long term and strategic objectives. However, Abell (1999) argues, decentralization and performance of these two agendas in parallel may lead to a trap. The failure happens because of few reasons: either because of the executive who cannot envision and identify the coming change at the business unit level; or because senior managers are not proactive enough to communicate and promote the important change at the top level. To avoid failure, first, managers at all levels should tackle present and future agendas simultaneously and second, an organization and its managers should set up the inter-level channels and communicate clearly on the significant change (Abell, 1999). To succeed in balancing between two agendas, an organization should promote thinking about both the present and about the future among leaders and managers at all levels (Abell, 1999).

Ambidexterity literature has a slightly modified vision on the role of leaders and leadership and proposes that managers themselves must be ambidextrous (Tushman and O’Reilly, 1996). But, it is still unclear how and at which level managers must be ambidextrous: e.g. executive, senior or at both.

The study from Tushman and O’Reilly, (1996) suggests that ambidextrous organizations should be managed by ambidextrous executives. Ambidextrous leaders ensure that an organization is willing to change and to meet the needs of the future. Such managers promote innovation, team work, people’s initiative, experimentation and risk taking (Tushman and O’Reilly, 1996). Another study proposes that both senior managers and executives must be ambidextrous (O’Reilly and Tushman, 2004). The ambidextrous managers have the ability to understand the needs of explorative and exploitative types of businesses (O’Reilly and Tushman, 2004). In creating an ambidextrous organization, the crucial point is the ambidextrous leadership, who will share the common vision and communicate it to the rest of the organization. One more important factor is the managers’ commitment both to exploration and to exploitation: “senior teams must be committed to operating ambidextrously, even if individuals from these teams are not ambidextrous themselves”

(O'Reilly and Tushman, 2004, p. 9). To achieve ambidexterity, they must act as if they were ambidextrous individuals with the ability to explore and exploit.

In addition, the study on strategic leadership (Jansen et al., 2009) demonstrates different types of behavior to enhance exploration and exploitation. Transformational leadership supports exploratory innovation. Those leaders are known as innovation champions; they are able to identify innovative ideas and pursue an exploratory activity as well as encourage other individuals to think creatively. Transformational leadership, in contrast, supports exploitative innovation (Jansen et al., 2009). They communicate to the employees the need to improve existing knowledge, processes, products, etc. and reward them on new ideas for incremental improvements.

Some scholars argue on the import role of the leadership for achieving ambidexterity. (e.g. Jansen et al., 2009; O'Reilly and Tushman, 2004; Tushman and O'Reilly, 1996). But these studies do not explain how senior managers and executives deal with tensions and conflicts between exploration and exploitation to sustain ambidexterity. O'Reilly and Tushman (2013) propose that to be successful, the leaders of an ambidextrous organization should wisely allocate resources between the old and new businesses. However, these topics on how managers deal with contradicting demands and how do they make decisions on allocation of resources are still unclear (see also Birkinshaw and Gupta, 2013; O'Reilly and Tushman, 2013).

After reviewing different streams of literature, it is becoming obvious that the managerial capability to manage conflicts and synergies between exploration and exploitation is central for achieving ambidexterity. To understand how ambidexterity can be achieved and sustained, it is important to know who are the decision-makers, how do they make these decisions and what are the results (see also Birkinshaw and Gupta, 2013).

Brief summary (Part 1-2)

To complete the first two parts of this chapter and to move to the next section on methodology, we propose a brief summary. This chapter started from the analysis of the existing knowledge on the essence and the balance between two contrasting activities of exploration and exploitation. It continued with the description of the concept on the ambidextrous organizations and several solutions to achieve the balance.

We have seen that ambidexterity is a complex and interrelated organizational phenomenon. At the same time, the term of ambidexterity is undefined and ambiguous. During a process or in any other context, it might be hard to determine what is exploration

and what is exploitation. The presence of uncertainties and multiple open, but critical for understanding questions, indicates that the concept is currently at its intermediate stage of the development. A lot should be done to expand beyond the existing knowledge on ambidexterity.

Our research proposes to take a step further and to explore the phenomenon of the ambidextrous organizations by using a multilayer methodology. We use this method to cross more than one level of analysis and to understand how the time influences on ambidexterity. The next section will describe the methodology and discuss the ambidexterity from multilevel perspective.

2.3. Multilayer methodology to organizational ambidexterity

After observing the existing literature on exploration, exploitation and ambidexterity we are now switching to the methodological part of our research. The present section is dedicated to a specific approach, called in our research as the “multilayer methodology”.

The methodology is built to fill the gaps in the existing concept of organizational ambidexterity. It takes into account some of the important undetermined areas and several open questions, raised in the research papers from the Symposium on ambidexterity (see The Academy of Management Perspectives, 2013, Vol. 27, No. 4). Precisely, our method addresses the question of organizational ambidexterity by using a cross-level analysis and by taking into account the time factor. This research method aims to cover some of the gaps that exist in the present literature, such as co-organization of inconsistent activities in a single organizational context, dynamics of ambidexterity and role of leaders and managers.

To search for the answers, we propose to start first, from reviewing the theoretical model of structural approach to ambidexterity. This model will extend the knowledge on structural ambidexterity, received in the previous theoretical section. As already described in Chapter 1, the ambidextrous company from our research has different structures to explore and to exploit. In this section, our second step is to justify the choice of the company and demonstrate its approach. Finally, we will present the design of our multilayer methodology and the steps of data collection.

2.3.1. The model of structural ambidexterity

So far, the most explicit description of structural ambidexterity is found in diverse studies from Tushman and O’Reilly. In their multiple studies, scholars propose that

simultaneous exploration and exploitation can be achieved in structurally separated units. (e.g. O'Reilly and Tushman, 2004, 2013; Tushman and O'Reilly, 2002, 1996). Ambidextrous are those companies, which can operate in two different dimensions. On the one hand, a company ensures operational efficiency in the short term. On the other hand, it simultaneously develops innovations for the long term. To do both, an organization has the ability to operate with diverse internally inconsistent architectures, competences and cultures in order to achieve efficiency and reliability and similarly to experiment and take risk (Tushman and O'Reilly, 2002).

In order to succeed in operating in two dimensions simultaneously, ambidextrous organizations should be able to separate and at the same time integrate both activities. From the previous theoretical section, we learned that it is yet unclear how an ambidextrous company can separate activities in different units and simultaneously link them to achieve synergies. To go further, another important question is about the nature of the different structures, characteristics and types of their activities.

The good news is that few scholars provide clarifications on these topics. Particularly Tushman and O'Reilly (2002) describe how exploration and exploitation can be organized in structural ambidexterity. Based on the research from Tushman and O'Reilly (2002), our research designs the model of structural ambidexterity (see Figure 2.1.). This model represents the behavior of an organization that is using structural separation to achieve ambidexterity. It also includes characteristics of the organizational structures that are involved in exploration and exploitation as well as the nature of their processes, orientation, cultures, activities etc.

We assume that ambidexterity is a complex and more likely to be a dynamic organizational phenomenon. To clarify the interrelated processes, we propose a small hint that is hidden in the illustrations to our research. In the Figure 2.1, and similarly in the following figures, the blue color is used to identify the concentration of exploitation (as in divisional business lines); the yellow color indicates the high intensity of exploration (as in the innovation unit).

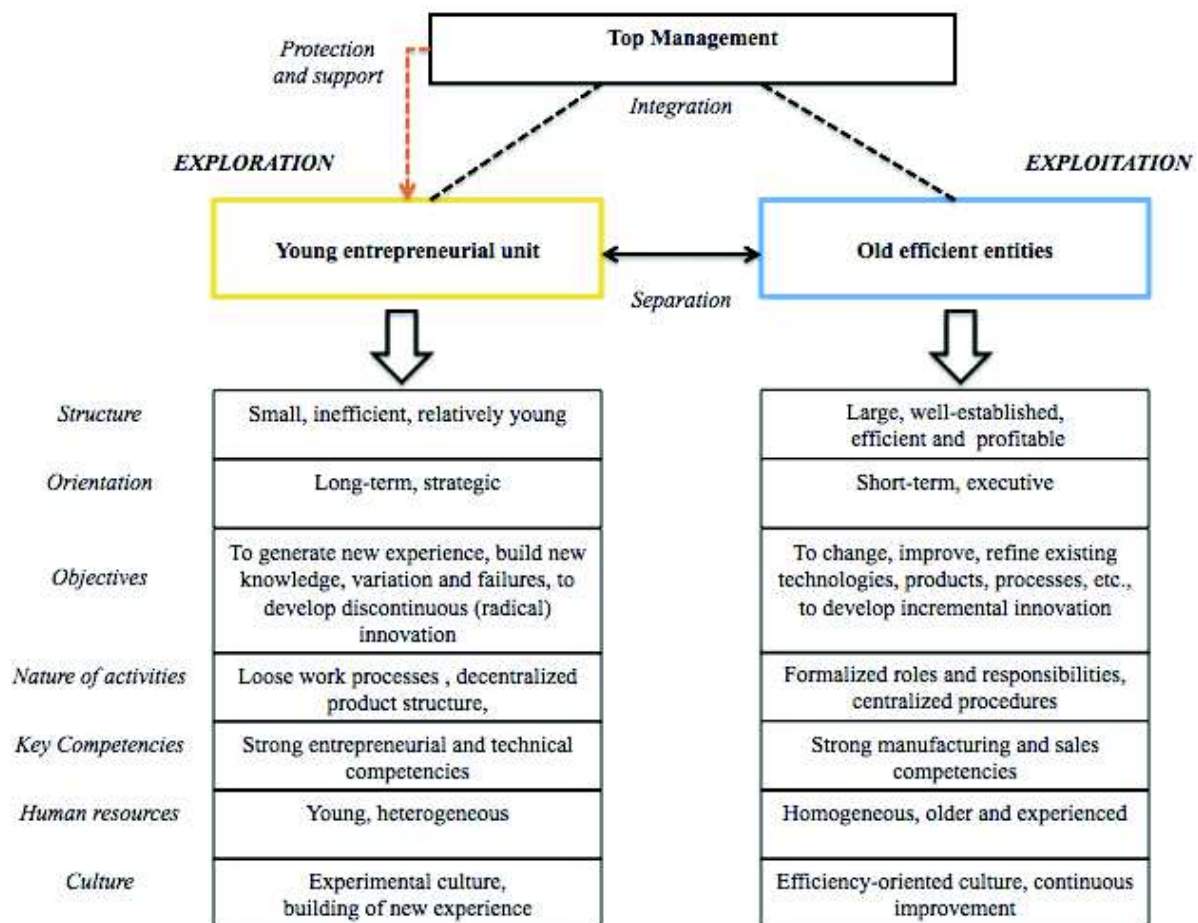


Figure 2.1. The model of structural ambidexterity *

First, the study suggests that *separation* of explorative and exploitative units is necessary because they develop different innovations (Tushman and O’Reilly, 2002). Separation is justified by the fact that different types of innovation need different organizational structures, cultures, human resources, reward schemes, etc. When a company is doing *incremental development* or changes existing products, services, technologies etc., it needs to follow the formalized processes, centralized procedures, execute specific roles and responsibilities. At that period, priority is given to the efficiency–focused culture, engineering processes, strong sales and manufacturing competences. The human resources are homogenous, old and experienced. As a rule, the units with a focus on efficiency have short-time orientation and successful histories. Scholars describe these structures as *old efficient entities* and their culture promotes productivity, effectiveness, continued incremental improvement and team work (Tushman and O’Reilly, 2002).

* This model is contracted based on a study from Tushman and O’Reilly (2002), Chapter 7, “Managing innovation streams in ambidextrous organizations” p. 155 - 180

The dramatic difference is when an organization is doing *discontinued (or radical) innovation*. These innovations emerge from the entrepreneurial type of organization. Tushman and O'Reilly (2002) name them as the **entrepreneurial units** and define as small in size and with loose work processes, decentralized structures, experiment-focused cultures, with strong technical and entrepreneurial skills. Often, employees and teams in such units are heterogeneous and young.

The main activity of an entrepreneurial unit is exploration of new domains. These units “build new experience basis and knowledge systems; they generate the experiments, the failures, the variation from which the senior team can make bets on possible dominant design and new technologies” (Tushman and O'Reilly, 2002, p. 169). In contrast to larger units, a small entrepreneurial unit does not have established histories, it is rarely profitable and often inefficient. Such units “break” the established norms and values from the larger units of an organization (Tushman and O'Reilly, 2002).

Studies show that the top management of an organization will always give more attention to incremental types of development, even if they encourage the development of radical innovation, experimentation and risk taking (e.g. Levinthal and March, 1993; Tushman and O'Reilly, 2002). The challenge of an ambidextrous organization is to address both agendas simultaneously and in particular, to be able to sustain exploration. Then, the role of the top managers would be critical. Even Tushman and O'Reilly, (2002) argues that to do so, *the top management teams must protect and support* the entrepreneurial units.

The reasoning why **executive support** is vital for explorative units is the uncertainty, the conflicts, trade-offs between the activities and high degree of risk. “The certainty of today’s incremental innovation can destroy the potential of tomorrow’s discontinuous innovation” (Tushman and O'Reilly, 2002, p. 171). The differences between the incremental and discontinuous innovation create conflict between different organizational units. The tensions emerge between “those historically profitable, large, efficient, older, cash generating units and young, entrepreneurial risky, cash-absorbing units” (p. 171). Large efficient units and small entrepreneurial units will be in competition for organizational resources. Tushman and O'Reilly (2002, p. 171) argue:

*“Because the power, resources and traditions of organizations are usually anchored in the more traditional units, these units usually try to ignore trample, or otherwise **kill** the entrepreneurial units. Thus, the management team must not only **protect** and **legitimize** the entrepreneurial units, but also **keep** them physically, culturally and structurally **separated** from the rest of the organization”*

The model from a study of Tushman and O'Reilly, (2002) shows that in structural ambidexterity, the appropriate structure for exploitation is the old efficient entities, and for exploration - the young entrepreneurial unit, because of the different type of the activities, processes, cultures and innovations. To avoid conflicts between the activities, these units must be structurally, functionally and culturally separated. A solution to integrate exploration and exploitation is found at the management level (executive and/or senior managers). But more important factor is that the executives must protect, support and legitimize the explorative activity of the entrepreneurial unit.

After describing the theoretical model of structural ambidexterity, we suggest to test it by using a case of the technology-based service company. Below, we determine why this case of an ambidextrous company is an appropriate one for our research on exploration and exploitation.

2.3.2. Reasoning about the choice of a case study

This study makes the analysis of the organizational ambidexterity on a case of the technology-based service company. It is an incumbent organization that operates in oilfield exploration and production business. It has a more than 80 years' old history and a global presence. This company is a science-based organization, which has significant R&D activities organized in diverse structures. Our research already presented the detailed description of the environmental and organizational characteristics of the company in Chapter 1. The company has similar characteristics as the ambidextrous organizations, described in the existing studies (e.g. Chen and Katila, 2008; Tushman and O'Reilly, 2002, 1996). Both external factors, such as industry and markets and also the internal factors such as the presence of different structures and activities makes this company a relevant for our research.

The company operates in the sector of new oil and gas fields exploration. It is a common belief that energy is a traditional and highly conservative industry. In this sector, innovation is more about incremental types of improvement that are made with a purpose to increase the efficiency of day-to-day operations and to enhance operational performance. Radical innovation and change, in contrast, are in a minority. These types of innovation have high costs and risks. The development process for radical innovation is uncertain and requires revolutionary change in the existing routines.

Except efficiency-driven culture, energy industry is a client-driven one. Often client-companies and oilfield service providers co-create in shared R&D projects, aimed to develop technological innovation. In this industry, companies are searching for operational efficiency,

secured strategies, effective and established solutions. Only a small number of companies in the sector are able to massively explore new areas that can bring radical shifts to the industry, because such innovative projects are hard to initiate and to execute in organizations.

In spite of the conservative approach to do business in the energy sector, studies show that activities of exploration, experimentation and learning are critical for organizational growth. The study from Shuen et al. (2014) describes the importance of innovation for the upstream oil and gas companies. The authors explain that the progress in the industry has enabled technologies that were not possible ten or twenty years ago. With the arrival of new technologies, operations in the unprocessed environments become possible. Modern technologies allow companies to perform operations in onshore and offshore, conventional or unconventional resources, with shallow water and deepwater processes and technological solutions. They also enable operations in harsh environments such as arctic, heavy oil reservoirs, tight, shale and shale oil and gas reservoirs (Shuen et al., 2014).

With the arrival of new technologies, some operational processes that were impossible in the past have now created new market opportunities. Among new technologies are for example, extract of fossil fuels, shale gas production, fracturing and fracking that are the new drilling techniques. By using new technologies and techniques companies are able to improve production and increase operational efficiency. For the oilfield service companies, exploitation, improvement and refinement of existing technologies are only one part of the game. Another is the exploration of new opportunities and development of radically new types of technologies.

Moreover, the oilfield service companies have an opportunity to be the pioneers of new technologies and able to introduce changes to the whole process of oil and gas exploration and production. These organizations provide technologies and services that stand in the beginning of the energy production cycle. By doing research and development, they can introduce revolutionary changes and set up new industry trends.

Innovation, which comes from oilfield service providers, can change markets and the industry as well as the old way of doing business for customers – the petroleum companies. As for any organization that wants to succeed in the long term, oilfield service companies should combine exploitation-refinement of the existing capabilities and exploration-the search for new opportunities. Taking into account our theoretical background on exploration, exploitation and ambidexterity, described in the previous sections, we propose that the following factors make the technology-based service firm an appropriate case for our research:

- Dynamic environment;
- The profile of the company;
- Innovation process;
- Exploitative structures and an explorative unit

The technology-based service firm is an appropriate case as it operates in a dynamic environment and depends much on technological innovation and advancement in its sector. As stated previously, to expand the existing knowledge on ambidexterity, it is critical to understand the behavior and evolution of ambidexterity over time. In an environment, where change occurs rapidly, it is necessary to analyze how a firm reacts to the shifts in the industry, what is the behavior of an ambidextrous organization, when and how it responds to the environmental turbulence?

Another indicator why the firm is a relevant case is the characteristics of the company and its profile. The selected case study fulfills several specific requirements on organizational ambidexterity. It is a large organization with a global presence, domestic and foreign operations, investments, products and service offerings in a home country and abroad. The R&D facilities of the company have local and foreign presence; they are concentrated in the divisional business lines and in a specific innovation unit.

The firm is a fully integrated organization with a vast portfolio of software and hardware solutions, services and equipment. The innovation process starts from the forecast of future trends, analysis of the market needs, follows by product development and ends with commercialization of new solutions on the markets.

In addition, the company has an innovation unit with a primary goal on development of radically new technological innovations. In the literature on ambidexterity this structure is defined as “young entrepreneurial unit” (see Tushman and O’Reilly, 2002). The unit stimulates ideation, creates processes and events related to the gathering and cultivation of new ideas and provides support to projects with a significant degree of novelty. Also, the company has the exploitative structures – the R&D departments in the divisional business lines that focus on the short term goals and incremental type of development. This activity is different from the one presented in the innovation unit and has more of an incremental nature.

In this study of the technology-based service firm, it is critical to distinguish between different types of activities and different types of R&D entities. The hypothesis of this study is that the technology-based service firm is an ambidextrous organization that uses structural separation of exploration and exploitation. Exploitation is devoted to the divisional business

lines and exploration is in the innovation specialized unit. Further we will review their characteristics.

By using a multilayer methodology, we test the model of structural ambidexterity (see Figure 2.1.) and observe such factors as time and change in the environment. To understand the nature of exploration and exploitation and to find out how can they co-exist, our research conducts the study on several organizational levels simultaneously. Also it observes the role of the leadership and executives in building and sustaining ambidexterity inside the company. The next section provides the description of the design and execution of the research method.

2.3.3. Design and execution of multilayer methodology

This study applies a case study methodology with an in-depth analysis of the complementarities of exploration and exploitation. The choice of the multilayer methodology is justified by following arguments. The case study approach is broadly used in the social science to explore and to investigate complex phenomena (Yin, 1994). In the organizational and management context, this method answers the “why” and “how” questions, especially, if it is applied to unexplored areas and topics (Eisenhardt and Graebner, 2007; Yin, 1994). This methodology helps to understand the meaning and the nature of the real-life events, such as relations, changes and processes at the organizational and individual levels (Yin, 1994).

Another advantage of the case study methodology is the diversity of research design. It can take the forms of a single case or the analysis of multiple cases. Scholars propose that single case is an appropriate design to investigate critical or unique cases (Eisenhardt and Graebner, 2007; Yin, 1994) and it can be used as a pilot case or as a “prelude for further study” (Yin, 1994, p. 41). Multiple cases, in contrast, serve for studies that aim to find similarities and/or replications of results to investigate repeating phenomena (Yin, 1994).

Our research uses the case study method with a purpose to build and to extend the theory about the activities and processes. By using a combination of different techniques and tools for the case, our research develops a particular *multilayer methodology* and applies it to the search for an answer to our question. Such a complex methodology that includes analysis of the multiple levels and layers has emerged due to several reasons: first, as the response to the progressive research of the organizational phenomenon; second, as a need to detect the diverse variables and finally, as a necessity to validate the assumptions at the different organizational levels. As the concept of organizational ambidexterity is at the intermediate stage of its development, for researchers it is a good opportunity to use the alternative methods and to bring new insights to the multiple open questions in this field.

A multiple organizational level's analysis in a single case study does not exist in the studies available in the literature. In most cases, the ambidexterity literature observes and builds theories only by making the analysis at a single level. A majority of scholars review the questions at the organizational (corporate) level (e.g. Boumgarden et al., 2012; Chen and Katila, 2008; Tushman and O'Reilly, 2002, 1996). Another stream of literature uses the individual level (e.g. Birkinshaw and Gibson, 2004; Birkinshaw and Gupta, 2013; Gibson and Birkinshaw, 2004; Kauppila, 2010). Several scholars also study ambidexterity at the executive and leadership level and refer to the term of ambidextrous leaders and individuals (Birkinshaw and Gupta, 2013; Tushman and O'Reilly, 2002).

Finally, few academics analyze ambidexterity at the project level. They observe both activities in complex engineering projects and how the ability to explore and exploit simultaneously influences the project performances (Liu et al., 2012; Liu and Leitner, 2012). But none of the studies crosses over the multiple organization levels to study the questions on ambidexterity. However complex and multilevel phenomena have specific characteristics and dynamics. The proposed multilayer methodology allows to observe them at least partially.

In contrast to the existing literature with single level focused approaches (such as corporate, unit, individual or project), our research suggests to analyze ambidexterity through multiple levels and layers to find out about their organization, interrelation and links. It is aimed to fill the gap in the existing literature and to propose an integrated view on the ambidexterity at different levels simultaneously. The objective of our multilayer methodology is to cross over several organizational levels and to study ambidexterity at the corporate, project and executive levels simultaneously.

At the same time, the idea to integrate more than one level is not revolutionary new. Several scholars from the Symposium on ambidexterity (see The Academy of Management Perspectives, 2013, Vol. 27, No.4) propose to study simultaneously several levels of an organization. For example, O'Reilly and Tushman (2013) propose to cross the levels of analysis; Birkinshaw and Gupta, (2013) to study several levels simultaneously. Similarly, Junni et al. (2013, p. 310) "*encourage future studies to focus on multiple levels of organizational ambidexterity simultaneously to specify how linkage between organizational ambidexterity at different levels contribute to performance*".

Researchers argue that to expand knowledge on ambidexterity it is necessary to study the phenomenon at different levels and to understand their linkage (Birkinshaw and Gupta, 2013; Junni et al., 2013). One of the reasons why a study at *multiple levels* might be useful is the question of co-existence of exploration and exploitation and the interplay between them.

Another important and unexplored factor is time. Exploration and exploitation have

different time horizons (Levinthal and March, 1993; March, 1991), but not many scholars include this factor into their studies on ambidexterity. In addition to multiple levels, researchers from the Symposium propose to investigate the dynamics of ambidexterity taking into account the *time* factor (Birkinshaw and Gupta, 2013; Junni et al., 2013; O'Reilly and Tushman, 2013).

Scholars suggest that to deepen the existing knowledge, future studies should find out how time influences the behavior of ambidexterity (Birkinshaw and Gupta, 2013; Junni et al., 2013; O'Reilly and Tushman, 2013). The question of timing might be different for different types of ambidexterity. For instance, in the structural approach, it might take the following format: how much of resources an organization should “engage in sufficient exploitation to ensure its current viability and at the same time, to engage in sufficient exploration to ensure its future success?” (O'Reilly and Tushman, 2013, p. 333). In the contextual ambidexterity, the similar issues could be addressed such as: “how much of my time should I spend exploiting my basic skills for the benefit of the organization and how much should I try to develop new skills and help the organization in creative ways?” (Birkinshaw and Gupta, 2013, p. 294).

These open questions leads to the general assumption of our research: no matter what the level of analysis is (organizational/corporate, business unit, project, individual) the question of conflict and the balance of exploration and exploitation will occur at all organizational levels and most probably, in a simultaneous fashion. Crossing multiple levels, taking into account the time factors and dynamics - these are only few strategies to expand the existing knowledge on ambidexterity, proposed by scholars at the Symposium. The multilayer methodology includes these elements.

This study defines the **multilayer methodology** as the specific consolidated approach that includes an embedded single case research of an incumbent organization and a combination of the analysis at diverse levels: the corporate (organizational) level, the project and executive levels, and the evolution of the exploratory unit over time. The methodology crosses different organizational levels and observes their interplay over time. This methodology is a convergence of different research tactics into a single methodological framework. The relevance of this research design is justified by the necessity to have a holistic study of the complex interrelated phenomenon of organizational ambidexterity, in particular at different levels and at different periods in time.

The multilayer methodology has a degree of originality. On the one hand, it follows the common research direction for theory building from the case studies. On the other hand, it goes beyond the mainstream approaches to study the topic of ambidexterity. By using a

combination of tools and techniques, this methodology builds new knowledge on ambidexterity and describes it at different levels and in diverse contexts.

This methodology provides the multidimensional description of ambidexterity and its dynamics in a large organization. This method analyses a complex interrelated phenomenon of ambidexterity through diverse lenses. Finally, it describes the dynamics of ambidexterity in different periods of time and in different parts of the organization.

Figure 2.2. presents the structure of the multilayer methodology. The methodology consists of three independent and interrelated parts – corporate, projects and executive. Each of the three parts includes such elements as structure, activities (e.g. product development, decision-making) or processes that deal with exploration and exploitation activities. Also, for each part the data collection and data analysis are different and consist of a combination of diverse tools and methods.

Each part of the multilayer methodology can be characterized as follows. First, at the *corporate level*, the study consists of the embedded single case of an incumbent company. The unit of analysis is a technology-based service firm and its structures - one explorative unit and two exploitative entities. The aim of this level is to receive a holistic analysis of an organization that uses structural approach to ambidexterity.

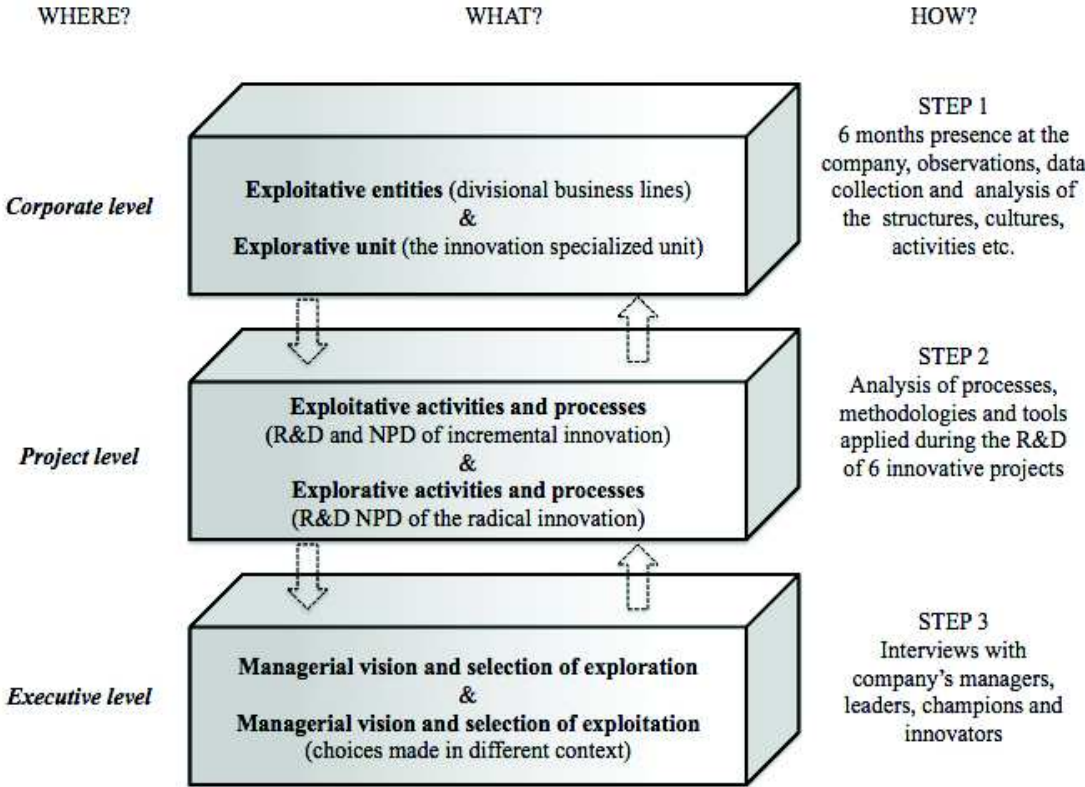


Figure 2.2. The structure of multilayer methodology

Second, at the *project level*, the study includes the analysis of multiple cases that are represented by the six different R&D projects. These are the projects in development of the incremental and radical technological innovations. The logic of this level is to find replication, similarities and divergences between different types of innovative projects and processes that might need different degrees of exploration and exploitation.

Third, at the *executive level*, the study makes the analysis of the managerial vision on exploration and exploitation, understanding of selection, choices, and allocation of resources for exploration and exploitation activities in different contexts (e.g. top management role and commitment to organizational innovation, allocation of resources for R&D projects of radically and incrementally new solutions, mission and role of the innovation unit, etc.). The aim is to understand the individual motivation and selection between exploration and exploitation activities under different conditions and in different organizational contexts.

In addition, the multilayer methodology takes into account the time factor and observes the *dynamics* of ambidexterity, its localization and evolution at different periods. It studies the history of the explorative unit, the reasoning of its initiation, describes the maturation and growth phases as well as the roles and functions of exploration, exploitation and ambidexterity for the whole company. By and large, our multilayer methodology represents the in-depth study of ambidexterity at different levels and at different periods in time, on the case of the technology-based service company.

In spite of the fact that the multilayer methodology combines diverse approaches, it remains to be a case study research. Although, in management literature, the number of case studies is constantly increasing, sometimes this research strategy might be seen as the less preferable one (Eisenhardt and Graebner, 2007; Yin, 1994). Among the common critics of the case studies are, for example, the lack of rigor, biased views, weak scientific generalization (Yin, 1994), complexity, narrow or too general theory (Eisenhardt, 1989), explicitness and justification of findings (Eisenhardt and Graebner, 2007).

The multilayer methodology solves the question of the robustness of a single case research. This particular methodology aims to build a solid theory from the in-depth study of ambidexterity by applying a case of the ambidextrous company. Scholars suggest that multiple sources of evidence can enhance the convergence and make the findings convincing and accurate (Yin, 1994). Similarly, the multilayer approach builds facts and theory from the convergence of multiple sources with the goal to increase the robustness of the findings.

To solve the question of robustness, this study uses a combination of multiple research methods and techniques. Different practices were applied to collect the data for each particular level. For example, at the corporate level, the data were collected and analyzed

during the six months-presence of the researcher at the company, working as a part of the innovation team. At the project and the executive levels, the data was collected by means of interviews with employees at different hierarchical and functional levels and also with executives and the leaders of the structures.

We collected data in three steps. The first step was dedicated to the data at the corporate level and included the information about the different structures, processes and procedures at both exploitative entities and an explorative unit to understand their similarities and differences. The second step refers to project level and the analysis of 6 projects. The goal of this level is to conduct an in-depth study of different innovative projects from the explorative unit to gain an understanding of the activity of this structure. The third step is an additional one and covers the executive level and the visions of managers and leaders from the explorative and exploitative entities. It has the purpose to get acquainted with the managerial approach to organize, coordinate, allocated sources and make choices between exploration and exploitation. The following sections review in detail the specific analytical tools applied at each step of our data collection.

2.3.4. Corporate level analytical tools (first step)

The *first step* started in early 2013. At that period, the researcher joined the exploratory structure of the technology-based service company. The role of exploration and the search for radically new ideas were assigned to the innovation specialized unit. It was a department that managed innovations and supported the R&D of projects with a significant degree of novelty across the organization. Inside this exploratory unit, the researcher joined a small group that was working on the topics of innovation management. As a member of the innovation team, the researcher spent 6 months in the company, working closely with the senior innovation manager and also managing few projects on the innovation processes and activities.

The mission of the innovation specialized unit was to develop advanced and breakthrough technologies and to manage the exploratory and innovation activities across different divisions. Informally, the unit represented a structure, which could be described as an internal “incubator” for new ideas, and for development of new complex engineering and software technological solutions.

In 2013, during six months, the researcher was involved in the activities of the innovation team, particularly related to the structuring of the exploration activity in the company. Among them were diverse processes and procedures on the search for new ideas,

maturation and implementation of innovative concept in projects. Being a part of the team, the researcher had access to internal data, initiated and led a few projects and participated in a number of activities on structuring and formalization of the exploration activity, attended meetings, formal and informal sessions and events.

Working daily as a part of the innovation team, the researcher obtained a notion of day-to-day operations in diverse organizational entities, collected and analyzed data on exploration and exploitation activities at the organizational level, including strategy, corporate structure, values, organizational culture, corporate R&D structures, processes and procedures, policies that support development of incremental and radical types of innovation, and localization of different R&D structures (divisional business line, functional departments, entities and groups etc.).

From the corporate level perspectives, the company is an ambidextrous organization. It uses structural separation of exploration and exploitation at different organizational structures. Exploitation of current certainties and improvement of existing technologies is dedicated to the divisional business lines. Exploration, search for and development of radically new solutions devoted to the innovation specialized unit. When the first step was completed, our research moved to the second part of data collection - the project level.

2.3.5. Project level analytical tools (second step)

The second step includes projects with different degrees of innovativeness and in particular radical and incremental technological innovations. At this level, we conducted the process analysis for the new product development (NPD) of three incrementally and three radically new projects. The projects were the engineering and software solutions, with different degrees of novelty and technological complexity. For all projects, the development process took place at the innovation specialized unit and was organized and managed by the team of the unit.

The final products from these projects served the needs of the onshore and offshore divisional business lines. In other words, business lines were the internal consumers of the returns from the six innovative projects. Divisional business lines were responsible for adaptation and usage of new technological solutions, which came from the development at innovation unit. As a rule, the new products aimed to provide technologies with advanced performance of seismic operations.

The project analysis was done in the context of two large divisional business lines and the innovation unit. According to the existing literature (see Tushman and O'Reilly,

2002) and the model of structural ambidexterity which was described previously (see §2.3.1.) divisional business lines had characteristics of the exploitative structure (as old efficient entities) and the innovation specialized unit had characteristics of an explorative structure (as young entrepreneurial unit).

The offshore and onshore business lines were among the major organizational structures. They formed a large part of the core-activity of the company. The choice of the business lines was justified by their effectiveness in the overall organizational performance, significant market shares, R&D capacities and the impact from their operational activity on the industry. Two business lines had similar types of R&D activities, but they were different in terms of market orientation. Both business lines produced equipment, hardware and software solutions for exploration of natural resources in different environment - in onshore and offshore zones.

In contrast to the divisional business lines, the innovation unit did not have a market specialization. It did not focus on a specific environment, market segment, field, or a technology, but covered all ranges of cross-disciplinary activities. The unit had a cross-divisional function on development of innovation. Particularly, it was involved in complex R&D projects, that had a high level of complexity, required engineering or technological expertise, needed significant input of resources and used research activities, a creative and non-standardized approach at different phases of NPD.

The selected for our study innovative projects of the unit were hardware and software products and services. We selected projects from the existing portfolio with the help of a senior manager, responsible for innovation in the company and the leaders from two divisional business lines. These were open and closed projects. Some of the projects have had significant impacts on the firm's performance in the past; others were expected to bring significant returns and industry shifts in the future. Each project was associated with radical or incremental types of innovations. Six projects were analyzed at different phases of their NPD, including initial and commercialization phases. These projects aimed to produce complex engineering and software solutions and during project management they consisted from multiple subprojects.

At this step we observed how the firm developed incremental improvements and radically new technological projects. The data for this analysis were collected by interviews with members of projects teams. Table 2.5. represents the structure, developed for the interviews with cross-functional R&D teams.

Table 2.5. Structure of interviews with cross-functional project teams

Type of Innovation	Project Number	Number of interviewees in diverse groups*				
		Project Leader or Initiator	R&D Specialists	Technical Support	Sales & Marketing	Operations
Radical	1	1	1	0	0	0
	2	1	1	1	0	1
	3	1	1	0	1	1
Incremental	4	1	0	0	1	0
	5	0	1	0	1	1
	6	1	1	1	0	1

During project management, different members joined the projects at different phases: some of them were involved at the project to perform only a particular activity, some of them stayed during all the phases of the development process. Several employees joined more than one phase and were involved more than in one project.

To cover the complete product development process, the researcher selected individuals whose activity was critical at the phases of creation, development and implementation. Members of project teams were selected with the help of the senior innovation manager and the leaders of the divisional business lines and after they were invited for the interviews that took place at the office of the company.

The invited participants were individuals of diverse profiles. They were employees at the different hierarchical levels and members of different organizational structures of the technology-based service firm. These were project and product leaders, initiators and idea holders, R&D specialists, members of sales and marketing, technical support and operational departments. However, all of them were involved in the product development process of the six innovative projects. These were individuals mainly from two divisional business lines and from the innovation specialized unit. All members contributed to the development of six innovative projects. The majority of the interviewees were the company's key-players. Some of them had significant experience and held leading positions in the company and performed critical roles during the development of the selected projects.

The interviews with members of project teams had a semi-structured format and included 10 open questions on the ideation, processes of NPD, project management, decision-

* Some of the interviewees were involved more than in one project

making, resources allocation, etc. The discussions covered the development process for each project, starting from the early initiation and conceptualization and finishing with the commercialization and market launch.

During the interviews, additional attention was devoted to the relation between the innovation specialized unit and the divisional business lines and the interplay between the explorative and exploitative R&D activities. Participants were questioned on the types of linkage, interaction and coordination between business lines and the innovation unit during the NPD process of the innovative projects.

Each question asked during the interviews was associated with a specific checklist that helped the researcher to track and to capture the terms and activities related to exploration and exploitation activities during the NPD of the innovative projects and in collaboration between the different R&D structures. Table 2.6. presents the questions and the checklist for members of the project teams. Checklist served as a method to capture and to identify the activity related to exploration and exploitation during the discussions with members of the project teams.

Table 2.6. Questions and checklist for interviews with members of project teams

N	Questions	Checklist
1	How can you describe your project: is/was it different from your previous projects?	Radical or incremental; same organization or not; application of standard R&D processes and procedures or not;
2	How can you describe the innovation ecosystem of the firm and what is the location of you project within a corporate R&D system?	Place of innovation in the org. structure; innovation and strategy; support of innovation; innovation unit; main executors - in general and specific to the project
3	How and where did you search for an idea and why it was selected for implementation/project?	Sources (collective/individual); collaboration; market-driven or inspirational; idea progress and maturity; idea implementation, decision – makers
4	How do/did you turn your idea into a solution? What is/was your role in this process?	Beginning of the project, creation of project team; decision-makers; owner of the idea and leader of the project; sources of budget; “idea advocate”; criteria to kill/not to kill an idea
5	Which problems/difficulties do/did you have during your project?	Existing/new technology; additional research needed; lack of resources (budget, expertise, time, technologies, software, etc.)

6	Why do/did you involve internal/external expertise in your project and when (stage/phase of the NPD)?	Reasoning for involvement (ex. complexity, lack of expertise in project team) – how and where they were found, when they were involved into the process
7	How do/did you assess the execution of the project? When do/did you stop the project?	Control of phases (costs, time, delays, employees); responsible of the project assessment; problem – solving process; indicators and factors to stop the project
8	How and when do/did you involve client in the development process?	Role of clients in ideation; client and project teams; role of clients during final phases of NPD; clients’ support after market launch
9	How do/did you make decisions about resources allocation for each particular section or phase of the NPD (ex. additional research, external expertise)? Is/was it liner lever or top – down decisions?	Projects’ alignment with the strategy; role of top management; strategic committee; role of senior managers; role or influence of other business units; budget suppliers (business unit, function, executives); role of marketing and sales dep.; top – down / bottom – up decision making process.
10	In you department, which tools and metrics do you use to measure the impact of your project and innovation, in general?	R&D portfolio, ROI, budget allocated; number of launched solutions; revenues from innovations; payback period, sales growth, number of patent and licenses etc.

In the analysis at the project level, the diversity of profiles and different functional involvements of members were among the biggest advantage of the collected data. It helped capture the complete picture of the development process and illustrate the path “from idea to a product”.

At this step, the contribution of the analysis was in the diversity and variety of facts and opinions on what project teams “should do” and what they “actually do” as well as the intersection between the desired, expected and the real human behavior, managerial practices and project team performance. Such an approach to analyze the project level enabled the tracking of diverse visions and the building of factual theories escaping biased views on the processes. The extension of the project level analysis was the next step – the executive vision on the exploration and the exploitation and interviews with some of the leaders and managers of the technology-based service company.

2.3.6. Analysis at the executive level (third step)

The third step of data collection in the multilayer methodology was done at the executive level. It is a complementary level with the following objectives: first, to validate with managers and leaders the results from the first and the second steps. Second, to understand managerial vision, selection and allocation of resources for exploration and exploitation.

In fact, we use the third step to understand the motivation of managers in senior and executive positions regarding the decision-making, selection and allocation of resources between exploration and exploitation. The objective of the interviews with managers and leaders was to learn and to analyze the managerial vision on the radical and incremental innovation, on the relations between divisional business lines and the innovation specialized unit. Another function of the third step was to test and to confirm the results of the first and second steps from multilayer methodology.

At this step, the data were acquired through interviews with senior and executive managers. In contrast to project-based discussions with members of the project teams, the interviews with managers had a more general focus on the processes and diverse strategies for the present and for future business. The questions were devoted to different types of innovations (radical and incremental) and different R&D activities, degrees of importance, the localization and coordination in different entities and in the company as a whole.

The profiles of the participants were also diverse and included leaders and empowered managers at different levels. Employees were the representatives from the different R&D departments of the two divisional business lines and from the innovation specialized unit. In addition to several participants who attended the project-based interviews sessions (from the second step), several managers from the top management teams were invited to the discussions.

The interviews were carried out with individuals who held the following positions: the head of the innovation specialized unit, the head of the onshore and of the offshore divisional business lines, corporate strategy and integration senior manager, company's champions, senior manager responsible for innovation, senior technology development manager, chief scientists and chief engineer, senior engineer and scientists from the divisional business lines etc.

Due to the fact that these individuals held executive or leading positions, some of them were involved in the 6 innovative projects as initiators, experts, and decision-makers. For example, the chief engineer from the innovation specialized unit was known as the

initiator of several radically new projects and a “champion” of the company. Two of his project would be analyzed in the next chapter. He was not only the initiator, but also a member of the executive committee for decisions on R&D of complex projects. On regular basis he participated in a range of other projects as an expert and a decision-maker for go-no go decisions. In similar cases, when an individual was a leader and an executor, he was asked two types of questions (from the second and third steps of data collection).

Questions and checklist for the interviews with executives were built with the similar logic as the questions at the project level, but with some differences. At the previous level, the questions had a project-based focus and were structured around the NPD process. Questions for managers (see Table 2.7), in contrast, were oriented on the innovation activity, current organizational priorities, short-term plans and long-term strategic orientations. Senior and executive managers were asked about radical and incremental innovations, localization, relation and coordination between the exploration and exploitation R&D structures, internal (e.g. R&D expenditure) and external factors (markets, industry) that influence the decision about the allocation of resources between exploration and exploitation.

Interviews at the project and at the executive levels included discussions with 24 employees of the technology-based service company. This number refers to the members of the project teams and managers with senior and executives positions. Each discussion had a minimum duration of one hour and a maximum duration of two hours. All participants were asked at least 10 open questions from the list or more, when it was necessary to receive additional clarifications.

Table 2.7. Questions and checklist for interviews with senior and executive managers

N	Question	Checklist
1	What is the localization of radical and incremental innovations inside the company?	Placement of radical and incremental innovations, innovation unit, divisional business lines
2	What is the relation between the innovation unit and divisional business lines?	Shared responsibilities, functions, sharing of resources to sponsor the development phases, etc.
3	What are the criteria to select radically new ideas and projects for NPD?	Alignment with strategy, time to market, ROI, available resources, sponsorship support, top-down decisions, support from business lines, co-development, partnerships

4	When do you involve external and internal experts/partners into the development process?	Complex/simple projects, phases - beginning of the project, creation of project team; decision-makers; owner of the idea and leader of the project; sources of budget; “idea advocate”; criteria to kill/not to kill an idea
5	How do you allocate resources for current business needs and for new business domains?	Strategy, priorities, top-down and bottom-up allocation of resources for innovative projects, emergence on the concepts inside the business lines, sponsorship from divisional leaders, killing of new ideas, influence of market and industry factors
6	Who is responsible for exploratory activity and for bringing new technologies to the market?	Innovation specialized unit, other teams and groups inside the divisional business lines
7	What are the means and resources to support exploratory activity and sponsor the R&D of radical innovations?	Top management, innovation specialized unit, leaders of the division, external partners and future clients, private and public organizations and companies, etc.
8	What is the role of divisional business lines?	Current business needs, incremental types of improvement, operational efficiency, research capability and allocation of resources for R&D
9	What are the metrics to measure the performance of the innovation unit and divisional business lines?	Similar or different metrics, R&D portfolio, ROI, budget allocated; number of launched solutions; revenues from innovations; payback period, sales growth, number of patent and licenses etc.

Interviewees were able to introduce their stories and share their personal experience on the project development, organization and management of exploration and exploitation in the company. The discussions with employees were protected according to the corporate confidentiality issue. All interviews took place at the company’s premises and were held by two researchers. The discussions were recorded and transcribed for interpretation.

Overview and conclusion

The chapter presented its three main parts: the analysis of the existing literature on exploration and exploitation, the analysis of studies on organizational ambidexterity and the structure and description of the multilayer methodology.

The study of the existing literature shows that in the organizational context, *exploration* activity is linked to search for and experimentation with new opportunities. The

aim of this activity is to create new knowledge, technologies, competencies, to develop new products and services etc. **Exploitation**, in contrast, deals with selection, production and efficiency. Its objective is to improve and refine existing knowledge, technologies, incrementally improve products and services etc.

These activities are contrasting and contradictory. They have different natures, characteristics and they are in competition for organizational resources. Activities are different in terms of rationality, search space, search processes, environment. They have diverse time frames and different returns. In spite of the competition for scarce resources, exploration and exploitation are more likely to be complementary as both activities are necessary for long term organizational performance.

Following the logic from the organizational learning literature, the combination of exploration and exploitation is essential for organizational survival. The *balance* between both activities leads to prosperity and sustainable performance. What is this balance is hard to specify. Moreover, a balance between exploration and exploitation is hard to achieve. The reason is that in an organization, the conflicts, trade-offs and competition between exploration and exploitation activities emerge at multiple levels. In that context, an organization is a nested system that consists of diverse levels. An organization and managers need to deal with tensions at each level. Similarly, the choices and selection on the allocation of resources may depend on diverse factors, such as environment and the company's existing capabilities. The decision-making is also difficult, because of past experience, avoidance of failure, ambiguity, behavior and choices of the individuals etc.

The ambidexterity literature proposes to solve the question on balancing between exploration and exploitation by specific solutions. **Ambidextrous** are the organizations that are able simultaneously to exploit existing capacities and to explore new opportunities. To explore and exploit, an organization may use the following *approaches*: sequential, structural (simultaneous) and contextual. These are the different approaches to achieve ambidexterity, either by structural shifts, separation or by specific organizational context where individuals can divide their time between both activities.

Although, scholars did significant studies on organizational ambidexterity, none of the approaches provides a clear, well-defined and sustainable organizational solution to achieve the balance and keep balancing between exploration and exploitation over time. The question on finding the appropriate proportion of the activities is still open.

The analysis of the literature showed that the concept of ambidexterity is in its *intermediate stage of the development*. There are multiple questions that remain to be

explored. The answers to some of these open questions would be critical to understand and build new knowledge around such complex phenomenon as organizational ambidexterity.

To expand beyond the existing knowledge on ambidexterity, our research proposes an original research design- the *multilayer methodology*. This methodology simultaneously observes several levels of analysis: corporate, project and executive. Also, it takes into account such factors as time and dynamics of organizational ambidexterity.

For this research, we collected data in three steps. The first step was at the *corporate level* with a specific focus on explorative and exploitative R&D structures, their processes and activities. The second – at the *project level* - included the analysis of 6 innovative projects of radically new and incrementally improved innovative projects. The third was a complementary step, focused on the senior and *executive* management level. In particular, their vision and decision-making on allocation of resources between the activities.

This methodology helped identify exploration and exploitation at different organizational levels. The following chapter will present the analysis of exploration and exploitation at different levels as well as clarify the ambidexterity that emerges in a company and inside an organizational structure. In addition, it will provide the detailed description of structural ambidexterity and its evolution and discuss the effect from structural separation and its influence on exploration and exploitation at different levels of a company.

CHAPTER 3.

STRUCTURAL AMBIDEXTERITY: MAIN EVIDENCE OF THE CASE

The previous section described the theoretical background on exploration, exploitation and the concept of organizational ambidexterity as well as presented the multilayer methodology of our research. This chapter is dedicated to the first two levels of our research method and will analyze exploration and exploitation at the corporate and at the project levels. The third, executive level will be integrated at the further stages of our research and will serve as a tool to verify and to validate the results from the analysis at the corporate and at the project levels.

As it has been discussed in previous chapter, exploration and exploitation are inconsistent activities with contrasting logics. A solution to achieve ambidexterity can be found in structural separation of exploration and exploitation. The separation is necessary to avoid conflicts and tensions between two different activities. However, to benefit from both, a company should search their synergy and link the activities for e.g. at the management level.

In structural ambidexterity, executives have a crucial role in managing contradictions between exploration and exploitation and a specific role on protection of exploration. To preserve the potential from new ideas, top management must support and legitimize the activity of the entrepreneurial unit. Otherwise, innovative ideas and new business opportunities will not be able to compete with the efficiency-oriented structures, their processes and evaluation metrics. With time, an explorative structure could be killed as ineffective and unprofitable one. Particularly, if similar selection and assessment practices as in traditional efficient entities would be used to measure the impact from the activity of an entrepreneurial unit.

Our research suggests to test these theoretical assumptions and to demonstrate the evidence of structural ambidexterity by using a case of the technology-based service company. By crossing corporate and project levels of analysis we will identify and describe the actual work of different structures and show how the company can achieve (or not) the synergies between the separate activities. At the further stages, we will verify the roles and functions of managers on coping with tensions and on sustaining ambidexterity by using the executive level.

In this chapter, we will analyze the activities, processes and projects in the explorative and exploitative structures with the following objectives: first, to study the structural

separation of exploration and exploitation at the corporate level. Second, to analyze exploration and exploitation at the project level. The aim of this chapter is to answer the following questions:

How does a company organize structural separation?

- a. What is the location of exploration and exploitation?
- b. What are the types of projects and processes in different structures?

What is the exact activity of the explorative unit?

- a. Does the unit have an exclusive role on exploration?
- b. What are the projects and processes of the unit?

To answer these questions, our research first, makes the analysis of the structural and functional separation at the corporate level with the purpose to identify characteristics and differences between diverse structures. Second, it makes the in-depth analysis of the product development process for 6 innovative projects. Both corporate and project levels will refer to *new product development* (NPD) process. In the context of our research, the term of NPD can be used to describe the complete innovation process “from idea to a product” or to identify a specific phases of the process (such as ideation, conceptualization, development, commercialization).

3.1. Exploration and exploitation at the corporate level

The technology-based service company is a large, science-based and ambidextrous organization. To achieve ambidexterity, the firm uses structural separation of activities (see Figure 3.1.). The function of exploitation is assigned to the divisional business lines; the role of exploration is dedicated to the innovation specialized unit. The activities are structurally, functionally and culturally separated. At the same time, they are integrated at the top management level. For additional information of these structures see Chapter 1, which provides the detailed description of divisional business lines and the innovation unit, as well as their characteristics, processes and activities.

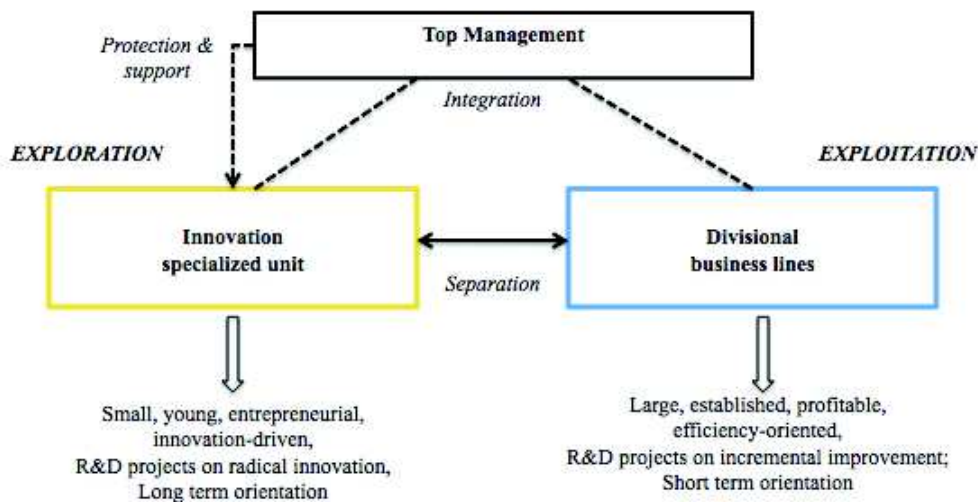


Figure 3.1. Structural ambidexterity in the technology-based service company
(Structural separation of activities at the corporate level)

Structural and functional separation of activities

In the technology-based service company, the *divisional business lines* are established, efficient and profitable structures. Their main function is to support effectiveness of the existing oilfield service operations. The R&D activity in business lines is incremental in nature. These structures develop incremental improvements and refinement for the existing technologies, products and services. The primary goal of these structures is to keep strong competitive positions on market segments and to satisfy the current business needs.

Business lines have exploitative type of activity, Short term orientation and give the priority to incremental innovations with rapid returns. In these structures, the development of

new products requires little research and modest experimentation. This process has low risks, because a technology or a solution is already available on the market. Usually, the R&D projects have low degrees of uncertainty and fast returns on investment (ROI). In general, to develop incremental improvement and to ensure the profitability of future innovation, business lines only work on re-designing of technology and engage in new development projects that are able to demonstrate technological feasibility and prove their operational effectiveness.

In contrast, the *innovation specialized unit* is relatively small, young and innovation-driven organizational structure. This unit is separated, independent and autonomous from the divisional business lines. The unit has an explorative type of activity. Its main function is to search for new ideas, knowledge and to develop radically new technological innovation. These are the breakthrough solutions with significant degrees of novelty and complexity.

The innovation unit has an independent R&D process. The activity has a strategic importance and long term orientation. The unit gives priority to the research –intense projects that develop complex solutions, and combine engineering and software equipment, products and services. Such solutions will serve for new markets and satisfy the needs of new clients.

During product development, the unit devotes significant attention to search and experimentation with new ideas and opportunities. The development process starts from the early development phases such as initiation, when an idea or a concept of the future innovation is not yet clarified. Such R&D projects have high risk of failure, uncertain and distant returns and require significant resources for development.

Another property of the innovation specialized unit is a strong support from the executives. Top management of the company legitimizes and protects the innovation unit and allocates resources for development of strategically important projects. They provide sponsorship to the unit and support its exploratory activity.

Divisional business lines and the innovation unit are not only structurally separate entities, but also functionally independent organizations. In other words, they have different R&D processes and activities. As the company is a science-based organization, with the extensive degrees of research and experimentation, the R&D itself is organized both in explorative and in exploitative structures. Precisely, the R&D activity is present in divisional business lines and in the innovation specialized unit but differs in orientation, process organization, products and project types. Our research already presented the detailed description of explorative and exploitative structures and their R&D activities in Chapter 1.

In the technology-based service firm, separation of exploration and exploitation is not only in structural, but also functional. In particular, the research and development activities in

divisional business lines and in the innovation unit have different focuses. Business lines give priority to incremental improvements of the existing technologies. They have strong development capabilities, technical and engineering competences and short term orientation.

The innovation specialized unit, in contrast, has a strong research capability and an innovation-driven culture. The R&D activity of the unit is intensive in research, innovation – focused and has a strategic importance for the company. The projects of the unit are complex, costly and often require research and co-development with partners. Working on the innovations for the future, the unit has an objective to bring breakthrough solutions to the market that can change the energy industry.

In these organizational structures, not only the research focus is different but also the organization of the product development processes. According to the internal data of the company and interviews with employees who participated in our research, the divisional business lines never start the development process when a technological concept is not defined and proven. Usually, the process begins from a prototyping, re-designing and tests of the existing technology. Unlike the business lines, the innovation unit starts the development from early initiation phases, from the search and experimentation of new ideas and concepts when the technology itself is not yet available. The unit does the necessary research and studies to prove the feasibility of a new concept and demonstrate future business opportunities.

To achieve structural ambidexterity, divisional business lines and the innovation unit focuses on different objectives, have diverse focus and apply distinct processes. These are autonomous structures with independent research and product development. Nevertheless, the activities in these entities are not completely disconnected. In fact, there is a space where the separate structures come across and merge. The integration happens at the intermediate stage during the development process of radically new projects. The following section describes this process and defines the roles of the explorative and exploitative structure, the reasoning for necessary integration and coordination.

3.1.1. Innovation process: Stage-gated new product development

The innovation process of the technology-based service company has a stage-gated format. The purpose of the process is to develop advanced and complex innovative technologies. As a rule, an innovation should be first explored at the innovation unit and then transferred for exploitation at the divisional business lines. Such an approach to create new technologies helps to share the creation process between different R&D structures and to

ensure the commercialization and market application of an innovation. Figure 3.2 represents the stage-gated process of innovation development.

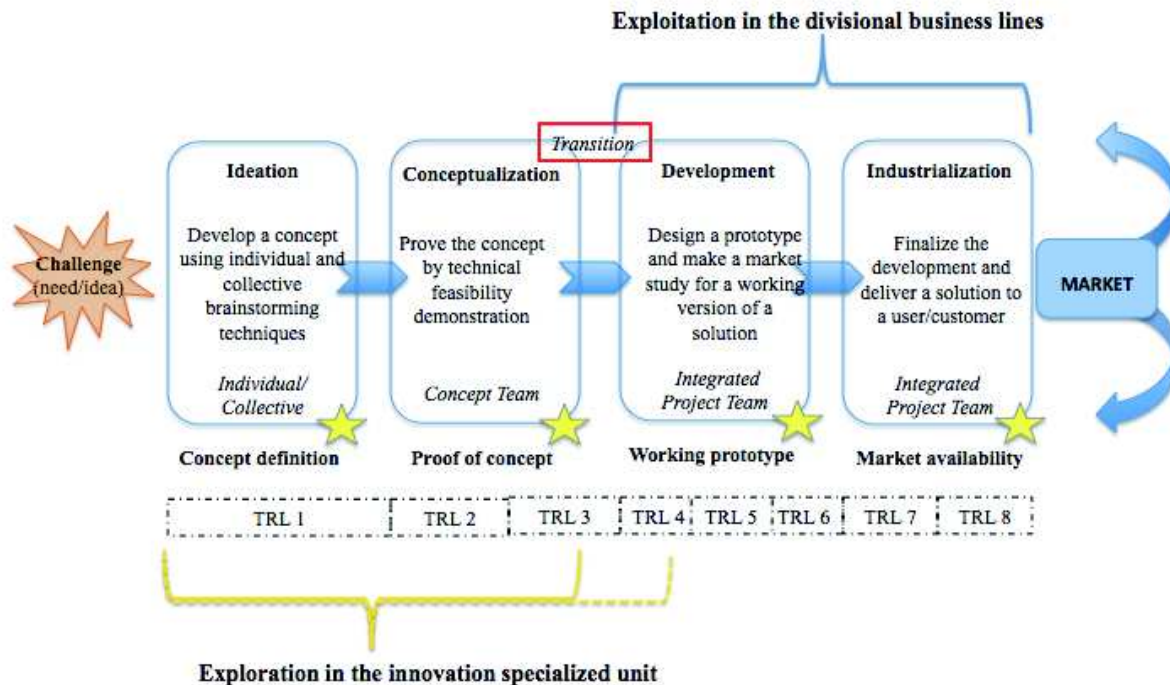


Figure 3.2. The stage-gated innovation process of the company
(Constructed from internal documentation)

In brief, the process of creation of an innovation has four main phases. Before initiating the process an individual (or a group of individuals) should propose an idea or a challenge to solve, which can come from the internal needs of the organization, from the market or client needs.

The process starts from the initiation phase, which is aimed to define a concept by means of individual or collective brainstorming techniques. The next phase is the conceptualization of a new idea. At this stage, the initiator and the concept team should work together in order to prove the technical feasibility, to develop the necessary specifications and to make tests and demonstrate preliminary versions of a future product. Then, an important decision is made to go or not-go to the next phase of the process. This period can be defined as a transition between exploration and exploitation and it will be described further.

The development phase is aimed to build the prototype of a new solution. At this stage, the goal of the integrated project team is to validate the complete solution, including

technological feasibility reports and a market opportunity study. The development is finalized with the industrialization phase, when the solution is ready to be launched on the market and could be available for customers. After the process finishes, the new technology is transferred to operations where it can be improved, upgraded and maintained. In order to control the maturity of the technology, the firm uses a technology readiness level methodology (TRL). This method is used to evaluate critical steps during the development of new technology.

Technology readiness level (TRL)

Except for the product development process, the company uses another approach to measure and evaluate the technological advancement of a project. This methodology is the technology readiness approach. In general terms, the **technology readiness level (TRL)** is a method to evaluate maturity of a new technology during the development process (e.g. devices, materials, components, software solutions, etc.). It is used by diverse science-based and technological organizations to develop engineering and technological innovation, to frame and control each stage of the development.

TRL has nine different levels. It starts with scientific and applied research to formulate the concept of an invention. The R&D project can be initiated at the third level, which is aimed to make analytical studies and to validate the elements of the concept. Before that level, there is a search activity and definition of an idea.

The fourth and the fifth levels are mainly related to laboratory tests and preliminary validation of the components and the whole system. After the end of the experimentation and design development, the project may pass to the test of the prototype in the operation environment. At that stage, the working prototype should demonstrate the feasibility of the whole system and how it will operate in the actual environment.

Depending on the test results, a new technology of a system can have minor changes to solve the problems and recurring trials to demonstrate a better performance. The higher levels of the TRL represent the finalizing of the development process. The project team should proceed to the final test to evaluate the performance of the end solution. This will also prove that a system can work in necessary conditions and environments. TRL finishes with the application of the technology according to its specifications and operational mission.

To create innovations, the technology-based service company separates diverse activities in different structures. There is an emerging idea that exploration of new ideas and concept should be done at the innovation unit and exploitation and execution at the divisional business lines. The stage-gated development process describes that ideation and

conceptualization phases should take place at the innovation unit. Then, during a period let us call it as a transition or an intermediate step, a new project should be transferred to the divisional business lines for further development and industrialization.

Similar idea is represented by the TRL methodology, when during development of an innovation, the unit is responsible for managing the process and allocation of resources for the projects at the levels of TRL 1 till TRL 3 and in some cases, covers the TRL 4. The divisional businesses lines only work on the project at TRL 5 and bring then till TRL 8. These could be the incremental projects from divisions that starts from the re-designing of the existing technology or radically new projects, received from the innovation unit. Then, the role of the divisional business lines is to develop a prototype, test and launch an innovation.

Both stage-gated development process and TRL methodology shows that the innovation unit performs early research and exploratory activities, whereas the divisional business lines exploit, refine and improve the technological design, carry on the test and commercialize innovations. Further we provide a detailed description of activities that occur in the innovation specialized unit and in the divisional business lines to understand whether the applied in the company methodologies correspond to the actual work, activities and processes in the diverse structures. The description of NPD in different entities will help first, to understand the exact types of processes in the explorative and exploitative entities and to extend the existing knowledge on organization of activities in structural ambidexterity. Second, to justify why the separation is necessary and describe when the integration takes place.

3.1.2. “To explore...” - the job of the innovation unit

To fulfill the mission on creation of the advanced technologies, the innovation unit devotes significant efforts to search for new ideas and experimentation with new opportunities. The exploratory activity starts before the process and continues during the phases of development. Before the initiation of any new project, the innovation unit engages in high-level exploratory activity. The unit is a place where all new ideas are collected and stored. It is a kind of a “bank of ideas” and a source of future technological innovation. The aim of this activity is to select the best ideas and to initiate their development. New ideas form “the new challenges” which are the entry point of the process of creation of innovation.

To be transformed into a new challenge, an idea should fulfill specific requirements. One of the possibilities is that a new idea represents a market need. The demand from a client could be a starting point for a new product or a service. Another option is when an employee

or a group of employees propose their own idea for development. In all cases, an idea should open a new business possibility and inspire a future team to create an innovation.

The sources for new ideas can also be diverse. A new idea might come from an individual, who is working in the company. He or she can suggest to the innovation unit to develop or to improve an organizational process, product or a service. Alternatively, members of the divisional business lines can come up with proposals to create new solution. In that case, the divisional team that proposes a new challenge serves as an internal customer for the activity of the innovation specialized unit. Finally, external clients can identify the new market need that should be met. The development starts when the idea or the scope of the future topic to be explored is identified.

In the innovation specialized unit, the early initiation starts from submission of a new idea or a proposal and follows by a selection of a specific challenge. This is the *ideation phase*, characterized by the gathering of additional information on a challenge, selection and maturation process. Each selected idea should have an initiator or a group of individuals who will bring an innovation to the market. The pre-selection for new ideas differ from one case to another. It is not well determined and specified procedure, but it relies more on the expertise and visions of managers, who participate in brainstorming, negotiation sessions and empowered with decision making.

After accepting the challenge for development, the innovation specialized unit helps an initiator collect additional data, meet and receive the visions from diverse experts e.g. professionals in the divisional R&D departments and external specialists. Using specific techniques such as informal discussions and cross-divisional brainstorming methods, the unit facilitates the maturation of new ideas and allows an initiator to prepare the early concept proposals of the future solution. At the end of this phase, a project-initiator should be able to demonstrate technical and market proposals. The deliverables are first the potential usage of a new product or a service and its added value; second, description of the components and specifications of the system; third, forecast of costs and proposals on future business opportunities (clients, markets, sales).

The decision-making process to go or not go depends on the type of a project. For divisional projects the responsible entity is the divisional management, which is able to make independently the decisions on allocation of resources for R&D projects in divisions. For projects, that involve more than one divisional business line, the decisions must be taken by the innovation unit and by members of the top management team. In this phase, the go/no-go decisions are made based on the resources necessary for a project and the alignment of future technological innovation with the short term planning or long term strategies of the company.

Next in the development of the future innovation is the *conceptualization phase*. The objective of the phase is to deliver accurate definitions of the solution for further technological development. The initiator or a leader of the project must obtain a precise description of a concept. The project must be developed by the concept team, include experts of diverse fields who will work together on the creation of the innovation.

At this stage, the concept team has to deliver operational and functional specifications, and the market study. The team should demonstrate the feasibility of the future system and the concept and make the preliminary tests of an innovation. To prove the concept, the innovation unit helps the team organize structured brainstorming sessions with invited professionals. The unit also provides a consultancy service to the cross-divisional project team and advices on the project management tools and time management techniques.

At this phase of the process, the deliverables include operation models of new system, specifications on functions (e.g. activities and processes of the innovation) and technical requirements. Finally, a project team delivers a description of the business specifications, with an analysis of the project costs, future returns, risks and expected market performances. At this stage, the IP study on the selected concept is also necessary to ensure the protection of the operational and functional systems of the concept.

During conceptualization phase, the decision making committee consists of the members or the innovation specialized unit and/or divisional management. Their role is to decide on the project launch for the next phase, confirm the structure of the integrated project team and ensure smooth coordination between the phases and between the concept and integrated project teams. As in the previous phase, the decision to move to the next phase depends on the necessary resources and coherence with the company's short term planning and long term strategies.

According to the illustrated above stage-gated process of development (see Figure 3.2.), the exploration in the innovation unit finishes with the end of the conceptualization phase. Then the project should be transferred to the divisional business lines for further phases of the development and industrialization. The phases of development and commercialization refer to the refinement of the design of already proven and technically available technology. The objectives of these phases are first, to make prototypes and necessary tests in the environment and second, to improve operational performance. This type of activity should take place in the R&D departments of the divisional business lines, whereas for the innovation unit, the exploratory activity, the innovation process and project itself should be considered as the closed ones. There is an accepted belief that exploration stops at this stage and exploitation starts in divisional business lines.

3.1.3. “To exploit...” – the job of the divisional business lines

During the development process, exploitation starts from the actual creation and prototyping of the future technological innovation. This process occurs at the divisional business lines. The goal of the *development phase* is to build, test and refine a prototype in a controlled environment. The purpose of the activity is to verify the design and functionality of the future technological solution.

To perform this activity, the integrated team may invite additional specialists such as engineers, geoscientists, specialists in marketing, production and operation, IP experts. At this stage, the project team is responsible for building a prototype of the whole technical system and its components. The deliverables of the previous phases, such as analysis, simulation and testing reports can be used to make the necessary tests and to prove the feasibility of a new technology. At the same time, the team should develop a plan and prepare reports with technological specifications that will be used at the next phase of the development process.

The deliverable of this phase is a working version of the future technology. According to the internal documentation on the development of technological innovations, the working version of the solution should fulfill at least 80% of the functional specifications and could be used in a controlled environment. This means, that a version of a prototype should be available at the pre-final stage and at the same time, it should pass the experiments in the field. Also, the project team delivers the design, integration and validation reports, IP protection plans and time to market study.

When the working prototype and related reports are available, the project can move to the production of the standardized market version of the solution. The decision to move the project to the next phase could be taken by the leading committee of the innovation unit (for cross-divisional projects) and by divisional R&D management (for divisional projects). The decision to move to the next phase must be approved by the executives of the company. As in previous phases, similar criteria of the coherence and alignment with the short term and long term objectives would be applied to make go/no-go project decisions.

If the project is approved and validated, it moves to the final phase of the development process. The aim of the *industrialization phase* is to deliver the final solution that will be ready for the market. Divisional business lines should commercialize (or internally consume) a solution from the innovation unit with a purpose to continue the usage and exploitation of a technology in their business operations. This stage requires additional clarification. In fact, during the development process, the innovation unit stops exploration when the project team is able to demonstrate technical feasibility of an innovation (end of conceptualization phase).

As a rule, this process takes place from TRL 1 till TRL 4. In some projects and depending on the complexity of a new technology, the innovation unit continues exploration and allocation of resources for development till the TRL 4. This process allows a unit to build a prototype and to ensure that divisional business lines will exploit and utilize new technology. It can also be seen as an approach to guarantee that the R&D departments of the exploitative structures will not reject a new project.

After a new technology is internally acquired, divisional business line(s) can test a new solution and if necessary, make optimization and technical refinement. The R&D departments of the business lines are also responsible for manufacturing and marketing plans. Apart from the operational and industrial specifications, the integrated project team should forecast the short term and medium term returns from operations define a pricing policy and finalize the remaining IP issues. These diverse plans are necessary to ensure the production capacities for a new technology and its entry on the market.

At this phase, the divisional business lines are the owners of a project. Based on the deployment ability and market attractiveness, the divisional management takes the decision to transfer a new solution to the operational department. After that, the operational team takes full responsibility for the production and exploitation of a new solution. The project then moves to the product portfolio and may need incremental improvements in the R&D departments of the divisional business lines.

Any radical change in the existing market technologies should start from the initiation phase and can take place in the innovation unit. In case of refinement or incremental improvement, the process should start from the change in the design and operational process optimization directly in the divisional business lines. This process can be considered as the development of an incremental technological improvement. After the description of exploration in the innovation unit and exploitation in the divisional business lines, we switch to the discussion on differentiation of labor and integration of activities.

3.1.4. Differentiation and integration of exploration and exploitation

To develop innovations, the technology-based service company relies on the stage-gated innovation process. As described previously, during this process, the explorative and exploitative structures perform different sets of activities and roles. Exploratory type of activity is dedicated to the innovation specialized unit, whereas the exploitative function is delegated to the divisional business lines. From the first glance, differentiation of roles and

division of labor allowed the company to explore new concepts at the innovation unit and at the same time to exploit technologies at the divisional business lines.

The development process was organized in the linear fashion as if there were no conflicts of interests and no emerging tensions between different structures and activities. In reality, this process was more often used as an approach to justify exploratory activity and to convince the company's management in the effectiveness, technical and commercial feasibility of the results from exploration.

Separation and emerging tensions

During the phases of the innovative process, there was an emerging tension between separate exploration and exploitation process. The divisional business lines were focused on the incremental type of improvement and their development process always started from the creation of the improved version of already existing technology. In the innovation process, it is describes as the development phase and covers the levels of TRL 5 – 6. At this stage, the R&D of any new technology brings the risks and levels of uncertainty to its minimum and guarantees technological and market success. Divisional management approved new projects only if the success from development activities was evident.

The development process in the innovation unit was completely different. The activity was more exploratory driven and research – oriented. The main goal was to decrease the high level of uncertainty by performing research and experimentation and to demonstrate the feasibility of a concept. To shows the potential success from any new technological innovation, the unit defined and prove the new concepts and sometimes created the first prototypes. This process of exploration of an innovation covered the TRL1 till TRL 3, and in some cases ended with TRL 4 by brining up the first prototype.

It turns out that there was an emerging tension between exploration and exploitation activities and structures. On the one hand, the innovation unit explored and delivered new technological concepts. On the other hand, the divisional business lines rejected to take over new projects for further exploitation in their R&D departments. There was a tension between the structures at the period of transition from exploration to exploitation and in between the interests of different structures (see Figure 3.3.). Further in our research we will describe 6 innovative projects, which illustrates these conflicts and shows the reasoning for rejecting the projects.

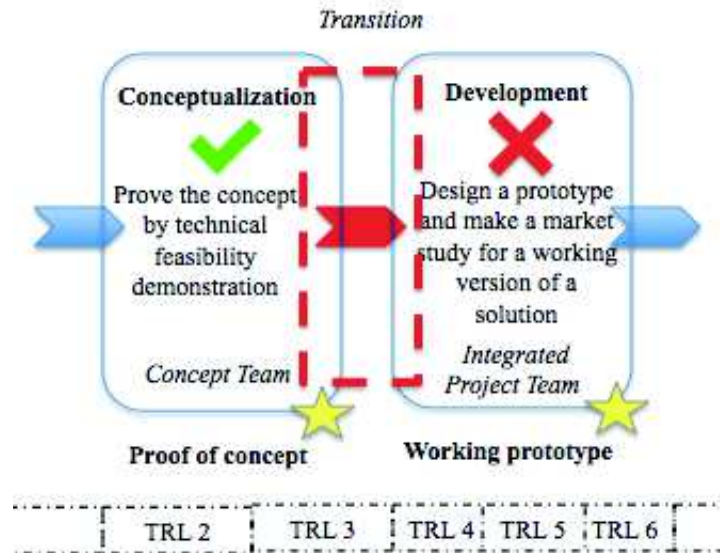


Figure 3.3. Emerging tensions in transition from exploration to exploitation

(Part of the stage-gated innovation process)

The divisional business lines rejected new projects coming from the unit because the approved concepts of new technologies were still uncertain and too risky to take them to the development and industrialization phases. Divisional management was not convinced in the technical and market feasibility of the innovations and proposed the unit to continue development activities till the moment when technology would be feasible enough (e.g. prototyping and tests at the TRL 4 – TRL 5).

As the number of the rejected projects increased, the innovation unit started to experience the decreased returns from exploration. The projects with new concepts were stopped after the conceptualization phase and did not moved to the exploitation at the divisional business lines. For most of them, the development process was postponed till the uncertain moment.

In spite of the fact that the innovation process aimed to link two activities, there was an increasing gap between the separate explorative and exploitative structures. After a period of time, the innovation unit turned into a cash-absorbing entity with low returns and became an internal competitor to the explorative structures for R&D resources, allocated from the top management of the company. There was a need to avoid complete isolation of the unit and improve the linkage with the exploitative structures.

Integration and linking mechanisms

To improve the relation with divisional business lines and to link exploration and exploitation at the corporate level, the management of the innovation unit took a decision to engage in a new type of activity and share the development process together with the business lines. The first mechanism that supposes to integrate the activities was the extension of the development process at the innovation unit. To bring an innovation to the desired feasibility stage, the unit agreed to fund and to continue the development, prototyping and in some cases testing of a new technology. At the process level, the unit covered not only the ideation and conceptualization phases, but also the development of models and making tests in the environment.

The second mechanism to link the structures was the new type of cross-divisional R&D projects. It was a co-creation type of engagement, when the innovation unit and divisional business lines supposed to work on development of a project together from the beginning of the innovation process. It was aimed to minimize the risks and to ensure that there is no longer conflict of interest between the structures and guarantee that technical and business priorities of the divisional business lines were taken into account by the innovation unit from the start of the projects.

The separation of activities in different structures allowed the company to explore and to exploit simultaneously. However, the tension between the activities and the conflict of interests made impossible the smooth coordination of activities during the transition period when a project moved from exploration to exploitation. The success from the implemented integrating mechanisms (extension of development process and cross-divisional projects) will be discovered and discussed in further sections.

So far, our research observed structural ambidexterity at the corporate level and identified a problem of inability to exploit the returns from exploration at the exploitative structures due to weak integration. In the next section we propose to observe the factual data on innovative projects and analyze the results both from separation and integration of exploration and exploitation at the corporate and project levels.

3.2. Relation between corporate and project levels

After describing the structural ambidexterity at the corporate level, the next step of our research is to analyze the projects from the explorative and exploitative organizational structure to understand the nature of activities in diverse entities. Also, this step will help us

to see whether the results from the structural ambidexterity identified at the corporate level, correspond to the actual data on projects from the unit and from the divisional business lines.

The overview of the projects is necessary to validate the assumptions received at the corporate level. Precisely, the goal is to ascertain whether the company is an organization with structural ambidexterity where the innovation specialized unit explores by developing radical innovations and, simultaneously, exploits by doing incremental innovation in the divisional business lines.

To understand the nature of different activities in the innovation unit and in business lines this study reviews a consolidated portfolio of projects (see Table 3.1.), created particularly for our research. The data were collected with the help of the management of the innovation unit and leaders of two divisional business lines. Members were asked to identify and select projects and technological solutions from their portfolios that fulfill two criteria: 1) correspond to the radical or incremental types of corporate innovation; 2) provide complex and/or unusual product development experience compare to their routine practices.

Table 3.1. Consolidated project portfolio*, 2013

Project Number	Project Location	Project Status	Type of Innovation	Involvement in NPD	Degree of Innovativeness	NPD Phase	Time (month)	Resources allocated	Status
1	Innov.Spec. Unit	active	radical	innovation unit	high	development	64	26 mil	data absent
2	Innov.Spec. Unit	closed	radical	cross-divisional	low	development	26	70K	stopped
3	Innov.Spec. Unit	closed	radical	cross-divisional	middle	commercialization	24	1 mil	on the market
4	Innov.Spec. Unit	closed	radical	innovation unit	high	development	80	25 mil	prototype manufacturing
5	Innov.Spec. Unit	closed	radical	cross-divisional	high	conceptualization	12	5K	additional reseach needed
6	Innov.Spec. Unit	active	radical	cross-divisional	high	development	18	280K	additional tests needed
7	Bus. Line Onshore	closed	incremental	divisional	low	development	9	180K	sold for further developm.
8	Bus. Line Onshore	active	radical	divisional	middle	development	13	120K	in process of testing
9	Bus.Line Onshore	active	incremental	divisional	low	commercialization	13	200K	on the market
10	Bus. Line Onshore	closed	incremental	divisional	low	commercialization	20	200K	on the market
11	Bus. Line Onshore	active	radical	divisional	middle	commercialization	32	400K	on the market
12	Bus. Line Onshore	active	incremental	divisional	low	commercialization	13	200K	on the market, improved
13	Bus. Line Offshore	active	incremental	divisional	low	data absent			data absent
14	Bus. Line Offshore	active	incremental	divisional	middle	development	64	500K	data absent
15	Bus. Line Offshore	active	incremental	cross-divisional	middle	commercialization	22	250K	on the market, improved
16	Bus. Line Offshore	active	incremental	divisional	low	commercialization	50	350K	on the market, improved

The selected solutions represent projects in different phases of the development process. Each project refers to the incremental or radical type of innovation and identifies the location of its development process within the divisional business lines or in the innovation specialized unit. The selected radical and incremental projects were analyzed according to the

* The data on the time spent and resources allocated are represented in approximate numbers due to 1) a lack of accuracy in the available information on the project management and 2) corporate confidentiality issues

type of innovation and degree of novelty, localization in diverse structures, phase of development, involvement and co-creation in partnerships, time horizon and budget allocated.

The data related to product development of the selected projects were collected using the organizational databases and tools on the project management. Additional information was received during the discussion with members of project teams, who participated in the development process and who initiated a project.

During our research, the consolidated project portfolio had two functions. First, it served as material for the current analysis in order to validate the results of the corporate level and to understand the interrelation between exploration and exploitation at corporate and project levels. Second, for the technology-based service company, this consolidated project portfolio was used as an approach to identify the measurable factors and metrics to assess the exploratory performance of the innovation unit. The study of these 16 different projects was aimed to develop key performance indicators (KPI) for the unit. These indicators represent a combination of factors used to measure the organizational value from the R&D activity in the explorative structure.

The detailed analysis of 16 projects provided the following information: the R&D in the innovation specialized unit has an exploratory nature. Indeed, the unit gives the priority to the development of radical innovations that require long and costly research and experimentation at the earlier phases of development process. In contrast, the R&D in the divisional business lines is focused on the exploitation and develops incremental innovations. Such projects are certain and require less funding for search and experimentation, rather than projects of radically new technologies. Divisional projects do not require long and consuming exploration, because the technology is already available in the market, but needs only minor changes and operational improvements.

The separate structures differ in terms of types of innovations and development processes. The innovation specialized unit works on solutions with a high degree of novelty. The projects in development can be characterized as complex, with high levels of uncertainty and degree of risk. The resources, e.g. timing and costs have higher indicators than projects in divisional business lines. The innovation unit develops radically new technologies that require several millions of budget expenditure and need several years for research and development. In some cases, to share the risks, costs and responsibilities the unit co-develops radical innovations in partnership with divisional business lines and external partners.

To understand the difference between exploration and exploitation structures and processes, we need to define and specify the essence of the innovative projects. *Radical projects* (N.1-N.6 in Table 3.1.) from the innovation specialized unit differ in terms of novelty

of the technological system and in terms of the development process. The projects include radically new component in the technological systems. The R&D of such projects requires longer search time and significant investments, in particular at the initial phases of the NPD process. Often, the project teams need to search for new knowledge, skills and experiment with alternatives. Such complex radical solutions need also a detailed description of the operational model, industrial specifications, risk analysis, detailed business plan, procurement and manufacturing plans.

In contrast to the innovation unit, the divisional business lines focus on the development of incremental innovations. The projects have middle and low degrees of technical novelty. It is aimed to create an improved version of the existing technology. Such projects also need fewer resources as time and funding for development. The budget for NPD can be measured by several hundred thousands and take on average 1,5 - 2 years of time till the market commercialization. Divisional business lines are the owners of the projects. They are responsible for allocation of resources and finding R&D teams that will work on incremental innovations.

Incremental projects (N.7 – N.16 in Table 3.1) from the offshore and onshore divisional business lines are less complex than projects from the innovation unit because their technological systems use existing technological components. The R&D in the business lines is aimed at the optimization of the existing systems and their structures. The initial phases of the NPD take less time and require moderate resources. In some cases, the research and experimentation phases are absent. Such incremental innovations have shorter durations of phases of the innovation process and shorter time frames to get to the market.

At the same time, the analysis of 16 incremental and radical projects from the innovation specialized unit and the onshore and offshore divisional business lines has a few limitations. One constraint is the number of the selected projects. 16 is not a statistically representative number to measure the impact and to evaluate the performance of the R&D from different entities. Another limitation is the lack of accuracy of the company's data on the project management and development process for selected projects. In more general terms, this might demonstrate that a company has a weak capability to track and display the data on innovation processes. It might also show a weak recognition of the successes and failures and a decreasing interest to learn from past experiences as well as to analyze and to improve various activities, practices and phases of the development process.

The overview of the consolidated project portfolio showed that the technology-based service company is an ambidextrous organization that creates radically new solutions and simultaneously develops incremental types of improvements. It also showed that the company

uses a structural approach to ambidexterity where exploration activity is allocated to the innovation specialized unit and the exploitation is organized in the divisional business lines. These are separated entities with different R&D focuses, targets and diverse NPD processes and types of projects.

Separation of activities allowed a company to achieve ambidexterity. But in parallel, the organization experienced weak linkage and suffered from a lack of integration between structures and activities engaged in exploration and exploitation. The stage-gated innovation process and cross divisional co-creative projects aimed to create the links between the structures and facilitate the transition of the innovation from exploration at the specialized unit to the exploitation at the business lines. But in reality, the process of creation of technological innovation is more complex than the process, described by the company's methodologies and documentations. In the next section we specify the differences between radical and incremental technological innovations and provides the detailed description of the creation and development of 6 innovative projects.

3.3. Ambidexterity at the project level: Radical and incremental innovation

The corporate level showed the relation between two different entities, based on differentiation and integration of structures. In particular, there is a weak linkage between the activities, identified in the period when in the product development process the innovation unit is performing research and experimentation activities, and then transfers the matured projects to the divisional business lines for improvement and commercialization of the technological innovation.

This section describes the ambidexterity in projects. Before moving to the analysis of projects, it is necessary to distinguish different types of innovations. Our research refers to the radical and incremental types of innovations, but these are only conditional definitions. It is necessary to explain the reasoning of choosing these terms and determine the meaning of radical and incremental technological innovations.

Radical and incremental technological innovations, what are they?

The projects from our research deal with the development process of technological innovations. In technology-intensive industries, innovations are the results of continued product improvements (Abernathy and Utterback, 1978; Burgelman et al., 2004; Christensen,

2000). In this context, innovations refer to a new type of technology, whereas the technology itself may consist of interrelated systems, components, activities, processes and etc.

C. Christensen defines **technology** as “a process, techniques or methodology represented by a product design, or in a manufacturing or service process, which transform inputs of labor, capital, information, material and energy into output of greater value” (2004, p. 210). Engineers, willing to create an innovation, can change either a component of a system or make changes in its architectural design. A *component* is a fundamental basis of the technology, whereas *architecture* refers to the design and the way the system is built.

The type of technology differs depending on the elements that were changed within the system. Architectural change is the creation of a new design of a system by re-combination of the existing components (Christensen., 2004). The contrary to the change in design is the change in the component. Christensen defines it as a modular innovation, that is a creation of a new component in the existing design of the system. In both types of change, one element is new, but incorporated into the old system.

Technological innovations are much more complex and how to differentiate them is not obvious. As a system, they can combine existing and new elements and still be considered as an innovation. They can also create a nested system with a different design and a different component. Diverse combinations of these changes would represent the type of technological innovation.

In the context of technological innovations, Christensen (2004, p. 211) differentiates radical innovation and incremental change and defines them as follows: “*Incremental change* refers to 1) improvement in component performance that builds upon the established technological concept or 2) refinement in the system design that involves no significant change in the technical relationships among components. *Radical innovation* involves both a new architecture and a new fundamental technological approach at the component level”

In our research, the terms of radical and incremental innovations refer to the degree of novelty of a solution. A **project** (or a solution) is a system that includes hardware products, software services or a combination of hardware and software products and services. As a system, each technological project consists of the combination of three main elements:

1. Component – the basis of a technology;
2. Architectural design – configuration of technological system;
3. Operational model - processes and functions of a technology

For the technology-based service company, the typology of innovations has been defined by using the “existing – improved – new” metrics. The measurement was applied to each of these three technical elements to evaluate their complexity and performances. In other words, each project, from this study was decomposed according to its component, design and operational model and then, each of these elements were evaluated according to the proposed metrics. The degree of novelty (high, medium, low) was identified based on the comparison between the values of different solutions.

Innovations that demonstrated the highest degree of novelty in terms of combination of components, architectural design and operational model were named radical innovation. Innovations that showed the medium and/or lower degree of novelty in terms of combination of a components, architectural design and operational model were associated with incremental innovations. To extend the definitions provided in Chapter 2 and to increase their accuracy and precision, our research determine technological innovations as the following:

- **Radical innovation** – a new technological project with a higher degree of novelty of a system, where a system is defined as a combination of a technological components, architectural design and operational model;
- **Incremental innovation** – an improved technological project with a medium or lower degree of novelty of a system, where a system is a combination of technological components, architectural design and operational model

This typology is used at the project level to analyze the company’s technological innovation. In contrast to the corporate level, which observes the explorative and exploitative R&D structures, the analysis at the project level focuses on the different types of innovations in the organizational structure responsible for exploration. The unit of analysis is the innovation specialized unit, as well as its activities and processes.

The project level includes the in-depth study of 3 radical and 3 incremental innovations from the innovation unit. The aim of this level is to answer the questions of how the firm develops innovations and how the explorative unit organizes different activities and processes during the development process. This level studies all phases of the stage-gated innovation process for 6 projects. It starts from exploration of new concepts at the innovation specialized unit and finishes with exploitation at the divisional business lines. This level covers the analysis of both explorative and exploitative R&D structures and exploration and exploitation activities during the creation process.

The data was collected by means of interviews with employees, who initiated and participated in the development process. These individuals belonged to different organizational structures and joined the project at different stages of project maturity. Among these individuals were the initiators and project leaders, developers and R&D specialists, members of marketing and sales, technical support and operational departments. Some of them were involved in more than one project and developed more than one technological innovation. Further, we present the stories of creation of 6 innovative projects from the company.

3.3.1. Project 1. “Successful technological innovation and market failure”

Project 1 - is an incrementally improved innovation that proposes a high-resolution system for continuous monitoring of the reservoir behavior in the onshore environment. This new system is used to capture the evolution of the reservoir during the offshore acquisition process.

During the onshore seismic acquisition, the standard seismic process requires the relocation of the tools and machinery equipment to the examined field. Using specific tools, such as source and sensors, the operational team records the data about the state of the reservoir. After that, a team makes the analysis of the seismic data. A new system enables a permanent monitoring. This means, the new technology is able to record continually the image of the field and the evolution of the reservoir. Instead of using the image of the reservoir in the acquisition, a new system allows the creation of a video about the behavior of the environment.

The search of this new technology was initiated in 2002. It started from a collaborative project with a research institute and a client that was a large petroleum company. Initially, the idea of this innovation was to develop a technology that makes it possible not only to record data about the field, but also to monitor the behavior of this field.

For oil exploitation and production processes, it is important to identify the reservoirs and to monitor them. Such an approach on the monitoring of the properties of the reservoirs with natural resources was new to the company. In fact, it was the experimentation with a new opportunity and exploration of a new business domain. Historically, the firm used to have a focus on the exploration process of natural resources. A new technology targeted both exploration and production process. For the company, it was a new business opportunity and a new market.

The project started from the development of a specific hardware (sources and sensors) and software in order to have completely autonomous systems. Explaining the main concept of a new technology, the head of the onshore business line describes:

“Normally, a seismic crew has 500 people including workers and engineers to record seismic data and to re-locate equipment and machines. The idea of this new technology is that once you have installed the equipment, you can connect and control it over the Internet. Then, there is no need to have people in the field each day to get the necessary indicators. We use a lot of software to make this process work and to ensure that everything is mastered and connected at each stage of the process”

Onshore business line was in the origin of this new technology. Although, from a technical point of view it is a complex solution, for the company this project is an incremental innovation. The same results as in the new technology can be achieved by repeating several surveys and by making comparison between them, to search for differences between the images. In the onshore environment, the first 10-15 meter deep layer absorbs waves and therefore the results of the different surveys can change significantly. Sometimes they have distortions in the measurements and the only solution to get the accurate information is to proceed below this zone. Before the arrival of this technology, the repeated surveys were the only solution to get the same data on the reservoir, and not only about the state of the surface. The old process was not only complex, but also costly in operations.

To solve this problem, the research team from the onshore business line started to work with two partners. One of them was a research institution. The innovation unit had already the established collaborations and several common projects with the institution. Another partnership was established with a large French energy company. The client company provided the reservoirs that were used by the protect team to perform research and experimentation activities for the new technology.

During this project, the company and its two partners were involved in the intensive research and experimentation. Initially, this project was located at the R&D of the onshore divisional business line, but it was not a pure divisional project. It was different from the regular development practices. Because of the complexity and amount of capabilities needed for R&D, the top management decided to move the project to the innovation unit. Hence, from being purely divisional, the project turned into a cross-divisional project, while the development process required involvement of partners with a purpose to share development functions and resources.

At the innovation specialized unit, the project was able to receive the necessary skills, competences and resources to cover the research and experimentation costs. This technology was developed in collaboration, whereas resources and responsibilities were shared between the partners. To cover exploration, a big portion of the investments came from the management of the onshore divisional business line. Some of the costs were also shared with external partners – the research institution and the energy company.

The top management of the company supported the development of this project. Part of the allocated funding from the executives was used to cover the R&D costs. To create this innovation, the company also received governmental grant. For 6-7 years, the French government subsidized the development phases for this project. The resources from the state were used to cover some intensive tests, but not the actual commercial project.

This technology is the example of complex co-development project. To develop hardware and software technology, the company used subcontractors, small, specialized firms research institute, client company and its own divisional business line. The development process of this technology produced 10 patents. The company owns the property right for the hardware, and some of the software patents are shared with the two external partners.

However, for the company this technology is not a radical innovation, because the core of this technology comes from internal structures. The onshore business line uses the existing recording system and applies it in the new seismic process. The disruptive element in this innovation is the concept itself. The fact that the technology is able to record continually opens up new opportunities for the onshore seismic surveys. The continued recording technology was initiated in 2006. In 2014 the innovation was ready to be integrated into operations in seismic fields by using the new experience and new technological elements for the old processes.

Exploration of a new business opportunity and the development of this complex, but still an incremental innovation was costly for the company. Only in 2008 did the firm start to get some commercial successes from implementation of the new technology. But the real success came only in 2014, when the technology was used to perform market operations. Evaluating the project performance, the head of the onshore business lines says:

“It took us 12 years to develop this technology and now I can relatively say that this project is a success. But still it is costly. It is a technical success, but costs are not at the level our clients cannot afford. We are now working on cost optimization”

The troubles arrived after the end of the exploration phase: when the research team had finished its search for a new technology and when it was time to move to the development and exploitation at the business lines. At that time, the technology was mature and it was a time to transfer it to the final phases of development and to commercialize it on the market. The development team realized that the concept of the new technology was very attractive, but the costs to perform operations were too high. From the technological standpoint it is a successful technology. However, the organization experience difficulties to make it attractive to the market. The reason is that the market price of the technology is higher than customers can pay for it.

In this project, the technological success was due to the talented R&D people, such as researchers, engineers and developers. The marketing failure happened because of the absence of the proper marketing approach and structured project management at the initial stages of the development. The senior marketing and sales manager, who joined the project only at the development phase, explains:

“I joined the project during the business development phase, in late 2011. I said - we should stop it. We could not sell it. Why? First, because this project was not structured and managed properly as we do it in technological project management. Second, because researchers, who initiated and managed this project, haven’t done any marketing studies. They are good researchers and developers, but they have no idea about the costs of their idea for the market”

To overcome the marketing problem and to optimize costs and define a price policy, this successful technology required additional R&D activities and expenditures. In 2014, the firm was selling the technology only to one big client – a global petroleum company that is able to pay for such a pioneering service. A member of the marketing team described that to provide it to other clients, people in the divisional R&D department should find a way to cut the costs by 4 from the current market price. Another constraint is the existing functionality. Till now, it is only used in one area in Canada. The functionality is limited and serves only for locations with heavy oil. The senior marketing and sales manager argues:

“If we don’t provide what our client wants, there will be no way to recover the costs that we had spent for the R&D of this project during last 10 years. We were 20 people in the team, working daily on this project. If we don’t find the way to optimize the project, this would mean we wasted thousands from our budget each day”

This incremental innovation is the example of the R&D activity that produced a successful technology, but failed to succeed on the market because of the high price. Unstructured technology project management and absence of marketing specialists at the early phases of NPD turned the technology into a costly product, inaccessible for most of the clients. For the company, the creation of this innovation took more than 12 years of R&D activity. And still, it is not finished yet. Additional resources are necessary to optimize the costs of the technology and make it accessible not only to global petroleum companies, but also to smaller market players. The good news is that this project initiated the development of another technology. A radical innovation, that emerged as a response to the advancement in the seismic technology. The creation process of this technology discussed below.

Resume on **PROJECT 1**: Incremental innovation

- 2002, initiated in the divisional business line and moved to the innovation unit as a complex, costly, research-intensive project;
- Represent a successful improvement of the existing technology with radically new concept;
- Co-developed in partnership with a research institution and a large client company;
- Resources allocated by the onshore business line, innovation unit and top management;
- Part of the research activity sponsored by the client and a governmental organization;
- Produced 10 patents;
- Business failure due to high market price
- 2014, project needs additional R&D to optimize operational performance on the affordable market price

3.3.2. Project 2. “The right idea for the future”

Project 2 – is a customized system that has a representation of an application for visualization, organization and interaction with various data on the seismic monitoring and accessible for users at platforms of different digital devices such as computers, tablets and smartphones.

The idea to develop this product emerged as a response to the problem in the repeated seismic surveys (see Project 1). In general, the repeated seismic surveys consist of the chain of different activities. First, the seismic team processes the surveys in the field during several months or years. Then, the results of the surveys are transferred to the company’s office for

further analysis and storage. Finally, at the office, the team processes again the data, generates new sets of information and transfers the results to the client company. The client uses the final results of the surveys to optimize the decision-making on the oil and gas production process.

The old technology provided different sets of data on the reservoir behavior in the separated blocks. This means that a user had access to different kinds of information e.g. temperature, pressure, injection curves etc. through different sections of the surveys. The new system suggests to generate the complete data set in one system and to personalize and to organize the information according to the needs of the client. It also simplifies the complex algorithm for managing the data process and provides a user with a simplified and customized solution, accessible by the range of digital platforms.

The idea to develop this technology came from an employee who worked at the R&D department of the offshore divisional business line. To solve the problem of complexity and data management, a software developer created and suggested a system that could simplify the existing process to his management. Talking about this idea, the initiator explains:

“I wanted to create something simple for users that run our complex process. I wanted to find the way to organize and simplify the information we generate for our clients. We had a huge amount of data to make decisions, but we didn’t have processes to make it simple. With new system we can make precise decisions faster and better”

Driven by an innovative idea, the initiator performed preliminary research in his department. As he was already working on solving diverse IT issues, he did not require any additional resources to work on the creation of a new program at the early beginning. However, when the idea was defined he started to look for people who could join his team and for resources to develop and refine the new system. He talked to his senior manager in the divisional business line about starting a new project. He also shared his concept with people from other business lines, as this technology could be applied to process the data received from other operational fields.

After several meetings, he got the interest from other divisional business lines and the approval of his idea, but not the resources to start the development of a new project. In the interview, he clarified the influence of the conservative culture of the company and the industry and how hard it was to convince people to accept a completely new technology:

“During the meeting with people from different business lines, they said to me it was a fantastic idea and we needed to move in this direction. But when I asked senior managers in divisions for resources to start my project, they told me this development was not critical and not urgent for the company. It is true that we have old processes that still work. But we do not want to change, even if some of them are becoming painful. We are a very conservative industry”

The idea to create a new system was an interesting one for people in divisional R&D. However, as this project was not critical for the company, managers in the divisions were not ready to allocate resources to start the development process. The initiator was also aware about the existence of the innovation unit that was responsible for exploration and maturation of the innovative ideas and new business opportunities. He decided to propose his idea to the team of the unit and negotiate on the initiation of the development inside the unit. The technology development manager of the innovation unit describes his first experience from meeting the initiator and learning about his innovation:

“He knocked in our office and said he had a good project to initiate. He said: Why don't we give touch pads to our clients instead of uploading and comparing huge files every day? Why don't we make the information accessible to the user everywhere and through all devices? That was his initial idea”

After learning about this idea, the management of the innovation unit took a decision to start exploration and perform necessary research. During the first meeting with the head of the innovation specialized unit, the software developer presented his idea and the development plan.

To create a new system, he needed resources and people, who could work with him on the project. The management of the innovation unit saw the potential in this project. However, they proposed the initiator to review his initial concept and to think about a technology that could be used not only by a specific divisional business lines, but also applied in other business lines. In other words, instead of creating a product only for the onshore division, the management of the innovation unit proposed to co-develop in the cross-divisional project and to create together a technology, which could be used by the whole company.

The first step of the innovation unit was exploration and gaining knowledge about the new field. It started with the brainstorming session, organized between the R&D professionals from different business lines. The goal was to share the new idea with employees from the

different divisions and to collect their feedback. The technology manager of the innovation unit describes this event:

“We brought people from everywhere and proposed to think about this idea from the start. We wanted to hear about challenges, constraints, and drivers... and not about technologies. We did that and came with the mind maps”

When the cross-divisional challenges and the future functionality of the system were identified, the project moved to the next step, that was a technical demonstration of the concept. To work on the technical specifications, the team of the innovation unit selected and invited people from different business lines. At that phase, the development was organized as a co-creation process. The main idea was to put common efforts to develop a technology that could be used by several business lines. The technology development manager describes the organization of this project:

“To develop this project, we searched for people from the whole company. We knew that one of our business lines has knowledge, tools and architectures in the interactive part. Another business line knows how to deal with a big amount of data. The third – knows how the whole system can operate. We identified the challenges, we had the constraints and decided to design together the architecture that will answer this need”

After two months of work, the project team was able to demonstrate the technical feasibility of the product. Then it was a time to create a first prototype. The problem emerged during the prototyping phase. In fact, the members of the project team, who wanted to create the new system, were busy with their ongoing divisional projects. The members of the project team were not able to share the time and be involved in the routine projects and at the same time in the creation of the new system. Moreover, it was hardly possible that a divisional manager would allow the employees to spend a part of their time working on a more creative project. Divisional business line did not see any interest to invest in development of this project, even if it was only the human resources.

The solution was found only because of the support from the head of the innovation unit, who was persuasive in continuing the project. The innovation unit selected the most motivated individuals willing to work on the project and asked their divisional managers for 20% of their working time, which would be spent on the new project. The head of the innovation unit was able to convince the management of the business lines to assign their

R&D employees to work on the development of a new system. His main argument was the strategic importance of the project and innovativeness of the new technological system.

Nevertheless, not all the divisional managers appreciated this initiative. Some of them were not ready to allow divisional R&D employees to work on the project of the innovation unit. A technology manager from the innovation unit explains:

“Not all divisional bosses were happy that we asked for employees who would work 20% of their time on the new project. We needed to demonstrate that this would bring value. We are rather conservative in this company. Some managers are looking only for the short-term deliverables. It is true, we have to deliver, but we should also think about the future. We have to change this conservative culture”

For the innovation unit, this project was creative and unusual in terms of organization of the process. It did not fit in the routine processes and standard project management practices. Normally, the innovation unit has its own team that works on the project development. In the case of this project, the team members came from different divisional business lines. They had different profiles, but what they had in common, was the interest and motivation to create a new system together.

In terms of supervision, the unit decided to apply the action-related approach or the “pushy” management strategy. It had the following organization: the project team had the freedom to use the time for research and experimentation with new concepts, but at the same time, they needed to demonstrate the deliverables. For the unit and for the project team, that was a win – win approach. On the one side, the project team was able to play and experiment using modern devices. On the other hand, the management of the unit was able to ensure the results and tangible deliverables. A technology manager, who was responsible for the project, describes the original and creative approach they used to develop the innovation:

“For this project, we used a new approach to organize the work. We selected the most motivated people and created a very good team. We let them think about the best way to do it, but we also asked them to deliver results. The motivation was not the money. Those guys wanted to make it happen because it was absolutely a new thing. For me, as for their supervisor, it was also very different from what I used to do”

To develop a new system and to apply it to digital devices, the team needed not only skills and competences in information technologies, but also financial resources and

equipment. The innovation unit decided to provide the team with all necessary equipment. Another goal was to ensure that the leaders and experts of any field would be accessible for communication, exchange and knowledge creation with members of the project team. A technology development manager explains:

“If you want people to succeed, you need to give them the necessary means. We asked them what did they need and we bought all these cool stuff for them. They were able to get together, play and organize meetings whenever they wanted. I put the leaders together and asked them to work on this project. And they did it. After 3 months they came with a small prototype and everything worked just good”

Later, the idea to create a new system that would optimize the operational time for data processing was known in all divisions of the company. Divisional business lines were interested to commercialize this project and to use the new technology in their operations. In the end of the conceptualization phase, the team showed the prototype of the new system. They proved that this technology could be used in all divisional business lines. At the organizational level, the work of the project team was also recognized and rewarded with internal innovation award for the innovative technology.

For the company, this project was a successful one. The team demonstrated the feasibility of the innovative system and a new approach to organize and to perform product development. During this project, the management practices were unusual and original. This was a purely explorative project, with a high degree of research and experimentation. It was an individual idea and its creation and implementation was possible only because of the collective efforts. Discussing the returns, a technology development manager of the innovation unit argues:

“For sure, it was a success. We did not spend much of our budget. In this project, most of the people were working outside of their normal working hours. The innovation is the idea, the concept and the way we made it happen. It was an individual idea and an innovation created collectively in co-development. We need to ensure that this type of management and approach to development is recognized officially in our company”.

For this project the ideation and conceptualization phases took 1,5 years. After the intense collaboration between the project initiator (the software developer from the divisional business line) and the team from the innovation unit, the new system was ready for the

industrialization phase. After 6 months of intense work in the innovation unit, the project team was able to demonstrate the feasibility of the concept and to ensure future business opportunities.

In 2014 the project was still in development and in need of resources to be finalized. The proof of technical feasibility is the last phase where the innovation unit is able to take decisions and allocate resources for development. The project passed this phase. After that phase, the innovation should be commercialized and continued in divisional business lines. They should take decisions and find resources for the further development and exploitation of a new system in operations.

For the innovation unit this project was finished. With successful deliverables as the concept feasibility and the first prototype, it was time to move the project to the divisional business lines for further development and exploitation. The new system is now at the onshore divisional business lines. The idea initiator attended meetings with managers of different levels and still searched for the divisional resources to commercialize his innovation.

Resume on the **PROJECT 2: Radical innovation**

- 2012, breakthrough idea, emerged as an individual innovation at the divisional business line, but rejected as not a critical project
- Transferred to the innovation unit;
- Re-thinking of the initial concept and proposing of a technology for multiple business lines;
- Project supported and sponsored by the innovation unit;
- Original approach to development of a project: driven by initiator, motivated team members came from different divisions, partial involvement of project team (only 20% of the working time);
- Received the internal innovation award for an innovative technology;
- Concept is proven and transferred to the business lines for further development;
- 2014, initiator is searching for resources to commercialize the system in a business line

3.3.3. Project 3. “Technology that brings radical change”

Project 3 - is a new vibration-based technology for offshore seismic acquisition surveys.

The idea of this technology emerged as a response to technological obsolescence. For the company it was a new market opportunity. Initially, the project emerged as an individual innovation. The initiator was a company’s champion, who also holds the position of chief

engineer in the innovation specialized unit. In the interview, he described how he came up with a radically new idea:

“When I became a part of the innovation unit, I was able to talk transversally to all divisions. I started to hear complains about existing air gun technology from the people in the offshore divisions. I looked at the problem and made a gap analysis. There was no innovation, no differentiation; everybody was offering the same thing. On the one hand, the innovation in this field has stopped. On the other hand, people said there was a need for a new technology. I realized that it was an opportunity to do something differently”

The need for a radically new technology was justified by a couple of reasons. First, and the main one, was the obsolescence of the existing technology used in seismic surveys in the offshore. The old air gun technology had become less efficient. At that time, some components (such as source, streamers, etc.) of the whole seismic system had already achieved a significant advancement. As a result, the old technology in a new system faced several technical problems. In particular, it was not stable, no longer reliable and had difficulties of synchronization.

The second reason in favor of a new technology was the environmental footprint. The old technology was not secure for the marine species, especially for the dolphins. During operations, there was a chance that animals would be harmed by specific acoustic frequencies, produced by the air guns. The clients had also expressed the demand for a new technology. Petroleum companies started to search for more environmentally friendly solutions to perform marine oilfield exploration processes.

After identifying the new opportunity to fill the market gap, the initiator started with exploration of knowledge in a new domain. The ideation on a new technology took place at the innovation unit. In one of the interviews, the project manager from the innovation unit described the re-initiation of the project:

“The idea of this technology has been around for 40 years. Our competitors have tried to do it, but nobody succeeded. We thought it could be our future technology. We started exploration in a small team of 1-2 people to expand the knowledge in a new for us domain”

The project was initiated in late 2008 in the innovation specialized unit. New technology supposed to perform the surveys and operations for the offshore business line. Taking into account the fact that the future user of the technology would be the marine

business line, the management of the innovation unit proposed its management to co-create new technology. The aim of the unit was to share resources and responsibilities and to co-develop a new technology not only for marine sector, but also for the rest of the company.

After receiving the proposal from the innovation unit, the management of the offshore divisional business line decided not to participate in the uncertain exploration, but to postpone the decision till the moment when the unit would prove the feasibility of a new technology. The divisional management proposed to the unit that they explored the technology first, and later transferred to a business line for further exploitation. The senior engineering manager from the innovation unit explained:

“To create this technology, we suggested the offshore divisional business line to share the resources. But we had a strong message from the head of their R&D - “This is perfect for you!” They said they would be happy to take it over, if it would be a successful project. But they were not ready to participate in the initial research and share the risky part. Their job is to take credits and make benefits. Our job is to do the risk. In business lines, they have to make money”

After refusal, the innovation unit decided to start a project using its own resources. In the beginning, there were only two people working on the project, including an initiator and one engineer. At the earlier initiation phases, the unit had invited several sub-contractors to work on the research part of the project. It also worked in collaboration with experts from the R&D of the offshore business line. During this phase, with the major focus on research and experimentation, the innovation unit allocated approximately 1,8 million euro of the budget to the project. In 2010 the team demonstrated the concept of the new technology.

For the innovation specialized unit it was the first project. The reason is that the innovation unit was officially created in 2009. Before, there was nothing central; there was no department empowered and responsible for the innovation in the company. As this project was complex and needed a non-typical approach to development, the management decided to place the development process in the specific unit that would work on the innovation. We will review the creation and maturation of the innovation unit further in our research.

For the unit and for the company, this project was a purely explorative one. The initiation and the conceptualization phases of the NPD were based on research, experimentation, acquiring new knowledge and skills to build an innovation. In the initiation phase, the project team explored new areas of physics, they were searching how to validate and qualify, measure the things and how to design the models. Before passing to the next

phase, they did the feasibility studies. The team needed to validate the model and predict its performance. They created almost a full-scale scientific prototype and built new knowledge on that. This model allowed the team to make the complete check of the technology and to validate theory and newly acquired competences.

The conceptualization phase was aimed to transfer the scientific lab knowledge to the first demonstration of the concept and to the future product. The goal was to move the project from the TRL 3 to the TRL 6. In the end of the phase, the team produced two different prototypes that were aimed to fulfill different needs of seismic surveys. A senior technology manager of the innovation unit described:

“In this project we were learning how to do it, we were putting in place the teams and development partners. We were building the skill itself and building teams with more and more people, accumulating the knowledge and evolving a concept of the global system that would become our new solution”

It should be kept in mind that the idea of this technology was not new to the industry. However, there were several reasons why the company perceived this technology as radical innovation. The new technology was designed not to disrupt the operational model, but to fit into the existing one. This technology could be harmonized and combined with any existing operational model to maximize the market attractiveness. It was a compatible technology and could be combined with diverse technological models and perform operations in various environments. Another function of this solution was to address the limitation of the existing air gun technology, including the environmental effect. It also served as a new approach to increase productivity and to optimize the speed of the seismic surveys and to eliminate the downtime.

In fact, during many years, the idea of this innovation existed in the industry. The breakthrough element for the company was the technological capacity to produce the power. The senior engineering manager of the offshore divisional business line explained:

“The value of the new technology is the capacity to push more power. The existing technologies are limited in power compared to what we need. The new system will be more powerful and enable deeper penetration. This is a real technological progress. If it fails once it does not mean that it won't work. Sometimes ideas are hard to implement, but people, somehow have intuition that one day it will work”

Steadily, the client companies started to show the interest in the emerging new technology, as there was no similar system available on the market. However, the constraint was the price for the operations. Before engaging with the client companies in co-creation of the new technology, the project team needed to assure the feasibility of the technology and its operational performance at the affordable market price. The project manager explained that the reason why did the clients wanted to assess the value of the new technology at the early phases of its creation was the following:

“We need to ensure that our big clients want to use this new technology. Indeed, they want it, but they are not ready to pay for it. They know, that 40 years ago the attempt to develop this technology wasn’t successful. Today, they want to ensure that they will get the value out of it. To move forward in the development, we need to make sure that our big clients are interested in this technology”

For this project, the team succeeded in engaging one of the largest client companies. In 2013, the company had signed an agreement for sponsorship and attracted a client to the design of the operational model. The senior engineering manager described this initiative as “absolutely one of the best strategies to move forward in development, especially in TRL 5 and TRL 6”. Gradually, a few divisional business lines started to participate in the development process. The project team worked with a group from the processing division to explore the electronic aspects of the future technology.

In the technology-based service company, the business lines are highly specialized entities. They have skills and competences in particular fields of activity (for more details see Chapter 1). Such cross-divisional cooperation in NPD creates a beneficial situation. On the one hand, the innovation unit can exploit skills and competences and apply them to the creation process of new technologies. On the other hand, business lines can assure exploitation of a new technology in their departments. They can learn about it, immediately provide the feedback, improve and refine the system before the actual commercialization phase, not after the technology is delivered, but in parallel to exploration of the technology.

By and large, the process of creation of this project had an exploratory nature. It started from the problem search, idea sensing and concept definition. The project team was building new knowledge, experimenting with possible concepts and designing all possible models for the future system. At the same time, this project had a degree of exploitation, when the project team needed to check the feasibility, build a prototype and ensure the operational mode of the system. That was an example of a project, where the exploration

activity was simultaneously done with exploitation. Discussing the mix of different activities during the development process, the project manager of the innovation unit said:

“We can assume, that at the beginning of the project we played, we were experimenting with ideas and concepts. But when you put millions of dollars on the table to create a new technology, it is no longer a game. It is an engineering project, where you have to build something. Of course, you don’t know if that it will bring you back the money in the future. You expect it, but you are not sure about it. This is the uncertainty. But when you invest money, you can not just play, you have to deliver”

The innovation unit proved the concept of the new technology. It designed two prototypes and showed its technical feasibility. In 2014, the project was ready to be moved to the divisional business line for further development and commercialization phases, as well as for exploitation in the operational department. Although the divisional management started to show interest in this project, they were not ready yet to accept and sponsor the development of this technology. The senior engineering manager of the innovation unit and the initiator, explained why:

“The divisional business lines still think it is too early, too immature to take over this project and continue its development. Frankly speaking, they do not have the perfect skills for that. This is a heavy engineering project. In the business line they do not do product development. And for this project, you really need people who have experience in complex product development. We have it in the innovation unit”

Development of this technology is still a long term strategic project. Compared with the old technology, the new system brings advantages in terms of speed, repeatability, and precision. The new technology also optimizes the costs of the seismic surveys, but it would be hardly possible to make it as cheap as the old air gun technology. To bring the technology to the market, the company will probably spend 10 more years. The project will need millions of resources to finalize the development of the technology. Nevertheless, for a company it is a successful project. The development started in 2008, and the project already passed two critical milestones in 2011 and 2014 and the company envisions taking the next important step somewhere around 2020.

Resume on the **PROJECT 3**: Radical innovation

- 2008, individual innovation, identified by a market gap analysis due to technological obsolescence;
- Initiated and started at the innovation unit;
- Co-development proposed to the divisional business line, but refused as uncertain, high risk and purely research project;
- Research-intense: research and experimentation with new knowledge, new domain by the team of the innovation unit,
- Achieved the proof of technological feasibility and design of two prototypes;
- 2013, signed an agreement with a largest client company for to share the development costs of the operational model;
- 2014, project is ready to be transferred to divisional business lines for further development and exploitation (pending)

3.3.4. Project 4 “Radical technology at the right moment”

Project 4 - is the integrated technology that combines specific equipment, deep acquisition techniques and imaging technology. It is used for the acquisition and analysis of seismic data in the offshore environment.

The value of this technology is made by the unique position of the streamers and by the system that allows the streamers to reach the deepest position. Another advantage is the advanced data processing and a high quality of images. This technology provides high resolution of the data on reservoir characterization. High quality data decreases the uncertainty about the reservoir and helps to improve the important decisions on the production process of natural resources.

Originally, the idea of the new technology emerged in the company as a problem-solving approach. It was a response to the obsolescence of already existing technology. Because of the rapid development of the technologies in seismic acquisition, there was a need to improve the quality of the imaging that would help make precise decisions on the reservoir exploitation. To increase the quality of data, one of the options was to provide a deeper penetration of the streamers.

The idea of the new technology that enables deeper penetration of the streamers started at the innovation unit. A member of the unit, who was also known to be a company’s champion, searched for a solution that could combine two different activities in the marine field - seismic acquisition and data processing technologies. It was another new opportunity for the company with certain success. There was a need on the market and the demand from

clients. Moreover, competitors had already started to search for a new solution to meet the market needs.

Since he was looking for a new solution that would solve the problem of marine seismic acquisition, the initiator had shared his thoughts with a colleague, who was a senior scientist in one of the divisional business lines. At that time, the senior scientist was working on data processing technologies, whereas the marine seismic operations were not in the scope of his regular projects. Out of curiosity, he predicted that one day this problem of combination of marine seismic surveys and data processing activities would emerge. He explained the first discussion he had on the new technology with his colleague from the innovation unit:

“This project is on marine acquisition and processing solution. In normal conditions, these activities are outside of my role. I had some thoughts how in my business line, we could have done the acquisition, but it was not my main role. In fact, I had this problem in my sketches, but I did not go far to develop it because it was outside of my scope. Then, my colleague from the innovation unit came and said that we had this problem and needed to find a solution, because there was a threat coming from our competitor. I said that I had something that could possibly solve the problem. That’s how I joined the project”

Being curious about the problem and having an idea how to solve it, the senior scientist of a business line was invited to join the project team in the innovation unit. He became a co-developer and started to work closely with his colleague from the unit on the creation of the new technology.

The development of this technology was not time-consuming in comparison with the development process for other projects of the innovation unit. It happened mainly, because a match between the problem and the solution suggested by a senior scientist from a business line. The senior scientists explained:

“I wanted to link my solution to the problem of the innovation unit. So we jumped into the problem before having the missing links. Fortunately, we found them afterwards”

The project team was based at the innovation unit. The senior scientist and the senior engineer were appointed responsible for the project development. They spent 1,5 year to move from the main idea to the final solution, because the need was envisioned and identified beforehand. It took the team less than two years of time from starting the project till the

presentation of the final product at the international conference for companies in oilfield sector.

The creation process of this technology started from the proof of concept to show the future value. At that time, the project was located at the innovation unit for several reasons. First, it was a cross-divisional project and needed a combination of skills and competences from data processing and marine departments. Second, because the unit was able to sponsor the research part in the development of the new technology. Third, the unit had expertise and the experience of management of complex technological R&D projects. From the organizational point of view, the unit had an appropriate structure to support this type of exploratory project.

To explore new idea and to validate the concept, the project team needed to pass through critical steps. The primary goals were to perform acquisition, to process the data and to show factual results from the tests. The research started in a small team that consisted of a developer, a researcher, a tester and a senior scientist and a senior engineer. The project team, that had only 5 members, needed to build the model, to perform the test and to process the data for the first demonstration of the new technology.

The resources for research and experimentation were shared between the innovation unit and the offshore divisional business line. As the innovation unit was interested in the final product, they covered the major part of the expenses to develop the project. The unit sponsored the ideation and conceptualization phases. The senior scientist used the resources from his business line to perform the acquisition test. For the next phase on data processing, the project team requested the funding from the divisional business line, specialized in processing.

In this project, the remarkable feature was the relation between the innovation unit and the marine divisional R&D department, which now users of the new technology in operations. As described above, the business line did not participate in the conceptualization phase. They only provided the vessel to make the tests of the new technology in the real environment. At that stage of the project, the marine department was not convinced that the technology would have any success. Divisional managers were not ready to take the risk and cover the experimentation costs. The senior scientist explained the relation with the business line during the experimentation:

“The innovation unit requested the boat for the tests from the offshore business line. At that time, they suggested their option, but it was not a good boat, located in inappropriate for us area. They just wanted us to pay for the usage of their boat that was not demanded by

the market. To test the new technology we needed a specific boat in the particular area with specific deep water level. At that stage, our main goal was to convince them to sell us a good boat to make a test in good conditions. It was difficult for us, because they were not interested in this project”

After successful tests of a new model in the real environment the team started to look for additional resources to fund the next phase of development and commercialization. The team presented the technology to the operational department only when the system had passed the tests.

During this project, one of the strategic decisions of the team was not to involve people from the operational department at the early phases of the development process. The co-developer explained that to develop an innovative solution the project team needed to make radical changes. His argument was that operational people do not like changes and try to keep the old processes:

“I did not want to have processing and production people too early at the process of development. They would have killed the project by imposing the usual way of data processing. The problem is that people are used to a certain way of performing the process. If you change that position and if you keep the same processing, you would not get the same results. To see the advantages you need to change acquisition and also to change the processing. I insisted on keeping control. I did it on my own team, so I could at least, test the idea and learn how the processing should be changed to get the advantage on the acquisition and to analyze final results”

When the technology was ready, the project team decided to work on the marketing, without any help from marketing and sales departments. They invited the leader of a divisional business line and the head of the scientific research operations from the innovation unit to work on the marketing positioning of a new product. The senior scientist described the first step to the market:

“We were preparing to show the product at the international conference. But we did not have any marketing people; we did it by ourselves. We knew the advantages of the product and we decided to present it as a global solution linking with material, the solid streamers, acquisition and processing. We said we would make the empathies on the lower frequencies that we believed, we did the best”.

When the project reached the advanced phases of development, the team decided to share it with the sales and marketing groups. Basically, the final product was ready for the exploitation in the operational department. However, it did not have the marketing plan, deployment strategy and the pricing policy. When a senior sales and marketing manager heard about the project for the first time, the new product was ready and it was too late to do any changes:

“In fact, when I have heard about the new technology for the first time, the product was ready. None of the marketing people were involved in the development process. The researchers and developers from the innovation unit said to me, it was a fantastic technology, but in marketing team, we were not able to understand what was the key point and how should we sell it”

This was a time, when a conflict emerged between the exploration and exploitation activities. Particularly, it occurred between researchers from the innovation unit and the operational team who needed to deploy and commercialize the product. Indeed, the test of the new technology had showed positive results. From a technological point of view, it was a successful project. But from an operational standpoint, the new technology was unrealistic and disconnected from the market reality. A senior sales and marketing manager from the operational department explained:

“This project was totally disconnected from the requirements we have in the operational department. There were times, when we had to ignore the R&D people only to take further the project. We did not have any other option, because in our department we have to sell the new technology. We need to control it, because the first consumer of any new technology will get all—either success or a failure. And then, it will be our responsibility to solve the problems, if a new technology does not perform as it was expected”

Despite of the conflict between different activities, project and R&D and marketing teams, the company evaluated the development of this technology as a successful one. The challenge during the product development was to understand how to change the old processes of data acquisition and processing simultaneously in order to get better results. Such an approach to find a solution was radically new, compared to the existing technology. The radically new factor in the technology was the logic to change several parts of the system

simultaneously. In addition, the innovative was also the new method for data processing that was found and applied to the new technology.

For the company, this project created a new type of collaboration. It stimulated the creation of links between the offshore and processing business lines that have not existed before. This type of connection was new to both entities. This project was co-developed between three different entities: the innovation unit, the offshore and processing business lines. For these entities, the project created new skills, expanded knowledge and built new experiences of co-development in cross-divisional teams. Such an experience also showed that the capabilities and skills of diverse business lines were important and meaningful for organizational innovation. The project showed that common efforts could be applied to create technological innovation for the whole company.

This innovative technology was commercialized and applied in operations by the processing business line. According to the data from the interviews with a senior marketing manager, the percentage of the acquisition process that uses the new technology is equal to 60%. Nevertheless, the technology remains relatively new for the data processing activity. It demonstrates the slow, but continuous adaptation and continuous growth.

This project is one more example of the exploratory activity. It was initiated to find the solution to a problem. The initial phases of the project were not formalized and started with the definition of the problem, research and experimentation activities. A senior scientist described this activity as non-formalized and light:

“We were searching for a specific solution to solve the existing problem. Every 3 months we had meetings with top managers where we were presenting our plans for the coming months. Every 3 months we had a meeting to discuss what we would try to do, but in the end we never did what we planned, but at the same time, we were progressing. This was a kind of administrative world around this project. As for the rest, it was very light, no chart, no planning, no cost prediction”

In terms of technology, this product is a radical innovation. However, it is not absolutely evolutionary for the market and the industry. In the interview, the senior manager of the sales and marketing admitted that some of their advanced clients had been searching for this technology:

“Early adopters of this technology were the customers, the key companies in the energy industry. They actually were thinking about it before. They were looking for the lower

frequencies, better data and better signals of noise. But we did not know who were these advanced and pioneering clients. So, in the beginning of the creation process we were kind of blind. For this technology, we did exceptionally well for recognizing the technological value, but we did exceptionally bad formalizing the market value”

In 2014 the new technology was transferred to a business line for exploitation. It is now a new market product that needs incremental improvements. The co-developer explained that in such innovative projects the R&D does not stop, even if the product is on the market. The company continues to do incremental improvements of this technology and this process is under the responsibility of a divisional business line. For this technology the existing main concern is the cost optimization. The development of this radically new project has initiated the creation of another project, aimed on the development of an incremental innovation. The case of this technology is reviewed below.

Resume on the **PROJECT 4**: Radical innovation

- 2012, initiated at the innovation unit, by one of the company’s champions;
- Started as the search for a solution to solve the market problem in the existing technology;
- Research and experimentation done by the innovation unit;
- Co-developed between the innovation unit and two business lines;
- Emerging conflict between R&D and marketing teams due to weak marketing study during phases of exploration;
- High operational costs and marketing price;
- 2014, technology is in exploitation, its incremental improvements is the responsibility of the divisional business line

3.3.5. Project 5 “Rapid response to market competition”

Project 5 – is a technology with multi-level sources that combines different types of guns and enables coordinated operations at the different water depths. The technology is the continuous incremental improvement of the marine acquisition and processing solution (Project 4). The main function of this technology is to provide a better resolution of the sub-surface images, received during the seismic surveys.

From the technological point of view, this solution is an incremental improvement. The technology is not new to the company neither to the industry. Moreover, the company's competitors provide a similar service. Nevertheless, the company owns the unique approach to provide multi-level source technology. The mechanical project leader explained:

“Our competitors provide the similar service, but they use other approaches because of the patent. We were lucky to launch this project, because it gives us a competitive advantage. We are the only company who uses this technology in such a particular way. Other firms use different principles to get the same results”

The principle of this technology is to install different types of guns at different depths. The solution has two types of guns that operate in a coordinated fashion. During the seismic survey, one of the guns produces a signal; another one “catches” the arriving waves. Such a coordinated operational mode helps increase the quality of the sub-surface images.

This technology is an incremental improvement and the extension of an existing technology. The idea to have the two-level source to avoid the ghost effects is relatively new to the market. Before 2010 such a multi-level technology was not present in the seismic sector. The push to go further in the exploration of a new approach for seismic surveys was in fact, initiated by progressing competition. In particular, one of the competitors did research in the same domain of expertise and launched a new streamer technology to decrease the ghost effect. For the technology-based service company, the initiation of the new technology was linked to a need to protect its market.

The idea to create a multi-streamer emerged in the innovation unit. A senior engineering manager of the innovation unit proposed to study a new approach. For the company, it had become almost a regular practice that a new idea that required additional research, experimentation and validation would be managed by the innovation specialized unit. In 2010, the senior engineering manager from the innovation unit and the senior engineer of the offshore business line came up with the suggestion that a two-level source could be a solution to the problem. Besides, this approach could be complementary to the existing seismic survey technology. The senior engineer from a business line who was assigned as a project manager, described the early stages of the development:

“We knew that one of our competitors has launched a product. We needed to react rapidly and the management of the innovation unit took the decision to start a project in late

2010. I discussed with the senior engineering manager. Then, we worked together on the multi-level solution and quickly prepared a patent”

This project was a response to competition. The project team wanted to go fast in the development process in order to be able to protect the market share. At that time, the oilfield service sector had started to decrease, but the management of the company decided not to stop the project. Members of the project team came from different divisional business lines. It consisted of the senior engineering manager from the innovation unit, the senior research engineer of the offshore divisional R&D, the leader of the offshore business line, a member of the mechanical department and a member of the data processing group. The project manager explained that having such a cross-divisional team was “difficult, but at the same time very exciting”.

The development process of the technology was rather fast. As it was an incremental improvement of the existing technology, the project did not have long phases with costly exploration. In fact, the project team started their work from creating a new design of the existing solution. After 6 months the team had built the first prototype and decided to perform the test. The first test failed. To fix the problem, the project passed through several re-design processes and repeated prototype tests. The project manager from a business line explained:

“The first test we did was the test of a prototype. We had some damage. In fact we destroyed it, because we wanted to see the impact. The, we developed another one to use it in production. We had three prototypes in general, but in fact, there was no need to do the first one. We wanted to show the results as fast as possible”

This project had an exploitative type of development. The team used the principles of the old technology, but created a new approach to perform operations. The main difficulty was to find the right layout. The problem was to define the appropriate design frame for the new technology, because there was a need to search for a new approach to analyze the image by using the existing equipment.

After damages of the prototype during the first test trial, the project team decided to work with one of the old clients. They invited a client-company to co-develop a second prototype of the technology. The client specialized in sea trials and equipment to make the marine tests and had a particular competences and skills in testing techniques. The project manager argued that during the project, the cooperation with the client was positive and productive. Both parties gained from this collaboration. On the one hand, the project team

received resources to perform the costly sea tests. On the other hand, the client acquired a new technique and bought the second prototype of the solution.

The tests of the second prototype were successful. This design version worked well and it provided the image in 3D format. Then, after 6 months the team presented the third and final prototype of the new solution that could be applied at the intermediate water depth for seismic acquisition. This prototype represented the final design of the market product.

For the company this project is undoubtedly a big success. From a technological point of view, the technology has several benefits. The big advantage of the solution is a better imaging from shallow and deep areas. Also it uses a new source method to improve high frequency of the image. Finally, the technology offers the best quality of the images if it is combined with Project 4 (see above). At the current moment, this technology provides the best quality of service on the existing market. Evaluating the project, a senior engineer of a business line argued:

“This technology is definitely a success. Our competitors were trying to develop similar source, but we were the first who came with the idea and launched the product on the market. We went faster than the rivals. Even if we compare a technology with something similar from our main competitor, we have the advantage. Our solution has more combination of guns at different levels, it is more flexible and the spectrum is better. I can say this is our best product”

In terms of development, the process was mainly focused on the experimentation, refinement of the existing technological design and test performance. The development process was linear, but the main concern of the project team was the configuration of the source. A member of the technical support argued that the project had limited resources and experienced a shortage of time. Another factor for rapid development was the available market technology, launched by a competitor. The new solution was based on the existing technology, which means the reframing and improvement of the existing concept. The team was able to build the new solution at the affordable price. The project had also a fast deployment. In general, the team spent 2 years for development of the technology and launched it in 2014.

This project of the incremental improvement belongs to the offshore business line. However, the innovation unit had a significant role in its co-development. First, because the unit had initiated the process, allocated the resources, provided technical advice and support to the project team during the initial phases of the development. Second, the unit convinced

the divisional managers from the offshore business line to develop the new technology. When the development of the project was done, the team received the internal award for excellent delivery and deployment of a new technology.

For the company, this project was a successful example of integrated projects and the efficient cooperation between members of diverse business lines. The team got the recognition from the top management regarding the contribution, effective project management practices and rapid market delivery.

This project also brought two patents for a specific layout and coordination techniques. At the current stage, the solution is in exploitation and under continuous incremental improvement. The R&D team of offshore business lines is now working on product refinement to design a deeper source and as well as to experiment with the design in order to provide a customized version of the technology.

Resume on the **PROJECT 5**: Incremental innovation

- 2010, initiated at the innovation unit as a technology to respond to proactive competition and to protect the market segment;
- Improvement of the existing technology and complementary system that can be used in combination with Project 4;
- Technology with unique multilevel and coordinated approach of operations;
- Focus on refinement of the design, prototype build and tests;
- Research activity and sea trials with a client company;
- Partly co-developed with a divisional business line;
- Rapid deployment (in 2 years);
- 2 patents;
- Internal innovation award for excellent technological delivery and deployment and top management recognition;
- 2014, market launch, continuing refinement at the divisional business line

3.3.6. Project 6 “New technology for process optimization”

Project 6 – is a new technological approach for a seismic spread that helps achieve operational improvement and increase productivity of the whole system that performs the seismic surveys. It is an improvement of the existing operational system, which is aimed to deliver faster results at a better price.

The principle of this technology lies in the increasing number of deflectors. Cables connect the deflectors with streamers and a seismic vessel. The advantage from having a larger number of small deflectors is the increasing level of flexibility. For the whole seismic system, this means a dramatic reduction of the costs of operations.

Initially, the idea had emerged in 2009, in the offshore business lines as a “dream” to create a new solution. At that time, a member of the offshore R&D group was working on a new concept together with a Norwegian partner. After two years of cooperation, they were able to build a prototype and perform a test on the seismic vessel. However, the test failed, mainly because of the technical problem linked to stability. After the failure of the test, the development of a new technology was stopped.

After 6 months of silence, the project was forwarded to a new manager, who was the senior R&D leader of the offshore business line. His team decided to start the project from the beginning. They improved the technical specification and were preparing to make the test on the vessel with the same partner. But at this period, the Norwegian partner went bankrupt and the project team needed to start the project from scratch. The main goal for the team was to understand what had happened during the first test and why it had failed.

The renewed project was initiated at the offshore business line, but then, it was transferred to the innovation unit as complex and research-intense one. At a first step, the leader of this project proposed to identify individuals that would fit well into the development of such a technology. To understand the failure and find a possible solution, the project team worked with a few external organizations that had specific expertise in marine environment. When the problems of the first test and failure were identified, the project team started to search for new ideas and solution to avoid them in future.

As the core of the technology was available, the goal of the project team was to search for the appropriate design that would solve the stability problem. The solution was found in the integrated approach that merges technical design and specific composite materials. During the development, there was a separation of activities: the project team did the design part of the project, whereas the research on composite materials and engineering were subcontracted.

The team worked with a specific manufacturer who had a good knowledge of composite materials and with an engineering company who manufactured the necessary elements. The project team tested diverse design and conceptual aspects of the solution. This type of work can be described as the integration of the subcontracted elements into a unique technological system.

For the company, such a cooperative process of development was less time and cost consuming and more effective rather than acquiring and developing new knowledge and

competences inside the company. The project manager explained that the execution of the project was possible because of interaction and cooperation with subcontractors, who carried out the research and proposed a solution to solve the problem on stability. It started from the idea that was identified by the team and then it was transferred to the subcontractors for exploration and research. For the unit, it took a form of an outsourcing of an exploratory capability.

The utilization of this technology started in January 2014. But since the original idea that had emerged in 2009, this incremental technology passed through several important improvements. The working design of the solution was developed in January 2011, but the project was stopped because of the stability problem. This project is now used to perform seismic surveys in the operational department of a business line. The development of this technology is the example of a stepwise development. The senior engineer of a business line explained:

“We are always looking for such stepwise development, because the risks and costs of failure will cost us a week of additional work. This time would be necessary to recover everything in order to bring it back into production”

This solution is an incremental innovation that uses a new concept. In particular, the novelty is the application of a high-tech approach that is new in the seismic industry. The advantage of this technology is the optimization of the costs and cheaper price for seismic surveys. According to the interviews with members of the project team, the allocated resources for this project were approximately 0,7 million euro that is considered as a small project.

The technology is now in commercialization, but the R&D team of the offshore business line continues to work on the architectural design to improve the operational performance of the technology. One possible way to refine this technology is to deploy the spread and to achieve significant savings on the fuel during the seismic surveys.

Compare to other projects of incremental innovation, the development of the technology took extra time. For typical incremental technological improvement, the organization spends on average around 3 years. For this technology, the time spent was 5 years. One of the largest constraints was a lack of the appropriate research and exploration at the initial phases of the development. The project manager argued:

“If I needed to re-do the project, I would put more efforts to develop better the concept of the new technology, and only after I would search for the right partners to develop and industrialize the product”

The second reason why the company spent so much time for development was the problem of logistics. The team lost significant amount of resources preparing the technology and making the tests on the marine seismic vessels, which meant 3 - 4 months for each test.

The company identifies this project is a successful one. The senior operation manager considered that the initial idea of the new technology was very ambitious. The project team succeeded in implementing the technology on the small scale and showed the positive results on the middle one. The next step for this technology is to find a way to make it efficient on the larger scale. Therefore, the company still needs to make major investments into improvement of the technology to achieve higher commercial success.

Resume on **PROJECT 6**: Incremental innovation

- 2009, initiated at the divisional business line;
- Research on improvement of the existing technology in cooperation with a partner;
- Low attention to exploration, focus on tests and execution;
- Failure of the first trial test;
- Transferred to the innovation unit as complex and underexplored project;
- Re-thinking the original concept, re-designing and solving the technical problems of stability;
- Subcontracting sets of research and engineering tests;
- 2014, commercialization at the divisional business line and search for new ways of optimization

Therefore, the description of the technological innovations shows that the innovation specialized unit has the ability to combine different sets of activities. To recall, the observed technological innovations are the projects of the innovation unit. In parallel to its principal activity, which is the R&D of radical innovation, the innovation unit also develops incremental improvement for the existing technologies. Table 3.2. represent project ambidexterity during the process of development of technological innovations in the innovation unit.

Table 3.2. Exploration and exploitation in projects of technological innovation

Technological Innovation	Portion of Exploration	Portion of Exploitation	Duration (years)	Returns from exploration	Transition to Operation
Project 1, Incremental	Intensive research with 2 partners; governmental funding (7 years)	Reservoir's tests and optimization	12	10 patents	Accepted, price and functionality optimization
Project 2, Radical	Low entry costs, funding for HR, IT equipment and tools	Proof of technical feasibility and business opportunities	2	Internal award for the innovative technology	Stopped, low priority
Project 3, Radical	Building new knowledge, collaboration with R&D experts and subcontractors	Proof of technical feasibility, 2 prototypes	6	Co-development agreement with the largest client company	Stopped, immature
Project 4, Radical	Problem-solving approach to technological obsolescence, research performed by a small team of scientists and engineers	Tests in the real environment	2	Continuous market adaptation and growth	Accepted, price optimization
Project 5, Incremental	Extension of the existing technology, search for appropriate layout and design	2 prototypes and tests with a client company	2	2 patents, internal reward for excellent technological delivery and deployment	Accepted, continuing refinement
Project 6, Incremental	Re-design and search for a solution to a technical problem, subcontracting research	Integration of the elements and engineering tests	5	Cost optimization	Accepted, design and price optimization

The analysis of projects and their different phases of development process shows that the innovation unit works on the radical and incremental technological innovation. Independently from the types of innovation, the unit engages in the exploratory processes (e.g. research and conceptualization) and at the same time performs exploitative activities (e.g. prototyping and test). It is also important to mention that the distinction between technological innovations is not explicitly clear. Such factors as the number of patents and years spend for development does not obligatory lead to the creation of radical innovation (e.g. Project 1 in the Table 3.2, for more details see 3.3.1), but might result in the incremental improvement. Similarly, short period of development can result in creation of radically new technology (e.g. Project 2, table 3.2, for more details see 3.3.2). These processes deal with complexity of technological products and services, obsolescence and change (as previously described in this chapter and also in Chapter 2). It is particularly important issue, if we observe it the case of the technological change and in the context of science-based organizations.

What is clear is that for radically new projects, the early phases of development are more time and costs consuming, because additional resources are needed to make studies and prove new technological concept. For the incremental improvements, where technology is already available, the main focus during the development process is dedicated to re-design and test.

Our project analysis demonstrates that the distinction between the radical and incremental technological innovation is in the intensity and proportions of exploration and exploitation. Radical projects have higher intensity of search and experimentation in new domain of knowledge, creation of new skills and capabilities. In incremental projects, exploration is focused on solving a specific technological problem. Table 3.3 presents the main characteristics of radical and incremental technological innovations and has a slightly similar representation as our Table 2.2 on characteristics of exploration and exploitation (see 2.1.4 in Chapter 2).

Table 3.3. Characteristics of radical and incremental technological innovation

Radical technological innovation	Incremental technological innovation
Significant resources for exploration	Moderate resources for exploration
Intensive and longer period of exploration	Intensive exploitation
High degree of uncertainty and risk	Primary in design, test and refinement
Longer-time orientation	Short-term orientation
Shared cost for research and experimentation	Subcontracting of research and experimentation
Co-development with external partners (clients companies)	Co-development with internal partners (divisional business lines)
Limited exploitation	Limited exploration
Top management support	Divisional management support

Radical technological innovation can be characterized as the research–intense projects, which, as a rule, have longer time frames and resource consuming initial phases of development, particularly during the period of their ideation and conceptualization. To develop new knowledge, competencies and skills and to explore new business domain, the innovation unit performs research and experimentation in cooperation with the internal and external partners. It subcontracts some of the research activities and services and co-develops with large client companies. The projects of radical innovation have intensive and long exploration, high degree of uncertainty and risks. Very often, the costs for the research and development are shared between the multiple actors and always funded and supported by the top management of the company.

Projects of incremental innovation, in contrast, have intense exploitation. They need fewer exploration, because of the availability of the technological system. In such project, the innovation unit does not search for new technology, but only explores a specific domain of knowledge to create and to refine a part or a component of the existing technology to achieve the improvement of the operational performance. It is more a problem solving approach to creation. The focus of the projects is dedicated to test and refinement activities and development process is always supported by the divisional management.

Overview and conclusion

This chapter observed exploration and exploitation at the corporate level and in projects. Our third level, the executive one, was proposed for the discussion in Chapter 4 with purpose to validate the results from the corporate and project levels. The company from our research uses the structural approach to achieve ambidexterity and develops both radical and incremental technological innovation in separate structures.

In the context of our research, the *structural ambidexterity* is organized in the following fashion: exploitation occurs in divisional business lines, exploration is assigned to the innovation specialized unit. The innovation unit explores new opportunities, selects ideas, learns about new domains, acquires new knowledge and experiments with new technologies. The job of the divisional business lines is to exploit technologies. They re-define concepts, re-design and refine existing technological systems in order to improve and increase operational performance of the existing technologies, products and services.

These separate structures have not only a different focus of activities, but also different processes and characteristics. The *innovation unit* is small, young and entrepreneurial one. It is an innovation driven and cash-absorbing structure. The R&D projects aimed to develop radical technological innovation and have strategic importance and a long term orientation.

The divisional business lines, in contrary, are large, well established, efficient and profitable structures. They are focused on high performance and have an efficiency-oriented culture. Their R&D projects aimed to develop incremental improvements for the existing technological innovation with the purpose to protect market segments and to generate revenues in the short term.

Integration between exploration and exploitation occurs at the executive level. *Top management* supports and protects the explorative activity of the innovative unit. We will discuss about the executive support in the next chapter. Moreover, the unit itself performs a small part of the integration function, as it must detect market threats and define future opportunities for divisional business lines. It develops proposals and suggests to business lines on technological innovation that can be explored.

At the process level, the innovation is shared between explorative and exploitative structures. The development of a new technology starts from exploration at the innovation unit. The innovation unit defines and proves technical and market feasibility for new concepts by using different methodologies, brainstorming technique, by learning and experimentation. In some cases it develops the first prototype and performs preliminary tests in the environment. After the concept is proven, the exploratory job of the innovation unit finishes, and the project should be transferred to the business line for further technological refinement and commercialization.

In the stage-gated development process, the job of the business lines is “to exploit” a technological innovation. When the business lines receive a project from the innovation unit, they should begin the development phase from re-designing and refinement of a working version of an innovation. Then, they should commercialize a technology, launch it on the market and perform operations.

Such an innovation process where exploration is devoted to the innovation unit and exploitation to the business lines is presented in a linear format. It is organized as if gates, decision-making and tensions between the activities and structures were absolutely absent. However, this process contradicts the organizational reality, because in practice, there are multiple tensions and conflicts of interest that emerge between different sets of activities and structures.

The description of the 6 innovative projects proved their existence and demonstrated the painful process of transition when an innovation passes from exploration at the innovation unit to exploitation at the operational structures of the company. Some of the identified problems from the disconnected exploration and exploitation include the following: weak marketing study at the earlier stages, high operational costs, unaffordable market price and the need for costly continuous incremental improvement and refinement.

Another critical issue, identified by the in-depth study of 6 innovative projects, was a *mix of activities* and different types of innovations inside the exploratory structure. It should be recalled that the mission of the innovation unit is to explore new opportunities and to develop radically new technological innovations. However, the analysis at the project level

identified the presence of radical and also incremental technological innovation. It means that the structure can switch its function from being exclusively focused on exploration to a combination of exploration and exploitation activities.

This process of combination of activities needs clarifications. In fact, it has been assumed that exploration stops at some point in time and after the exploitation starts, as for example the stage-gated process of development of innovation, discussed previously. Contrary to this assumption, the analysis at the project level shows that there is no pure differentiation and clear borders between exploration and exploitation for different types of technological innovation.

The study of 3 radical and 3 incremental innovations from the innovation unit showed that all projects contain exploitation and all 6 projects inevitably require exploration, but with different degree of intensity. That is also the reason why the development of these projects, the incremental ones in particular, was assigned to the innovation unit, and not to the business lines. In other words, the organization assumes that the role of the innovation unit is to deal with *all types of exploration* and independently from the proportion of research and experimentation or from the types of innovation (existing or new technology). In these 6 projects, the difference is the degree of exploration and concentration of new knowledge, skills and capabilities that need to be acquired. Hence, the function of the explorative structure is not static, as suggested by the model of structural ambidexterity. It is more likely to be *dynamic* and have the ability to change over time.

The following chapter reviews the result from the analysis at the corporate and project levels and compares it with reviews from the top management at our executive level. It explains why does the function of the innovation unit can change over time, whereas the divisional business lines remain focused exclusively on exploitation. It also discusses the managerial decisions, pitfalls of uncoordinated structural separation and the dynamics of organizational ambidexterity.

CHAPTER 4.

EVOLUTION AND DYNAMICS OF STRUCTURAL AMBIDEXTERITY

In previous chapter we discussed exploration and exploitation at the corporate levels and identified the mutual presence of the activities at the project level. It turns out, that the innovation unit, which is an innovation-focused structure, creates not only radical technological innovation, but also develops incremental improvements for the existing technologies. It has the ability to switch from having purely exploratory – orientation, to a combination of activities.

The aim of this chapter is to find out whether organizational ambidexterity is indeed a dynamic phenomenon and define the path for its evolution over time. It presents and interprets the results from the corporate and project levels and integrates the executive level to verify and justify the findings. Also, in this chapter our research provides the history of the innovation unit and its evolution to identify the reasoning for switching from exploration to simultaneous exploration and exploitation.

As discussed in Chapter 2, both exploration and exploitation deals with the process of creation of different kinds of innovations, such as radical (discontinued) and incremental one. The reason is that “different kinds of innovation require different kinds of organizational hardware –structures, systems and rewards – and different kinds of software – human resources, networks and cultures” (Tushman and O’Reilly, 2002, p. 167). Incremental improvements need formalized structures and the efficiency-oriented approach. In contrast, radical (or discontinued) innovations need flexibility, risk-taking and entrepreneurial type of work. These processes can be found in different organizational structures as entrepreneurial units and efficiency-oriented entities.

While in some sources of literature these activities and processes are inconsistent and contradictory, in others they are seen as complementary and even continuous. Taking into account the evolutionary perspective, a product or a service that is an incremental innovation today is used to be a radical one in the past. The processes of creation and development as well as the product life cycle can demonstrate this evolution.

Another concern is the evolution of technology. For most companies, radical innovation is very rare due to height degree of uncertainty, costs, risks and unclear returns. Most technological innovations are the improved versions of the old products and services.

Customers “generally don’t want...and initially can’t use” a technology that is radically different from the existing one (Christensen, 2000, p.20).

To sustain in the long term, an organization needs to perform both activities simultaneously. It is no longer effective for a company to perform either exploration or exploitation, to produce either radical innovation or incremental improvements, but it is essentially to do both in parallel. One of the way to both explore and exploit is by achieving structural ambidexterity.

To address both activities simultaneously, this approach proposes to separate them in different business units. The appropriate structure for exploration is young entrepreneurial unit(s), for exploitation, in contrast, large efficient entities. The core of this model is the separation of activities in different structures. It means that each of the structures focuses only (or mainly) on one process: either on exploration or on exploitation. However, it is yet unexplored whether at the level of the business unit such approach is sustainable and can be effective in the long term and particularly for the exploratory structures.

According to the organizational learning literature, long term organizational sustainability depends on the ability to balance between exploration and exploitation (Levinthal and March, 1993; March, 1991). But it does not specify what actually is an organization – either it is an incumbent company, a business unit of an organization, a venture sub-unit or a small group of individuals. For structural ambidexterity, it would be critical to know first, whether the actual activities of the exploratory and exploitative structures correspond to their expected performance and second, what happens with ambidexterity if for e.g. the top management loses the ability to support exploration activity of the entrepreneurial unit. Hence, the aim of this chapter is to answer the following questions:

How is ambidexterity organized at the corporate level?

What is the exact activity of the exploratory structure at the project level?

What happens with ambidexterity over time?

This chapter provides and explains the results from our multilayer methodology. First, we describe organization of structural ambidexterity of the company and introduce the story of creation of the innovation unit. Then, we present the project ambidexterity and interpret the emerging combination of activities in the innovation unit. Finally, we integrate the executive level and explain the evolution and dynamics of ambidexterity in the company.

4.1. Ambidexterity at the corporate level

In our research of the technology-based service company, we observed structural type of ambidexterity where exploration and exploitation were done in different structures. At the corporate level, the activity of *exploration* deals with search for new technological and industry challenges, acquiring of new knowledge about unknown domains and fields, searching for new ways of doing operations, experimentation with new technologies, creation and sharing of knowledge with partners, such as research universities and laboratories, clients and sub-contractors. This process occurs at the innovation specialized unit that is an exploration and innovation-focused structure of the company.

Exploitation refers to such activities as prototyping, re-designing, improvement of the components, the refinement of the design and its integration into the whole technical system. This process takes place at the divisional business lines. They improve and increase the performances of the existing on the markets technologies. These are highly specialized executive and efficiency-oriented entities.

At the *corporate level*, the analysis showed:

The technology-based service company is an ambidextrous organization that applies structural separation of activities. Exploration of new business opportunities, ideas and concepts is entrusted to the innovation specialized unit. Exploitation of current certainties and existing technologies occurs at the divisional business lines.

Because of the fact that the company is a science-based organization, it has the R&D in both the exploratory and exploitative structures. The innovation unit and the divisional business lines search for and develop new technological products and services. The difference is the focus and the scope of the activities. The mission of the innovation unit is to develop radically new technologies, whereas the objective of the business lines is to improve and refine the existing ones. The stage-gated innovation process aims to support such differentiation of functions and division on labor. Previously in Chapter 3, we described this process (see e.g. Figure 3.2) and identified the emerging tension during the transition period (see Figure 3.3).

Ambidexterity is present at the corporate level. The company differentiates exploration and exploitation in separate and independent structures (see Table 4.1). Not only

do they have different missions and targets, but they also differ in terms of activities, processes, project management practices, project orientation, resources and time horizons.

Table 4.1. Ambidexterity at the corporate level: Differentiation of activities in structures

	Innovation specialized unit	Divisional business lines
Main activity	Exploration type	Exploitation type
R&D focus	Future business (new solutions, markets, clients)	Current business (existing solutions, markets, clients)
NPD	“Idea-concept” search, experimentation, determination of a system, feasibility study	“Prototype-solution” (re)-design, refinement, environmental tests, production
Time frames	Long-term/mid-term	Short-term
Decisions / Resources allocation	Top management & Management of the unit	Divisional management

The innovation specialized unit has an explorative type of activity. It has an innovation-focused culture and gives priority to the search for and development of capabilities for future business. Its R&D activity focuses on search and experimentation of new ideas and solutions, discovery of new markets and clients, proof of feasibility for new technological concept.

The unit specializes in the initial phases of the stage-gated innovation process. It searches for new ideas and industry challenges, selects the appropriate ones, develops concepts and proves the feasibility of a future solution. The unit works on projects that create radically new technologies for new markets. Very often, these projects have long and costly phases of research, study and experimentation. They require significant investments, cross-disciplinary skills and capabilities and regularly they are co-developed with the internal and external partners. The projects of the unit have a strategic importance for the company as they define the future direction of the business and outline where the firm wants to go. Top management allocates resources for such projects, supports and protects the activity of the unit.

Divisional business lines have exploitative types of activity. These are the executive entities with the efficiency-oriented culture. In these structures, priority is given to the

improvement of the current business and markets. The R&D activity focuses on the refinement of the operational efficiency of the existing technologies, improvement of the market positioning and providing best services to the old clients.

These entities take over the new projects and work on more exploitation-oriented phases of the innovation process. In contrast to the innovation unit, the development in business lines starts from the re-designing and re-building of the already existing and proven technology. Their goal is to redefine a product and its components, to make tests in the real life environment and to develop and launch the final version of a technology.

As a rule, divisional projects do not have intensive research phases. They use the existing core of the technology and search for improvement of the design or the components. Very often, the project in development are short in time, need moderate resources and are always sponsored and supported by the divisional management. As the divisional structures have financial and operational freedom, their managers take their own decisions on how to allocate resources to achieve the short term plans.

Simultaneous separation and integration

Although the innovation unit and the divisional business lines are separate and independent structures, their activities are not completely disconnected. From the organizational point of view, these are the autonomous entities that are linked by several mechanisms. As described in previous chapter, they share the common innovation process and have a linkage at the top management level.

Originally, the innovation unit was initiated as a structure to do strategic research and execute radical innovations *top-down*. The executives of the technology-based service company use this structure to initiate and execute innovative projects that have a strategic intents and missions. It is also an explanation why most of the projects of the unit are supported and sponsored by the executives.

At the same time, the unit is not only a structure for the top-down, but also for the *bottom-up* innovation. It searches, identifies and selects new ideas independently or in cooperation with the divisional business lines and proposes them to the executives to initiate their development. An individual or a group of individuals from any part of the organization can propose their ideas and concepts to start a new project. Those could be the high risk, uncertain and research –intense ideas and projects that emerge at the divisional business lines, and which are not accepted to the development by the divisional management.

Very often, in the exploitative structures such ideas and projects are rejected because they do not fit into the regular R&D divisional processes. The new projects need resources to perform time-consuming research. This process is costly and uncertain in terms of returns. As a rule, divisional structures focus on the certain and routine types of activities and projects that require only incremental improvement. When a project requires any exploration, even if it is for the already existing technology, divisional management will reject the development of such project or will forward it to the innovation unit to perform research and feasibility study.

The third integration mechanism to link exploration and exploitation in the company is the *advisory* role of the innovation unit (also described in Chapter1). One of the responsibilities of the innovation unit is to identify future market opportunities and, in some cases, the threats coming from the competition and to suggest divisional business lines on the exploration of new technologies. These recommendations have a diverse format and may include proposals on development of an innovative technology, positioning on a market segment, partnerships with clients etc. Further in our research we will discuss the effectiveness of this advisory role of the unit, by using the data from the executive level.

Finally, the linking mechanism is also present during the period of transition in the stage-gated *innovation process* (for more details see Chapter 3). The transition occurs at the moment when the innovation unit finishes its exploratory activities (proof of concept and feasibility studies) and transfers an innovation to the divisional business lines for further exploitation (prototyping and commercialization). The role of the business lines is to take over the project, design and improve a technology and start its exploitation during the oilfield business operations. In previous chapter we showed that in the stage-gated process of development, the innovation unit is, in a sense, an internal supplier of the innovations to the divisional business lines. However, the coordination and interaction between the different structures does not always go smoothly, because of the emerging conflicts and unsolved tensions between the activities and, in some cases, it results in the rejection of projects for exploitation.

Therefore, at the corporate level we identified structural type of ambidexterity, with separated and integrated exploration and exploitation (see Figure 4.1.). Both exploration and exploitation were organized in different and independent structures. Exploration took place at the innovation unit and exploitation at the divisional business lines. The described above linking mechanism aimed to create linkage between the structures and avoid isolation of exploratory unit. The top-down and bottom-up innovations, recommendation and advisory functions, sharing of a common process of development were the approaches to link

exploration and exploitation and to achieve the synergies between the processes and structures.

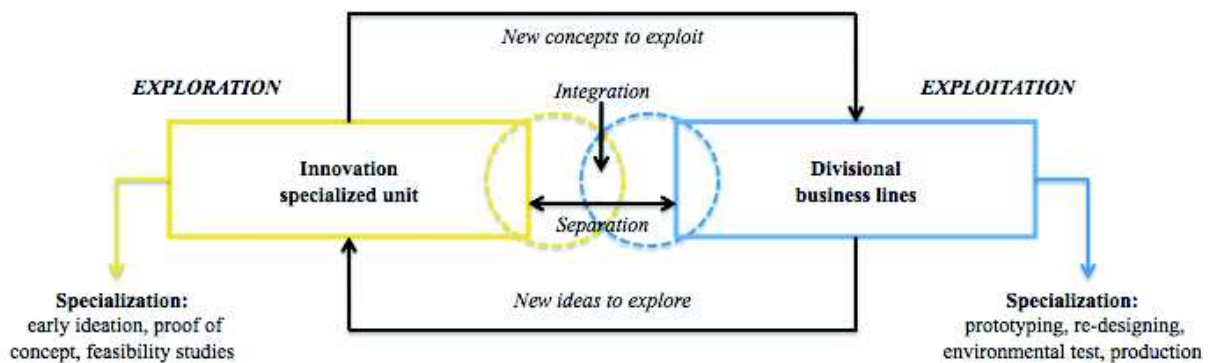


Figure 4.1. Corporate ambidexterity: Separation and integration of activities in different structures

For organizations that use structural approach to ambidexterity, the biggest challenge is to maintain the linkage between the exploration and exploitation. The danger is the uncoordinated activities that might lead to isolation of the exploratory structure and result in its low returns and weak performance. By using the study at the corporate level, we identified several mechanisms that can help to coordinate structures and be applied to achieve the synergies between the activities. These mechanisms are:

1. Top management support and protection of exploration;
2. Top-down and bottom-up strategic innovation at the exploratory structure;
3. Advisory mission and development of proposals by the explorative structure;
4. Integration of activities during the transition period at the product development process

The literature on structural ambidexterity argues that separation of activities in different structures is essential to cope with the conflicts and tensions between exploration and exploitation. In the same way, it describes the critical role of the top management that need to preserve exploration and to keep the potential from new ideas (e.g. Cohendet et al., 2000; Tushman et al., 2011; Tushman and O'Reilly, 2002). At the corporate level we, indeed, identified these key features of structural ambidexterity. The activities were separated in independent structures. At the same time, they were not completely disconnected, but linked at the process level, maintained and protected by the top management.

Although, in our research we were able to identify all the critical factors for structural ambidexterity, it did not solve the question of balance. By studying the activity of the innovation unit and particularly by analyzing its innovative projects (described in Chapter 3), we determined the presence of the exploitative type of activity in the exploratory structure. We found out that the innovation unit no longer owned the exclusive function on exploration of new opportunities, but started to combine different sets of skills and capabilities and to perform both exploration and exploitation. The reasoning why does the unit become itself ambidextrous is to be found in the end of this chapter.

Before moving to the results at the project level, we analyze the dynamics of ambidexterity. The next section describes the history, initiation and the evolution of the innovation unit and discusses the evidence on the re-focusing of exploration and exploitation in the company. It also expands the existing knowledge on how organizations can achieve structural ambidexterity and argues whether this type is a sustainable organizational solution to explore and exploit.

4.2. History of creation of the innovation unit

For the technology-based service company, the innovation unit has a strategic role. The mission of this structure is to deliver radical innovations and breakthrough technologies. Its function is to capture industry challenges, to identify and to explore the future trends of the energy industry. To explore new opportunities, the innovation unit engages in diverse types of activities and processes.

The principle activity of the unit is the search, discovery and experimentation with new ideas and concepts. It identifies new ideas that emerge inside and outside of the company, selects the best ones based on brainstorming and negotiation with senior and executive managers, initiate the development process and incubates innovations. Except managing the exploratory activities such as the proof of concept and feasibility studies for the brand new technologies, the innovation unit also engages in the exploitative type of activities. In parallel to creation of radical innovation, it develops incremental improvements for already existing technologies. The unit performs exploitation by managing such activities as the prototyping, re-designing and testing in diverse environments.

Despite of the fact that it is a relatively young and small organizational structure, it demonstrated the early value from the exploratory activity. The unit develops new technologies for new markets, brings a non-routine approach and creative problem solving to highly standardized and formalized processes of development that exist in the traditional-

oriented petroleum industry. In addition, the unit works on the re-thinking and re-focusing of the corporate culture and increases the attention on the technological innovation. Finally, it creates the organizational environment that fosters the development of radically new products and services across the whole organization. The following sections review the history of creation of the unit and its evolution inside the company.

4.2.1. Creation of a new unit as a response to organizational growth

As a new and an independent structure, the innovation unit emerged in the company in 2009. Its main responsibility was the development of strategically important radical innovations that were coming from the top organizational level. In fact, this period was associated with the organizational growth. The company increased in size and there was an emerging need to have a specific unit that would focus on innovation and which could take the function of a controlling and coordinating entity for the corporate R&D between diverse divisions and divisional business lines. It was the early initiation of the innovation unit and a strategic initiative, coming from the top management of the company.

Phase 1: Initiation of the innovation specialized unit

The need for the new unit, responsible for technological innovations was justified by several reasons. The first reason was the increase in size due to the recent acquisition of a new organization and its integration into the existing corporate structures. Becoming a larger organization, the company was in need to have the central entity that would coordinate the R&D activity across multiple divisional business lines and that would bring new technologies top-down.

At that time, the objective of the top management was to find out how to deal with the growing sizes of the company and the increasing complexity of the R&D activities and processes. Successful execution of M&A strategies, expanding markets, integration of new business activities into the old organization together with the growing and advancing industry were the reasons that stimulated the management to re-consider the old structures and to centralize the existing processes. A solution was found in the formation of a specialized unit with a set of responsibilities of coordination and with a particular role, dedicated to exploration, search and experimentation with radically new technologies.

The increase in size was not the only reason for the top management to initiate the creation of a new unit. The second reason was the development process for radical innovation,

which needed completely different types of activities and approaches, than the ones in the divisional business lines. At that time, a small group of engineers and researchers were working on a new project. They were exploring new domain, searching and experimenting with a radically new technology. This project was different from the previous R&D projects, in terms of technology and the approach to development and there was no any appropriate organizational structure that could support the original and non-routine type of R&D.

The processes of creation and development of the project were new for the company and they did not fit into the standardized and routine processes in the divisional business lines. The project required multiple skills and competences, needed the involvement of different internal and external partners and heavy investments for the research part. The project and its exploratory activities were fully supported and sponsored by the top management of the company.

Experimentation with a radically new technology revealed an organizational need to have a place where the project teams could apply unusual practices and procedures, to perform research and development of non-routine projects, complex engineering and technological solutions. The independent entity was also necessary because the creative type of activity could not exist in the traditional R&D structures. Divisional business lines were large and efficiency-focused entities with standardized and routine approaches to R&D and short term orientation. They did not support entrepreneurial, uncertain and high-risk projects in their departments.

The origin of the innovation unit came from the organizational problem. The organizational change in the company stimulated the creation of the independent and autonomous entity, which was the innovation unit. Organizational transformation occurred as the result of the acquisition and integration of a new organization inside the company and followed by the managerial attempts to integrate newly acquired entities with the existing structures in the company.

For the management, the main challenge was to integrate and to align new capabilities with the existing ones. To solve a centralization problem and define a place for explorative type of R&D, the management of a company decided to create the innovation specialized unit and to build its innovation team. One of the initiators of the unit and early adopters described:

“Before creating the innovation specialized unit in 2009 there was nothing central. We realized that we had become a larger company and it was a time to have a leading and coordinating body to bring new technologies top-down. It was our early decision to develop the innovation specialized unit. We had a management consultancy team who did a study for

us on how to create a corporate technology entity in our transformed and renewed organization”

In fact, the idea to create the innovation unit inside the company had an entrepreneurial spirit. After the initiation, the unit had only a few members, who were known as the company’s champions for their contribution to the development of new technologies in the past. Other members of the unit were selected and invited to join from the divisional structures. There were also newcomers, who came from the petroleum industry and recently joined the company. The individuals, who were a part of the innovation unit had skills and expertise in the initiation and development of complex engineering solutions and radically new technologies. Nevertheless, even having a highly skilled and experienced team, it was unclear for the company how a small number of people could create radical innovations for the oilfields sector.

In contrast to the internal uncertainty, the industry created a favorable environment to lead the radical change. At that period, the new technologies for exploration and production of natural resources caused the shifts in the old process of doing business operations (see also Shuen et al., 2014). Technological advancement opened new business horizons and increased the diversity of operations in the environment that were not exploited before (e.g. arctic, ultra deep water, coal bed, sea bed etc.). With new technological equipment and services, the energy companies were able to achieve operational efficiency by bringing new value to the markets and by reducing the costs of the existing operations.

The sharply progressing oil and gas industry enabled operations that were not possible twenty years ago. The new arriving technologies stimulated companies to be proactive on the markets. For the oilfield service providers and for their clients, the petroleum companies, innovation was seen as an approach to stay ahead of competition. At that time, the companies from the oil and gas industry had two strategic targets: on the one hand, they searched for the optimization of the existing processes to fulfill the market needs in the short term; on the other hand, they worked on the exploration of radically new technologies that could bring the value in the long term. The next section describes how the company from our study coped with different strategic intents and re-configured its structures to respond to the demands of the environment.

4.2.2. Re-organization of the corporate R&D activities

In the recently formed entity, another period of evolution was associated with the assignment of a new manager. A new leader of the innovation unit joined the company in late 2010. He came from the aerospace and defense industry where he had held a number of technical and managerial positions. He also got the experience in launching his own company, specialized in the creation of new technological systems. Having an entrepreneurial way of thinking, combined with the technical experience and managerial skills, he was an appropriate candidate to take the leading role in the recently formed unit.

As the leader of the innovation specialized unit, the new manager had the objective to enable radical innovations. He wanted to turn the company into a leading and an innovative organization and to enable the creation of technological innovation that would revolutionarily change the oilfield industry. In one of the interviews in 2013, he explained his vision on the radical innovation:

“In our company, radically new technological innovation is concentrated in the innovation unit. Radical innovation means that you do not raise the industry barriers, but you completely change the barriers. It also means that you create absolutely a new market”

Phase 2: R&D re-organization and restructuring

The mission of the new manager was to bring radical innovation to the company and to revolutionize the oilfield service sector. To do it, he needed to start from the re-organization of the existing R&D activities. In the early beginning, his main objective was to organize, to structure and to coordinate the activities across multiple divisional business lines. During this period, the innovation unit got a strong support from the executives. The members of the unit reported directly to the top management team. Talking about this period, a technology development manager of the innovation unit described:

“When I joined the unit in 2010 we needed to review the situation and to reorganize the R&D activity in the whole company. We had a strong support from our executives and a push from the technology board. We worked with divisional leaders and consultants, who helped us to develop a plan and to introduce new R&D processes and procedures in the company”

The shift from a traditional oilfield service firm to a leading and an innovative organization of the oil and gas industry required radical organizational changes. In other words, the firm needed to switch from the old structures and processes towards the new ones. This also required the integration and alignment of the existing and new entities, activities and processes.

To re-organize the existing R&D and by prioritizing the innovation, the new manager started from introducing the change in the research and development processes for the innovative technologies. One of his radical changes was a new industry-based approach to develop new products and service. The old methods, based on specific services were mainly focused on the efficiency and operational performance of the R&D activities in the divisional business lines. The business lines were independent and autonomous and had a freedom to organize their activities and operations. The new industry-based approach, in contrast, was based on integration and creation of a system of independent, but integrated and linked entities.

The structuring of the corporate R&D into a unique system had several benefits. First, the new method helped centralize and structure the activities in the divisional business lines. The company was able to align different R&D processes across multiple departments with the short term planning and the long term strategy and to ensure the execution of tasks in diverse organizational structures simultaneously. Secondly, the advantage was in the standardization of the R&D and the different processes for development of new technologies. The new approach formalized the project management practices and introduced the project maintenance and control systems during development. A technology development manager from the innovation unit, responsible for the shift to the new approach described:

“Our goal was to find the balance between the values we could bring and the resources we needed to invest into the development. Before, our R&D was more service-oriented and less oriented on the development of complex innovative projects in cross-divisional cooperation. We were more focused on key performance indicators (KPI). In divisional R&D they were free to do what ever they wanted. With the new industrial-based approach, we introduced the interdependent structures and processes to product development that are still available today”

The centralization of the R&D and standardization of the development process was aimed to enable the creation of radical innovation in the company. The initiative aimed to create a structure that could support and facilitate the processes and activities necessary for

the development of radically new technologies and complex engineering products and services that could occur in the innovation unit.

Soon the innovation unit became a place for exploration of new opportunities. With time, the unit turned into an internal incubator for innovations. It was a place for the research and discovery of new ideas and experimentation with new concepts. Particularly, those radical innovations and complex engineering and technological projects that were not accepted to the development by the R&D departments in the divisional business lines, could be suggested for development in the innovation unit. A technology development manager of the unit described a few projects:

“The ideas of some of the radically new projects came from our company’s champion and his team. The approach to develop these innovative technologies was quite new for us. We decided that a specialized unit would be a good place to get them matured”

Gradually, the innovation unit turned into a place for the research, maturation and experimentation with ideas, concepts and technologies that were aimed on the creation of radically new products and services. The innovation unit also established the incentive systems and recognition for the exploratory type of activity. It took the form of the internal innovation award and was granted for recognition and evaluation of the impact from the R&D activity of the project teams, particularly those, who developed a new product or service.

For the top management, the unit had a crucial function. Its role was to deliver the strategic and radically new technologies and to lead the development process of the important projects. For the executives, the unit was a place for execution of technological innovation top-down. But for the rest of the company, it turned into a separate, unknown and ineffective organizational structure. The innovation unit was isolated from the divisional business lines and was seen as cash-absorbing, risky and unprofitable internal organization.

4.2.3. Separation, isolation and the “ivory tower” syndrome

Being a young evolving entity, the innovation specialized unit enters into a maturity phase. Its activity from early 2012 to late 2013 was characterized as growth and stable development. The innovation unit was engaged in building a new corporate culture and reinforcing the power of innovation in the company. The team worked on the creation of the appropriate environment to stimulate innovation, such as the creative workspaces, where the

R&D project teams could organize brainstorming sessions, remote telecommunication and meetings with the help of digital tools.

The innovation team created the corporate newsletter, where the main topic was technical innovations in different industries and fields. This type of communication with the rest of the organization was aimed to deliver the message to all individuals and engage them in R&D of innovation. Another goal of the letter was to demonstrate that new ideas and concepts could come from all departments and that the innovation unit could help idea-holders recognize and valorize them.

In parallel, the unit formalized the procedures for project management and facilitate the projects that need non-ordinary approaches to problem – solving. It started to communicate and to promote the culture of innovations and technological excellence to employees at all levels, to the divisional business lines and to external audience.

The increasing number of the innovative projects of the unit demonstrated the early positive results from the exploration activity. Several incubated and developed solutions brought radical technologies to the market and a success to the company. The new technologies changed the old way of doing operations in oilfield exploration. Commercial success from some of these projects showed the company as a leading and innovative organization. In spite of the success from the projects, the innovation unit started to experience the lack of linkage with the exploitative structures and faced with a problem of isolation.

Phase 3: Isolation of the innovation unit: The “ivory tower” syndrome

Structural separation of exploration and exploitation, discussed in Chapter 3 of our research, resulted in the differentiation of labor between the entities and their activities. The R&D of innovations was completely separated and occurred in autonomous structures. In one of the interviews in 2014, the chief engineer of the innovation unit explained the separation of the activities:

“In general, in the company we started to have emerging a nice idea, that divisional business lines are there to do mostly incremental improvement and this types of development, whereas the really risky stuff could be done by the innovation unit”

Separation of activities was necessary to ensure their mutual presence in the company and to cope with the emerging conflicts and tensions. In fact, the differentiation of labor was

essential for managing diverse projects with different objectives and to ensure the execution of different processes and procedures for different types of development. Moreover, maintaining the distance between the innovation unit and the rest of the company was critical for sustaining its ability and capacity for exploration. In the interview, the head of the innovation unit argued on the separation and division of activities:

“If radical innovations had been led by divisional business lines, they would have been killed by business”

Indeed, there is a vast difference between the explorative and exploitative structures and activities. When the project teams are doing incremental R&D, they improve existing technology. Primarily, they improve the design or performance of a component with a purpose to increase the operational efficiency of the whole technological system. In radical R&D, the project teams search for the brand new technology and create new markets and clients. They experiment with new products and services for future, even if the returns are not evident.

Moreover, there is a differentiation of the strategic intents, missions and objectives of the divisional business lines and the innovation unit. The goal of the innovation unit is to work on radical innovations and to deliver strategically important projects and technologies. The management of the divisional business lines, in contrast, has short-term objectives and obligations to reveal their results every quarter. Their main goal is to guarantee the margins and to ensure that they can respond to market pressure and demonstrate positive results to the stakeholders.

Being structurally, functionally and culturally separated from the divisional business lines, the innovation unit got isolated from the rest of the company. The returns from its exploratory activity were not well exploited by the divisional business lines and resulted in the increasing number of the rejected innovative projects. The chief engineer from the innovation unit argued:

“In the innovation unit we have good knowledge on complex product development compared to other parts of the company. The bad news is that we are not really closely linked to the rest of the organization. People see our unit as an “ivory tower”

To avoid isolation and to escape being the “ivory tower” the innovation specialized unit initiated a new type of collaborative R&D, where the main idea was based on co-creation

of innovations between the innovation unit and different business lines. This type of collaboration encouraged divisions and business lines to put common efforts and resources and to engage together in the development of complex incremental and radical types of innovations. In the management literature scholars argue that collaboration between different business units is central for creation of value (Martin and Eisenhardt, 2010). It is “particularly important for large companies in complex changing environments (p. 265). Such co-development activity deals with complex costly projects that require expertise from different fields.

Phase 4. Towards integration, co-development and ambidexterity

The first mechanism to create and reinforce the link between the innovation unit and divisional business lines was the co-development process. This process suggests sharing the activities and resources for new R&D projects. The chief engineer and the head of the innovation unit and described the critical step at the process and the relation with the divisional business lines:

“In the innovation unit, we are doing the early TRL levels. We explore a new technology till TRL 4-5, where we proof the feasibility, but we don’t have the industrial product yet. And then, we would have a decision how to make it faster to the product”

“When we develop radical innovation, we stop at a certain point. Usually it is the TRL 5-7. This means that a new product or a service will be completed at the divisional business lines in order to perfectly match the market expectations”

The second mechanism to link the explorative and exploitative entities was in the advisory role of the innovation unit (discussed also in Chapter 1). Initially, the purpose of the innovation unit was to create the entity that would ensure the delivery of innovations and decision top-down, The unit was seen as an integrating element to achieve the linkage between the top management and divisional business lines. In 2008-2009, business lines were independent and autonomous structures, with the freedom to organize and to perform their activities. The objective of the unit was to influence divisional business line on R&D activity and to develop proposals on exploration of the new business domains and new technologies.

However, such a new initiative from the top management was not well accepted at the exploitative structures. Very often, the divisional business lines rejected the proposals from

the innovation unit on exploration of new technological opportunities. The reasoning of the resistance was berried in the original structuring and organization of the company's activities. The executive manager for strategy and integration who was a member of the innovation unit explained:

“It is a hard job to influence on the R&D activity of the divisional business lines. It is not easy to advise divisions because they are rather strong by themselves. They tend to listen to our proposals. When they agree they say, “we agree”. When they don't – they say, “we don't agree”. That is the way I can describe this relationship”

It is important to recall, that the centralization of the corporate R&D was a relatively new process and divisional business lines continued to see themselves as the autonomous and independent entities. The overlap between the new R&D structuring and the still existing corporate habits created another organizational tension between the structures. On the one hand, the divisional business lines wanted to keep their independence in decision-making and management of the R&D. On the other hand, there were no incentives on place to reinforce the linkage and cooperation between the different structures, particularly coming from the higher company's levels (e.g. executive directions, cross-divisional investment programs, rewarding systems, etc.).

Another attempt of the unit to increase the interest to innovation among the divisional business lines and to improve the relations was the co-creation with clients. The unit search for and invited petroleum companies to join the process of development at the late prototyping and testing phases for new projects. It was an approach to demonstrate the effectiveness from the R&D of innovation and to show the increasing demand for new products and services, coming from the market. Also, co-creation was a way to share the experimentation costs and to receive preliminary contracts with clients for exploitation of the innovative technologies. These were the mechanisms to improve the linkage between the exploration and exploitation structures and activities as well as to de-risk exploratory projects and to demonstrate the returns from exploration.

4.3. Evolution of the innovation unit

As an independent exploratory structure of the technology-based service company, the innovation unit passed through several important steps. Figure 4.2. represents the evolution of the unit and the main phases of its development, which we discussed previously.

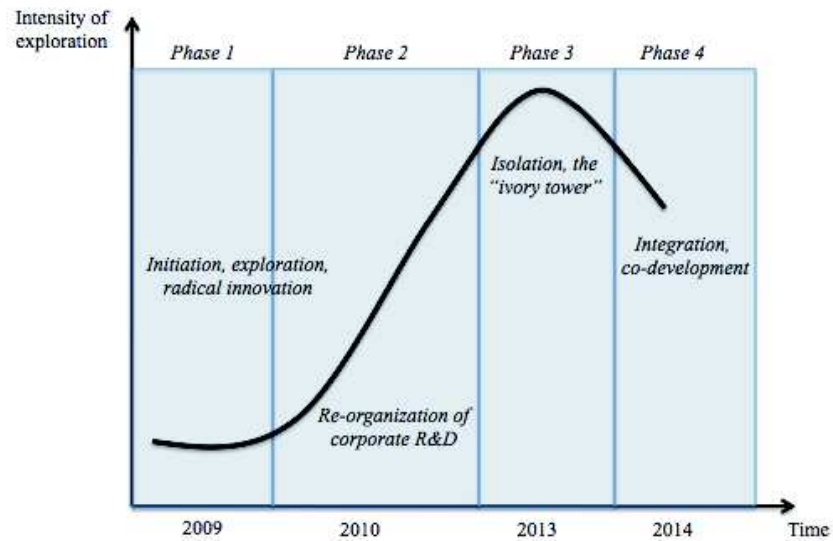


Figure 4.2. Evolution of the innovation unit

The evolution of the unit, including the periods covered by our research, includes the following phases:

Phase 1. Initiation by the top management and the exclusive focus on exploration of radical technological innovation;

Phase 2. Re-organization of the corporate R&D activities, managed by a new manager of the innovation unit and supported by the top management;

Phase 3. Isolation of the innovation unit and the emergence of the “ivory tower” syndrome;

Phase 4. Integration of exploration and exploitation through co-development and advisory activities (ambidexterity)

At the early initiation phases, the innovation unit had an exclusive focus on the exploration of radically new technological products and services and bringing innovations top-town. But, it was evident that doing exploration in isolation and without involvement of the divisional structures would lead to high experimentation costs and weak returns. To make a newly created entrepreneurial and innovation-driven unit effective, the company needed re-organize the old R&D capabilities and processes and to put in place the coordinated approach to create innovations across the whole organization.

The answer to the organizational need was found in the industry-oriented approach to R&D of technological innovations. It proposed to simultaneously separated the highly concentrated sets of activities in different structures and integrate them during the

development processes (see also Chapter 3). The new approach to R&D served for creation of a system of tightly linked activities and coordinated structures.

Such an organizational shift from disconnected structures to the system of integrated functions had a strategically important intent for the company. The notion of a system that consists from the tightly linked and coordinated activities is described in the strategic management literature. The fit between the multiple functions is essential to achieve constantly growing competitive advantage and organizational sustainability. “Positions built on systems of activities are far more sustainable than those built on individual activities” (Porter, 1996, p. 15). Without coordination and linkage between the activities “there is no distinctive strategy and little sustainability” (p. 17). It is the role of management to achieve the alignment and coordination between diverse structures and activities.

In practice, it is hard for organizations to build a system of tightly linked activities, because it requires coordination across multiple structures. It is also difficult, because very often the priority is given to the individual results, rather than to the results of the whole system (see also Levinthal and March, 1993). The pursuit of operational effectiveness is seductive because it is concrete and actionable” (Porter, 1996, p. 17). Organizations and managers are more likely “to deliver tangible and measurable” results and to demonstrate the assuring progress (p.17).

We observed the similar fact of prioritization of exploitation during the phases of the evolution of the innovation unit. The attempts to re-organize the corporate R&D and to create a new system of linked activities met the resistance from the exploitative structures. Being still driven by the old experience, the divisional business lines resisted the change. The divisional management wanted to keep their operational independence and the decision-making freedom. Moreover, as these structures were traditionally large, efficient and cash-generating entities, they did not wanted to cover the costs for the uncertain and research-intense innovative projects, share responsibilities and resources with the cash-absorbing entrepreneurial unit. It was a purely financial aspect that prevented exploitative structures to change their existing way of organization and to switch to the new coordinated type of corporate R&D.

Also, the attention should be given to the top management in the described organizational change. In parallel to the attempts to build a new system of linked activities, the executives of the company continued to provide a strong support to the exploratory activity of the innovation unit. During the phase 2 and at the early phase 3, they allocated resources to cover the development of the research-intense innovative projects of the unit. The

examples of the innovative projects (from Chapter 3) demonstrate that indeed, the exploratory activity was protected and funded by the executives.

While the top management patronized exploration (which is the essential condition for structural ambidexterity), nothing has been done to help the exploitative structures to switch to the new way of doing R&D. Porter (1996) describes “attempts to compete in the several ways at once create confusion and undermine organizational motivation and focus” (p.19). The divisional management found themselves in the state of confusion, where on the one hand, they were expected to demonstrate short term operational effectiveness as in the past. On the other hand, they needed to start a new activity, which was the allocation of their own resources for the innovative projects with uncertain and distant results. Confusion, the loss of focus and absence of a clear vision and plan from the higher organizational levels created a tension in the exploitative structures. Divisional managers did not understand how their structures should continue to be operationally effective and at the same time, allocate resources and cover the costs of exploration at the innovation unit.

Our view is that communication coming from the top management on a clear vision, strategy and plan for achieving an integration between the multiple activities could be a solution to solve the emerging tension in the structures. Another one could be a creation of linkage between the leaders and senior managers of different structures and making them work for a common goal (as proposed for example by O’Reilly and Tushman, 2004; Tushman et al., 2011). In our case and because of the absence of proactive role coming from the higher levels, the company turned into an organization with two separate, but uncoordinated activities. The divisional structures stayed in their old efficiency-driven mode of operations and the entrepreneurial unit got isolated from the rest of the company and turned into an “ivory tower “ as risky, cash-absorbing and unprofitable entity.

The absence of sufficient integration and linking mechanisms created an increasing gap between the structures and activities. In the late phase 3 and early phase 4, the innovation unit still had the executive support, but the amount of the allocated resources started to decrease steadily. The innovation unit explored new domains without any implications from the divisional business lines. As the result, many of the innovative projects were rejected to exploitation. For the company, the innovation unit started to have the image of a risky and costly entity. Even in spite of the strong support from the executives, the unit was not able to demonstrate the similar effectiveness as the divisional business lines. Trying to assess the performance of the innovation unit, it was clear that it cannot compete with the efficient exploitative structures. That is why with time the entrepreneurial unit turned into an internal

rival and started to compete with the divisional business lines for allocation of the R&D resources from the top management.

Having the decreasing support from the executives (phase 4), the innovation unit searched for a new ways to demonstrate its efficiency and proof the legitimacy. To show the credibility, it has begun to explore not only for the projects of radical innovation, but also for incremental improvements of the existing technologies. To survive without executive support, the innovation unit started to combine different activities and became itself ambidextrous. We identified this new ability of the entrepreneurial unit to be ambidextrous by making the analysis of its innovative projects. In the next section we discuss the results and explain the ambidexterity at the project level.

4.4. Ambidexterity at the project level

From the analysis at the corporate level, we learned that the innovation unit is a structure dedicated to exploration and learning with the primary goal to develop radical technological innovation in the company. The overview of the history of the unit identified that initially, it was the only structure, which manage the innovative projects with significant degree of novelty and exploration. At its early development phases, the activity of the unit was exclusively focused on exploration, research and discovery of new opportunities.

The evolution of the entrepreneurial structure, in contrast shows that without integration and linking mechanisms, it has become isolated from the exploitative entities and turned into an “ivory tower” for the rest of the company. For the divisional business lines, it was particularly difficult to exploit the results from the exploratory activity of the unit, because of the state of the maturity of new technology or its overall lack of fit into the existing market operations. Often, divisional structures rejected new concepts and projects coming from the unit because of weak alignment to market demands or because the project needed additional exploration. To avoid isolation and unprofitable exploration activity, the innovation unit started co-develop projects together with exploitative structures. Divisional business lines were invited to join the new project at the earlier phases of the development and share the costs and responsibilities. This activity took a form of co-development of the incremental technological innovation.

Our analysis of the different innovative projects shows that over time the unit switches from being focused only on the radically new type of development to a combination of projects and activities. The in-depth analysis of 6 technological innovations demonstrated the presence of both radical and incremental innovation at the exploratory structure.

The mix of exploration and exploitation activities in the unit was represented by its ability to engage simultaneously at diverse projects. *Radical innovations* refer to a new core of a technology, new processes, new systems and new operational capabilities. These projects are large, resource consuming, have long initial phases and require several years for research. Projects of *incremental innovations* are oriented on the advancement of the existing technologies, current processes and operations. Such projects are less risky and have certain results. They need less time for research and experimentation, because the core of the technology was already available and its feasibility was proven by the market. The development process for these types of innovation was organized as co-development projects and shared between the innovation unit and with the divisional business lines.

At the *project level*, the analysis showed:

The innovation specialized unit combines exploration and exploitation activities. It searches for and develops innovative projects for both radically new and incrementally improves the existing technologies. By combining different activities and types of innovation, the innovation unit becomes itself ambidextrous.

Our research identified the mix of exploration and exploitation at the exploratory structure. First, the unit develops both radical and incremental types of technological innovations and second, it gets involved in processes and activities that refer to both exploration and exploitation. Previously in Chapter 3, we observed the innovative projects and the stories of their development and identified the reasoning for the combination of activities. Table 4.2 explains the ambidextrous nature of the exploratory structure, and includes the characteristics of exploration and exploitation activities in different product development processes and in different innovations. It is a complementary data to the Table 3.2 (see Chapter 3) on combination of activities in projects of the innovation unit.

Table 4.2. Ambidexterity at the project level: Radical and incremental projects of the innovation unit

	Projects of radical innovation	Projects of incremental innovation
Project's objectives	Define and demonstrate the feasibility of a new concept / new technology	Demonstrate the feasibility of an incremental improvements from the existing technology
Main role in the project	Actual R&D	Advisory / coordination of R&D
Type of activity	Search, experimentation, brainstorming sessions, subcontracting, partnering	Additional study, prototyping, testing, subcontracting, partnering
Time for exploration	2 - 3,5 yeas	1-2 years
Responsibilities / involvement	Owned by the unit	Shared with divisional business lines
Decisions / Resources allocation	Top management & Management of the unit	Management of the unit & Divisional management

Although, the innovation unit organized exploration both for radical and incremental innovations, it is essential to distinguish the differences between the activities necessary for creation of different technological innovations. In radical innovation, the purpose of the exploration activity of the innovation unit is to create new technology. This type of development process is focused on the definition of the new concept and on necessary technical and feasibility studies to estimate and to prove the effectiveness of a new product or service for the future market. Radical type of innovation introduces new concept, new models and/or a new system of a technology. The creation process develops new knowledge, skills and competences that did not existed before in the company.

During the development of the radically new projects, a large part of the activities and resources is spent on search, discovery, knowledge creation and experimentation. The innovation unit organizes cross-divisional brainstorming sessions where it invites professionals and experts from diverse divisions to identify new technological and industry challenges and /or to use creative problem-solving techniques for a specific idea. To create and acquire new knowledge, the innovation unit works with different partners and subcontractors. In large scientific projects the unit explores and perform research with scientific institutions and clients – petroleum companies. During phases of the projects, the unit works with sub-contractors, who perform specific studies or tests on a chosen domain.

The initial phases of the new product development process are long, uncertain, have high risk and costs. The approximate duration of research and experimentation is 2-3,5 years. After that period, the innovation unit is able to demonstrate the technical and market feasibility of a technological innovation.

This explorative process is fully organized, owned and sponsored by the innovation unit. Depending on the project, initial phases can involve internal and external partners. In such projects, the management of the innovation unit and the executives of the company are responsible for the decision-making and allocation of resources. The development process of radical innovations is supported and funded by the top management.

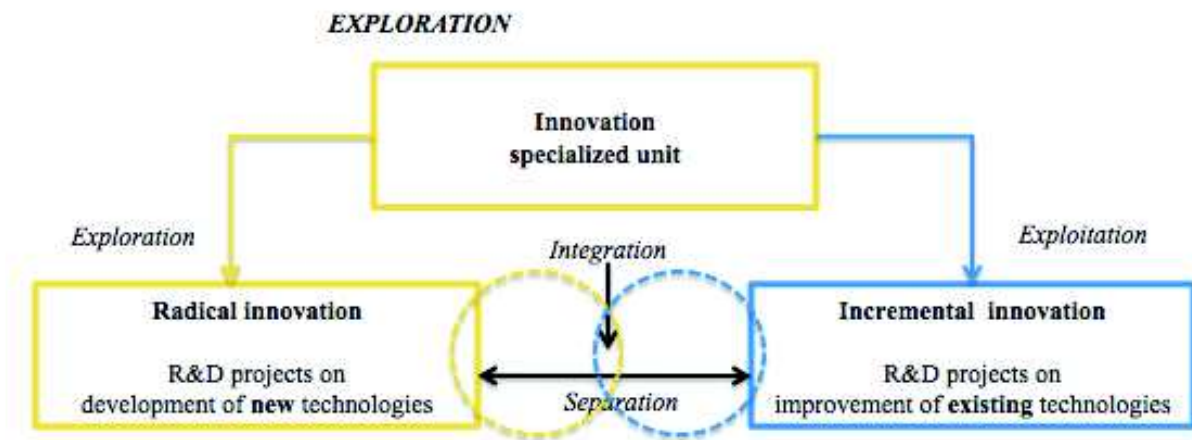
For incremental innovation, in contrast, the unit continues to do exploration, the scope of the research and experimentation is different than in projects of radical innovations. This activity is aimed at improvement of the existing technologies that are present on the markets. For such projects, the role of the innovation unit is to carry out the necessary studies and experimentation and to prove the feasibility of an incremental improvement e.g. improved design or component for the exiting technology.

In contrary to creation of brand new technologies, the projects of incremental innovations do not require heavy research, studies and experimentation. Because of the availability of the technological core, the unit only makes additional studies, prototyping, refinement and testing. In some cases, the project teams refer to partners to cover small parts of the research or experimentation in the fields. The initial phases of incremental projects last approximately 1-2 years. When the unit proves the feasibility of an incrementally improved technology, the project can be transferred to the divisional business lines for further exploitation and market launch.

For the innovation unit, the creation of incremental innovation is organized as the co-development process and projects. In general, the innovation unit does not own such projects, but host, facilitate and advise on the organization and coordination of the development between multiple internal and external partners. As a rule, the development process is shared between the unit and the divisional business lines. These are cross-divisional projects of incremental improvement.

By making the analysis at the project level, our research identified that the mission and the exploratory capability of the innovation unit can change over time. As in the case of our company, the unit has lost its exclusive function of exploration, creation of new knowledge and technologies and gradually switched to combination of exploratory and exploitative functions. Having a mix of activities and combination of different innovations, the innovation unit became itself ambidextrous. Hence, our project level analysis shows that

the innovation unit shifted from being exploration-focused to a combination of exploration and exploitation and with time started to perform both activities in parallel (see Figure 4.3).



**Figure 4.3. Project ambidexterity:
Separation and integration of activities in the innovation unit**

Figure 4.3.illustrates the ambidextrous nature of the exploratory structure of the company. The innovation unit is ambidextrous, not only because it develops radical innovation and incremental improvements, but also because is combines different sets of activities and processes. It search for new opportunities, creates new knowledge and radically new technologies and in parallel it develops and tests the prototypes for the improved versions of the exiting technologies.

This illustration is similar to the one that describes the ambidexterity at the corporate level (see Figure 4.1.) where the activities and processes are separated in different organizational structures (the innovation unit and the divisional business lines). In combination, these two figures confirm the existence of fractal nature of ambidexterity and show the replication of exploration and exploitation simultaneously at different organizational levels.

The visualization of fractal ambidexterity also gives us a hint that structural separation is not sufficient to achieve and even more, to sustain organizational ambidexterity. While separation is a way to deal with the conflicts and tensions between exploration and exploitation, the commonly emerging danger is the lack of synergies, regardless of a level. In other words, the linkage and integration between both activities is as important as their separation and the effect from synergies should not be neglected.

Ambidexterity has a tendency to emerge at multiple levels at the same time, as described already at the corporate and project levels. Moreover, the intensity of exploration and exploitation can change over time, for example as illustrated by the evolution of the innovation unit. Neither organizations, nor academics should ignore the replication and dynamics of exploration and exploitation. The reasoning to that phenomenon is partly discussed in the next section, dedicated to our executive level and will be further developed in the final chapter of our research.

4.5. Ambidexterity: A view from the executive level

As mentioned in our methodological part (Chapter 2), we use the executive level to assess the results from the previous two levels of our study and to understand the reasoning of the emerging ambidexterity in the innovation unit and its alignment with the ambidexterity at the corporate level. To collect the data, we asked senior and executive managers of the company to explain separation of activities in different structures and the approaches they used to achieve coordination and integration between them.

Previously, at the corporate level, we identified structural separation with the high concentration of activities. But taking the perspective from the project level, it was unclear why with time, the exploratory structure started to combine exploration and exploitation, whereas the exploitative entities continued to focus exclusively on exploitation. The technology development manager explained the separation of structures and differentiation of activities:

“The structure of the company reflects the separation of activities. Business lines are operational; they have to deliver benefits and results in the end of each quarter. They don’t put money into very long projects, knowing that at some point in time they will get those long term projects from the innovation unit. This is a purely financial aspect. People in the business lines have to deliver results”

Senior research engineer from a divisional business line described the routine and standardized type of work that was in priority for the exploitative structures:

“In the business line we work on the short term projects. We don’t have time to think about blue –sky ideas. We have to be pragmatic and efficient”

Additional attention should be given to the conservative culture of the industry and efficiency-oriented people's mindsets. In majority of cases, individuals are focused on small changes that can bring improvement and then on the refinement of the existing routines with a purpose to increase operational effectiveness. Senior operational manager of a divisional business line described the existing in the divisional structures culture:

“Because of the strong competition, the activity of the divisional business lines is very competitive. This business has high risk and investment, but low margins. The mindset of people, especially in the offshore operations, is very conservative. They don't like to see innovations on the vessels. They like to see reliable and proven technologies, that can ensure their margins in a short-term”

The resistance to change and low priority of innovation can be also justified by the operational and routine-focused mindsets of managers and employees, who choose to see the short term results and avoid risky, uncertain and long term projects. Head of a divisional business line explained why the managers of the divisional structures did not accept well the new strategic initiative from the top management about sharing the resources and co-development together with the innovation unit.

“It is difficult to convince people from divisional business lines who used to think about the quarterly results, profit and losses, that now half of their profits must be invested into the research projects and that the revenues will not be reflected immediately in the balance sheets”

The interviews with managers demonstrate that in the exploitative structures the priority is given to the routine and standardized type of work. The job of the divisional business lines is to make incremental improvements for existing technologies. Their goal is to execute short term planning and demonstrate quarterly returns.

The objective of the innovation unit, in contrast, is the exploration of new ideas and technologies. Its R&D projects have a long term orientation and strategic importance for the company. The unit has the necessary skills and competences to search for and create new complex technologies. These expertise and competencies are in minority in the divisional business lines. In the interview, the chief engineer from the innovation unit explained:

“In the innovation unit we have a good knowledge on complex product development compared to other parts of the company. The bad news is that we are not really closely linked

to the rest of the company. So we are a kind of an “ivory tower”. It’s what people think about us. Also, our product development knowledge are not always well utilized and engaged in the divisions”

The differentiation of labor, where exploration was entrusted to the innovation unit and exploitation to the divisional business lines created a particular relation between both entities. On the one hand, the management of the company was trying to link different R&D structures by establishing mutually beneficial relationship (e.g. delegation of responsibilities during the development process and shared resource allocation for innovative projects). On the other hand, this linkage and integration were not sufficient enough. The heads of divisional business lines were not convinced on allocating their own resources and engaging in exploration with the unit. In reality, they did not see the benefits for divisional structures from such types of collaborative projects. Besides, divisional business lines were certain that sooner or later they would get a new project for exploitation from the innovation unit. They only needed to wait for an appropriate moment.

For the innovation unit, such approach to organization of the innovation process was painful and had low performance. In fact, without any interest in exploratory activity from the divisional business lines, the unit got isolated and suffered from weak returns. The processes were organized in a linear fashion, where the unit did its exploration job and then transferred the project for exploitation in the business lines. In reality, such an approach to organize development was not effective. The structural isolation of the unit increased the uncertainty, risk and costs of failures from exploration. It is an open secret, that during the creation and development process, there are high chances of failures if the exploration is performed without any implication of exploitation. New ideas from the exploratory units might be too far from the market, or not feasible and not exploitable in the operational structures.

In the innovation unit, this problem of disconnected and uncoordinated activities and structures emerged during the R&D of radically new technologies. A chief scientist who was a co-developer of a new project described:

“When we started to develop new technology in the innovation unit, divisional business lines showed absolutely no interest in what we were doing. When we were trying to prove the concept, people were thinking that I and my other colleague were two crazy guys with a crazy idea that we wanted to test. Fortunately, the innovation unit had the resources for this activity”

This example demonstrates that the responsibilities on resource allocation were given to the innovation unit, the same applied to consequences and losses from possible failures. Sometimes, cooperation between explorative and exploitative structures might take unusual forms and serve as a means to fulfill the interests of one counterpart. A scientist from the divisional business line explained:

“ During the research and experimentation phases, one of the business lines saw in our new project a good opportunity to sell the boat that was not used by their clients. They were trying to give us their worst vessel in a bad area at the most expensive price. They were not thinking at all that this could be a successful technology. They didn’t believe in it”

Similar conflicts between uncoordinated exploration and exploitation were identified in another project of radically new technology. It explains a particular difficulty to convince divisional managers to invest in the long term development of strategic projects. One of the project of radically new technology needed additional funding for research and experimentation activities. The management of the innovation unit decided to suggest a business line to cover the part of the costs. The chief engineer from the innovation unit, who was the project initiator described:

“We needed 1,8 million to develop a new technology. We proposed to a business line to develop it together. They said they were happy to take a success but not to invest into the research and the initial risky part. Their job is to take credits and make benefits. The job of the innovation unit is to take the risk. They have to make money”

The interviews with the senior and executive managers from different organizational structures confirm that in the company, exploitation is concentrated in the divisional business lines and exploration in the innovation unit. The exploitative entities are large and efficient, whereas the unit is a costly and low performing entity. Protected by the top management, the innovation unit was able to keep its explorative mission. But at the same time, by doing strategic technical innovations without any integration of the divisional structures, the unit became isolated and suffered from unprofitable exploration.

During few years after the formal creation the unit owned an exclusive role on exploration. Having strong executive support, it succeeded to create organizational environment to incubate and develop several important innovative technologies. Although success from new products and services demonstrated benefits from exploration, the unit had

low returns. For the rest of the organization the innovation specialized unit was an entrepreneurial, costly and high-risk entity, whereas business lines remained efficient, profitable and cash-generating in their core business. To survive, the unit started to search for efficiency-oriented activity and develop also the projects of incrementally improved technologies. From an exploratory structure, the unit turned into an ambidextrous structure and switched to simultaneous exploration and exploitation.

4.6. Why did the innovation unit become ambidextrous?

In analyzing this phenomenon, the critical issue is to understand why the exploratory structure started to mix two activities and simultaneously explore and exploit. The reasoning of ambidexterity that emerged at the innovation unit was the change in the environment and the shift of the priorities of the company's top management. We identified three critical factors for the emerging ambidexterity at innovation unit.

The first factor was the **decreasing top management support** of the exploratory activity of the unit. Initially dependent on the sponsorship from the executives, the unit started to experience the declining interest from the executives. The first reason to that was the return from the exploratory activity and proof of efficiency of the unit. In 2014, which mean more than 5 years after the official creation, the company expected to evaluate the returns from innovation. For the unit, it was time to "pay back" and to demonstrate the results.

The second reason was the **market pressure** and the declining industry. In 2014 the energy sector experienced decreasing returns due to the collapse of the oil prices. Because of the turbulence in the environment, the company started to cut the expenses and investment schemes for long term R&D projects. Due to crises on the markets, top management began to search for more certain and secure options to for resource allocation.

In a given situation and with decreasing support from the executives, the innovation unit started to re-focus its exploratory activity. It started to develop not only radical innovations, but also incremental improved project to prove its legitimacy, credibility and efficiency to the top management of the company and to the heads of the divisional business lines. In incremental projects, the unit continued to do exploration, but the nature and degree of the exploratory activity has changed. Hence, to survive and **prove its legitimacy**, the innovation unit combined exploration and exploitation activities.

The evolution of the innovation unit and dynamics of ambidexterity shows that, originally, the function of exploration was given to the innovation unit. It priority was to search for new knowledge and create radically new technologies. Under the influence of

several factors, and particularly, by losing strong support from the top management, the unit decided to demonstrate its credibility, efficiency and prove its legitimacy. To survive in a given condition, the entrepreneurial unit developed a capability to act as an ambidextrous organization.

Overview and conclusion

This chapter interpreted and observed the ambidexterity at the corporate and project levels as well as integrated the results from the executive level. Also, it provided the description of a history of the innovation unit and its evolution in the company.

At *the corporate level*, ambidexterity is organized in different organizational entities. The company uses a *structural approach* to achieve ambidexterity. The exploration activity is entrusted to the innovation unit. Exploitation occurs at the divisional business lines. These are the separate structures. They have different types of activities, processes and projects. They have different targets, focus, culture and R&D. *The innovation unit* is a young entrepreneurial and innovation-oriented structure. The role of the unit is to search for new ideas, develop new concept and experiment with new technologies. Its mission is to acquire new knowledge and to develop radically new technological innovations for new markets.

Divisional business lines have contrasting characteristics. These are large, well-established and efficient entities. The entities are executive by nature and have short term orientation. The activity of the business lines is aimed at refinement of the existing capabilities. They improve performance and efficiency of the existing products, service and operations. The objective of the divisional business line is to improve existing knowledge and to develop incremental improvements for existing clients and markets.

Explorative and exploitative structures are separate and independent entities. The activity of the innovation unit is protected and supported by the top management of a company. Divisional business lines, in contrast, have operational and financial freedom. They are autonomous in making decisions on organization, management and allocation of resources for divisional R&D activity. At the corporate level, this study was able to identify two linking mechanisms that exist between exploration and exploitation:

- Integration and advisory role of the unit;
- Division of labor and specialization during the development process;

First, the innovation unit itself had a role of an integrator. It was aimed to link and coordinate the R&D activity from multiple divisions. On the one hand, the unit was a place for exploration of new ideas from visionary executives and execution of strategically important innovations top-down. On the other hand, it was responsible for selection of innovative ideas from the exploitative structures and proposing to the top management the innovative projects for development. The second mechanism that to link exploration and exploitation was the transition phase between the separate and specialized activities. The innovation unit performed exploration and transfer the new project to the business lines for exploitation.

Our research was able to observe the conflicts and tensions that emerged between exploration and exploitation. During stage-gate development process, the innovation unit had the responsibility for research and experimentation, and the role of the divisional structures was exploitation of the new technologies. However, often, the divisional business lines rejected the new projects as immature for exploitation. For their R&D, such projects of new technologies were not ready for the phases of development and commercialization. The result from the *disconnected* exploration and exploitation was the increasing number of rejected projects, increasing costs of research and experimentation and underperformance of the exploratory activity.

To decrease the gap between activities and to avoid complete *isolation* from the exploitative structures, the innovation unit started to develop new types of collaborative projects. These projects were aimed at the co-development of technological innovation, and sharing resources and responsibilities between divisional business lines.

The in-depth study of 6 projects of the unit (see Chapter 3) revealed a new fact about the exploratory structure. The innovative projects from the unit were aimed not only at the creation of radically new technology, but also at the development of incremental improvements for the existing technologies. The innovation unit switched from exclusive focus on exploration, to a combination of exploration and exploitation activities. Hence, over time the exploratory structure became itself ambidextrous.

The *evolution* of the innovation specialized unit in the company shows that the exploratory functions, roles and objectives of the unit have a tendency to change over time. For the unit, the critical role is to continue to do radical type of innovations, and to keep the appropriate proportion of exploration of new domains. If the unit decreases the number of radical innovations, it will mean the complete shift to exploitation. This indicates that in structural ambidexterity, the role of the exploratory structure exists only if it is protected and sponsored by the top management. Without support from the executives, the entrepreneurial

unit cannot sustain its performance. And as any organization, it starts both to explore and exploit in order to survive in a long term. The innovation unit becomes itself ambidextrous.

The results from our analysis at the corporate, project and executive levels demonstrated that ambidexterity has a tendency to emerge at multiple levels simultaneously. Structural ambidexterity, which is a way to organize exploration and exploitation at the corporate level is only one part of an “iceberg”. After careful examination of the activities at the exploratory structure, which supposed to focus only (or mainly) on exploration, it is becoming obvious that without a strong support from the top management, the entrepreneurial unit is more likely to turn into an internal ambidextrous organization. In the described context, we identified replication of ambidexterity: the organization is ambidextrous at the corporate level (by doing exploration and exploitation in separate structures) and at the same time, its exploratory unit is ambidextrous (by combining different processes and creating different types of innovations).

Our research explains this phenomenon of emerging exploration and exploitation at multiple organizational levels as fractal ambidexterity. We identified that exploration and exploitation can replicate and arise at the organizational and executive levels, inside the business unit and in projects and even more, that the proportion and intensity of the activities can shift and change over time. We argue on the existence of dynamic and fractal patterns of ambidexterity, which mean that exploration and exploitation have the ability to simultaneously emerge at diverse organizational levels and their intensity can change over time. The next and final chapter of our research introduces the fractal and dynamic perspective of organizational ambidexterity and presents the arguments about the existence of these patterns.

CHAPTER 5.

FRACTAL AND DYNAMIC: A NEW DIMENSION TO THE AMBIDEXTERITY OF ORGANISATIONS

The aim of this chapter is to define and take on board all the implications of the multilayer methodology and to capitalize the obtained results. In the previous chapters, our research described and analyzed ambidexterity at the corporate and at the project levels and also reviewed exploration and exploitation at the executive level. We identified that the technology-based service company is an ambidextrous organization that uses structural separation of activities. It simultaneously explores and exploits and produces different types of technological innovations.

By using our multilayer methodology, we detected the presence of exploration and exploitation simultaneously at different organizational levels of the company: corporate, project and executive. At the *corporate level*, ambidexterity is organized by means of structural separation of activities. Exploration, creation of new knowledge, research and experimentation take place at the innovation unit. It is an innovation – driven and an entrepreneurial organizational structure. Exploitation, improvement of existing capabilities refinement and production is dedicated to the divisional business lines. These are large, efficiency-driven and profitable structures. Divisional business lines are financially and operationally independent entities, whereas the exploratory activity of the unit relies on the top management support and protection.

After a closer examination of the actual activity of the innovation unit, we found that it does not perform exclusively exploration, but has a mix different processes and activities. Our findings at the *project level* demonstrate the combination of exploration and exploitation that take place at the exploratory structure. In particular, the innovation unit, not only does research and experimentation to create radically new technological innovations, but also participate in refinement, laboratory and real-life testing to develop incremental improvements for already existing technologies. With time, the unit shifted from being “purely” focused on exploration to a simultaneous exploration and exploitation. Hence, it became itself ambidextrous.

Senior and executive managers of the company confirmed our results from two previous levels. The finding at the executive level demonstrated ambidexterity at the corporate level and at the same time at the project level. The reasoning why the innovation

unit started to perform both exploration and exploitation was found in the lack of linkage between the activities and structures at the corporate level. Without sufficient integration with the exploitative structures, the innovation unit got isolated and suffered from low performance. As a result, the returns from of exploration were not well utilized at the operational departments and new projects were rejected to exploitation. With time, the company's innovation unit turned into a costly, high risk and cash-absorbing structure.

Another reason for the emerging ambidexterity in the unit was the change in the company's environment, which also caused the switch in the priorities of the top management. The evolving industry crises and the market pressure resulted in the decreasing amount of the allocated resources for exploration of projects of radical innovation. There was an organization need to re-consider the degree and intensity of exploration at the innovation unit. To survive without previously strong protection from the top management and to prove the legitimacy and credibility, the innovation unit turned into an ambidextrous structure. In parallel to exploration, the unit pursued exploitation and started to develop both radical and incremental technological innovations.

By using the case of the technology-based service company, our research demonstrates that the concept of structural ambidexterity has a set of serious limitations. First, separation of activities is not sufficient to achieve ambidexterity. The linkage and integration would be critical to achieve the synergies and to benefit from both activities. Second, it is only a temporal solution to explore and exploit in a given period of time. To remain ambidextrous and to sustain the appropriate degree of exploration, a company cannot rely only on the support from the top management. Any change at the higher levels (e.g. shift in priorities, rotation, etc.) would be immediately reflected on the organizational capability to innovate and to allocate resources for exploration. It also means that in the ambidextrous organizations, the top management must be and always remain ambidextrous, even during the serious shifts of the environment. Third, to remain sustainably ambidextrous organization, a company should take into account the fractal and dynamic patterns of ambidexterity and find the appropriate way to organize exploration and exploitation and wisely distribute their proportions simultaneously at multiple levels and in different periods of time.

This final chapter will capitalize the findings from our multilayer research and presents its main contribution on fractal and dynamic ambidexterity. It explains the phenomenon and shows the contrast between the theoretical and actual organizational approach to ambidexterity by means of structural separation.

The chapter has the following structure. First, it describes a theoretical and static representation of structural ambidexterity from the existing literature. Second, it demonstrates

the evidence from the case of the company on the multilevel dimension of ambidexterity. Third, it introduces definitions and explains the new concept of fractal and dynamic ambidexterity.

5.1. Theoretical and static structural ambidexterity

Organizational ambidexterity is the ability to explore and exploit simultaneously. To achieve ambidexterity, an organization can use a structural solution and separate exploration and exploitation in different organizational structures (O'Reilly and Tushman, 2004; Tushman and O'Reilly, 2002; Tushman and O'Reilly, 1996). The study (Tushman and O'Reilly, 2002) shows that exploration is more appropriate for young entrepreneurial units that are flexible and creative by nature and have an entrepreneurial approach to organize their work. For exploitation, the best fit is large, and efficiency-driven entities, which are routine, operational and executive by nature.

For structural ambidexterity, a critical function is given to the company's executives. Top management must protect and legitimize the exploratory activity of the entrepreneurial unit, in order to preserve the potential from new ideas and not to kill them too early in the process. In other words, the exploratory capability of the unit depends of the capacity of the top managers to protect, legitimize and support the exploration.

Moreover, scholars argue that in structural ambidexterity, managers must keep the exploratory unit "physically, structurally, culturally separated from the rest of the organization" (Tushman and O'Reilly, 2002, p. 171). Separation is a way to deal with conflicts and tensions that emerge between exploration and exploitation. Structural separation is inevitable because "the activities are so dramatically different that they cannot effectively coexist" (Birkinshaw and Gibson, 2004, p. 49). Indeed, the exploratory and exploitative structures apply different activities and processes. They have different cultures and produce different types of innovations. In addition, scholars propose that these structures must be not only separate, but also independent from each other (O'Reilly and Tushman, 2004; Tushman and O'Reilly, 2002).

Existing literature describes that to achieve ambidexterity through structural separation, an organization should fulfill several important requirements:

- 1) To *separate* exploration and exploitation in different structures with independent activities, processes, and cultures (O'Reilly and Tushman, 2004; Tushman and O'Reilly, 2002);
- 2) Top management should legitimize and *protect* the exploratory structure (young entrepreneurial unit) and separate them from the exploitative ones (old efficient entities) (Tushman and O'Reilly, 2002);

- 3) To *integrate* structures and activities at the management (senior and executive) level in order to benefit from synergies of exploration and exploitation (O'Reilly and Tushman, 2004; Tushman and O'Reilly, 1996)

These are the critical steps that a company should accomplish to achieve structural ambidexterity. It is becoming obvious that separation in different entities and top management protection of exploration are the important conditions to explore and exploit at the same time. But it is still unclear how senior and executive managers should deal with the emerging tensions and integrate activities and structures at the higher organizational levels. The influence of change in the organizational environment and rotation of top management are yet unexplored factors for structural ambidexterity.

If top management has a crucial function in ambidexterity, then it is important to find the answers to the questions as:

- Can an organization sustain exploration and exploitation, if top management decreases its capability to protect and support activity of the explorative structure? (e.g. because of the rotation or industry crises);
- Can an organization sustain exploration and exploitation without integration at the management level? (e.g. because of conflict of interest);
- Is it critical and sufficient for managers to be ambidextrous to organize and sustain simultaneous exploration and exploitation? (e.g. if managers are not ambidextrous)

To expand the knowledge on ambidexterity, scholars should pay attention to the question of sustainability of the structural solution and address such topics as influence of the organizational environment, the role of organizational bureaucracy, configurations of the structures, corporate politics and dealing with interests of different groups on more managerial level. Moreover, ambidextrous organizations must be observed as systems of the interrelated structures and activities, and not as a single unit of analysis.

5.1.1. Static representation of structural ambidexterity

So far, the literature on organizational ambidexterity presented different variations of the structural solution to balance exploration and exploitation, for example, as in the approach described above. Our research argues that this is only a *static* representation of ambidexterity.

According to the static understanding of organizational ambidexterity, exploration and

exploitation are organized in separate structures. Exploration can be entrusted to young entrepreneurial units, and exploitation to large efficient entities. Each of the separate structures has their own specialization. They are different in terms of activities, processes and cultures etc. This means that in an organization, there is a clear division of labor and event at the individual level, in structurally separate units people should focus only (or mainly) on one type of activity (either on exploration or on exploitation).

If we apply a static understanding of structural ambidexterity, as it described in the existing literature, to the case of the company from our research, it will have the following representation (see Figure 5.1.). The ambidexterity will be organized in structurally separate units, where the exploratory activity and creation of the radical technological innovation is entrusted to the innovation unit. Exploitation and refinement of existing technologies is entrusted to the divisional business lines.

The figure illustrates the static interpretation of structural ambidexterity through the lenses of our multilayer methodology. The different colors correspond to the exploratory (yellow) and exploitive (blue) type of activities. Within such organization, the separate units have different processes, projects and managed by managers with different priorities and mindsets.

At the corporate level the units have different types of structures and approaches to organize their work for e.g. in the entrepreneurial, executive and efficiency-oriented modes. At the project level, structural separation means that units have their own R&D projects and independent in their new product development processes. Being separate, they have the capability to produce different types of innovations as for e.g. radical and incremental improvements.

The exploratory and exploitative units need managers who will organize, coordinate and control their work. We assume, that to manage effectively a structure, leaders and senior managers of an entrepreneurial unit should have an exploratory and innovation-oriented mindset, tolerate experimentation, encourage risk taking and prioritize long term objectives. Leaders and senior managers in the exploitative structures, in contrast, should have efficiency-oriented mindsets, stimulate operational effectiveness and prioritize short term needs.

Moreover, even employees and their individual or group tasks, in different structures will be more exploration-driven or exploitation-focused. Individuals from the exploratory structure will be requested to have an innovation-oriented mindset and approaches to perform daily tasks. They should be flexible, visionary and have the ability for creative problem solving. Individuals in the exploitative structures are supposed to have an efficiency-oriented

behaviors. They must be executive and effective in routine operations and should be able to deliver results in the short term. Finally, the top management of the company should allocate resources to support and sponsor the activity of the innovation unit (indicated with a “dollar” sign in the Figure 5.1).

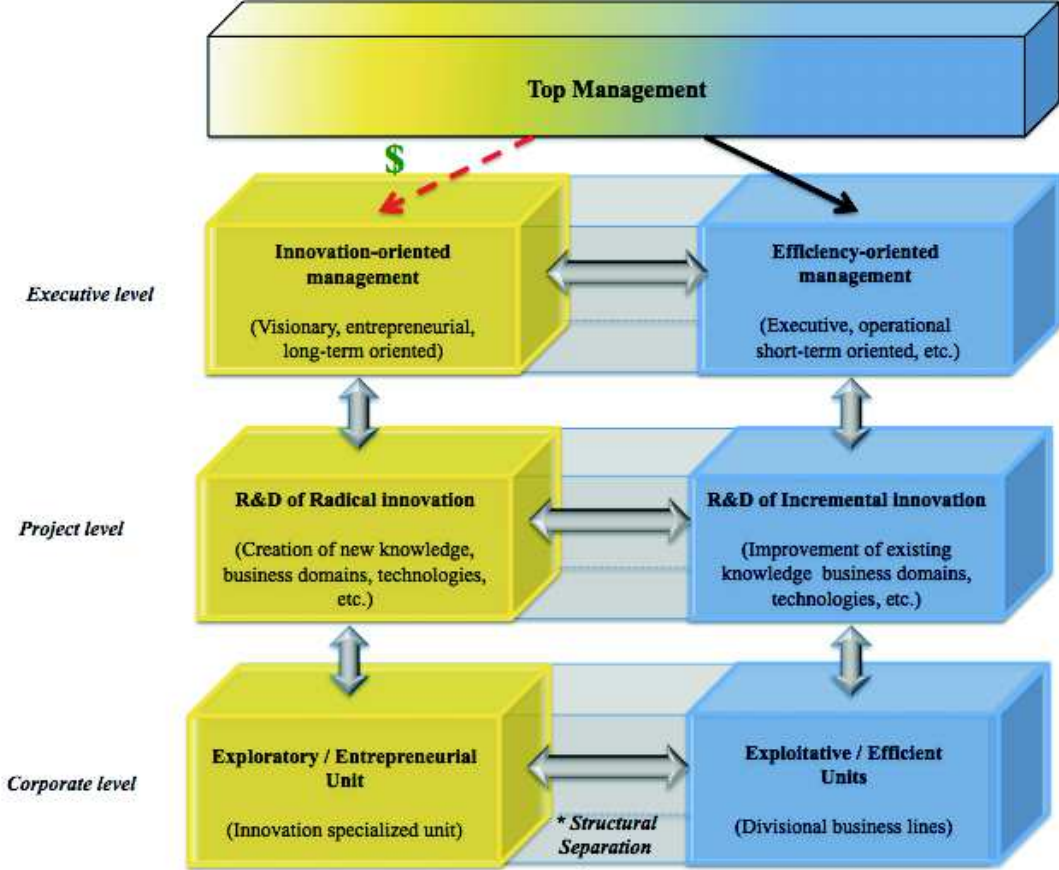


Figure 5.1. Static representation of structural ambidexterity

(Representation of model based on the case of the technology-based service company)

To make this organizational system effective, the top management must be themselves ambidextrous. As discussed previously, they must protect and support entrepreneurial unit, but also coordinate different activities in separate structures, manage and solve the emerging conflicts between the individuals, activities and processes. The tensions such as e.g. conflicts of interests at the senior management level, coordination of diverse objectives, prioritization of tasks and allocation of resources for different units etc.– must be solved at the higher organizational levels. It means that in a sense, the main responsibility for achieving structural ambidexterity lays on the shoulders of the top management.

Structural separation means that a company separates the activities and processes. Separation might be a solution to ambidexterity, if two structures have independent and fully

autonomous processes. For example, a creation of an internal venture unit to explore new domain of business, which is different from the core activity. The more serious problem of separation might emerge when two separate structures are the contributors to the one process. As in the case of our company, when the returns from exploration in the innovation unit are the inputs for exploitation at the divisional business lines. Regardless of the situation, either it is a new venture or the different, but interrelated structures, the ambidextrous company will need to search for synergies and get the benefits both from exploration and exploitation.

In reality, organizations are not able to remain structured and organized in a way as described and illustrated by our static representation of ambidexterity (Figure 5.1). Separation of exploration and exploitation is not sufficient to achieve and to sustain ambidexterity over time. It is difficult because, it seems that the top management have a crucial role in maintaining the ambidexterity. In particular, because it is not always an easy task for managers to remain committed to both activities and act as the ambidextrous executives. The existing studies do not analyze systematically the evolution of ambidexterity, if this function is not correctly executed by the top management.

Senior and executive managers have a tendency to be preoccupied with the operational efficiency, effectiveness of organizational performance and evaluation of tangible results. It is reasonable, because an organization can not succeed in the long term, without satisfying first its short terms needs (Levinthal and March, 1993). For organizations, it is not always easy to continue the allocation of resources to support the necessary proportion of exploration, even if the ambidextrous top managers are willing to do so. It is particularly difficult, when an organization is passing through the period of change or is influenced by the shifts in the industries and markets. But at the same time, if for a long period, an organization and managers devote too much attention to exploitation and effectiveness and neglect exploration, it will result in the short term benefits, but may turn into a failure in the long term (see also March, 1991; Tushman and O'Reilly, 1996).

Except the importance of the top management function, another critical and undervalued factor of structural ambidexterity is the separation of activities. Our research on the case of the company proves that separation is important, but not sufficient to achieve simultaneous exploration and exploitation.

5.1.2. Separation is not enough

Originally, separation of activities was an organizational solution to combine different sets of activities, processes and innovations and to address them both simultaneously.

Structural ambidexterity was preserved as an approach to both explore and exploit and at the same time be capable to avoid the emerging conflicts and tensions between them.

The evolution of studies in the field of organizational ambidexterity put under the question the proposed approach and in particular, expressed a concern whether only structural separation is sufficient enough for an organization to achieve ambidexterity. It is fair enough that the activities should be separated because they are so different that they cannot effectively exist together. But at the same time, their separation might lead to isolation of exploration and as a result, partial or a complete loss of synergies between the activities. Studies show (Birkinshaw and Gibson, 2004; Gibson and Birkinshaw, 2004) that the connection between exploration and exploitation is an important factor. It is a common practice that without sufficient integration, the exploratory structures “fail to get their ideas accepted because of their lack of linkage to the core-business” (Birkinshaw and Gibson 2004, p. 49). It leads to an organizational inability to exploit the returns from exploration, low performance of the exploratory unit and the increasing threat for its liquidation as unprofitable entity.

One of the existing studies of a Finnish ambidextrous firm (see Kauppila, 2010) proposes that indeed, separation of activities is necessary, but not sufficient condition to achieve ambidexterity. To explore and to exploit simultaneously, a firm needs to “integrate and balance both activities internally” (p. 294). Similarly, several other sources of literature propose that both separation and integration of exploration and exploitation are critical to achieve organizational ambidexterity (see also Andriopoulos and Lewis, 2009; Jansen et al., 2009).

There is an important emerging question for structurally ambidextrous organizations on how to separate both activities and at the same time, integrate them to achieve synergies. *On the one side*, the exploratory unit must be separate far enough from the exploitative entities and from the rest of the company in order to search for new innovative ideas, protect their potential and avoid killing them too early (see e.g. O’Reilly and Tushman, 2004; Tushman and O’Reilly, 2002). *On the other side*, the unit must stay close enough to the exploitative entities in order to prevent isolation and ensure exploitability of the returns from exploration. Without an appropriate linkage, the exploratory unit is more likely to get isolated and suffer from disconnected processes with the exploitative entities (see also Gibson and Birkinshaw, 2004; Kauppila, 2010; Levinthal and March, 1993).

To achieve ambidexterity, organizations and their managers should define how far separate the exploratory unit to search for new ideas, and how close it must be to the exploitative structures to improve and refine them. The vital questions are first, the degree of

exploration and exploitation and second, their coordination and integration to get the synergies.

It is no longer effective for organizations only to separate activities. Separation without integration is not a sustainable organizational solution to explore and exploit simultaneously. Although there is no yet a definite answer on how exactly ambidextrous companies can achieve separation and integration, some solutions can be found.

To coordinate both activities, existing literature proposes several options. More behavioral approach (contextual) suggest that companies may create cross-divisional groups, select individuals from different units to work on specific task or alternatively, create different teams within the unit (Birkinshaw and Gibson, 2004). In structural mode, it can be achieved by creation of a new unit separated from the rest of the company, as demonstrated by the cases of the USA Today, Ciba Vision companies (O'Reilly and Tushman, 2004) and linking them at the higher levels. These different approaches will need strong support at coordination from the top management. The executives will play an important function in managing ambidexterity.

5.1.3. Critical role of top management

In order to balance the activities, to separate and at the same time to integrate them, the top management of the ambidextrous companies must be themselves ambidextrous. The study of the ambidextrous CEO (Tushman et al., 2011) shows that it is a top management responsibility to take decision about the present and the future of a company, because at the senior management and operation level nobody is responsible for innovating. “Senior management time is dominated by the operational problem solving, with only occasional flashes of interest in the future” (p. 6). Executive managers must define and shape the company’s strategic uniqueness and clearly communicate it to lower levels (Porter, 1996).

As discussed previously, in structural ambidexterity top managers must devote a special attention to the exploratory activity of the entrepreneurial unit. They must support and legitimize it. In the same way, top managers must be cautious in the metrics they apply to evaluate performance of the unit. The study (Tushman et al., 2011) shows that very often managers use the similar metrics and assessment approaches as for exploitative structures, to measure the effectiveness of the activity from the innovation unit. In such situation, the unit is in disadvantage, as it can not compete with the effective performance of the established entities. To evaluate effectiveness of the unit, the executives should develop metrics different

from the one, which are used to assess the core-activity and adapt them to the state of maturity of the innovation unit.

We already mentioned that managers tend to prioritize short term needs via long term strategic intents. For the top management, it is not always possible to fully satisfy the organizational needs and to allocate sufficient resources both for exploration and exploitation. To maintain ambidexterity, “successful top management teams move resources between businesses as shifting needs demands” (Tushman et al., 2011, p. 8). They capitalize resources from exploration in one period and allocate them for exploitation in another. They move talented employees between the units and “make sure that the best people are placed where they are needed most” (p. 8). These are probably the most reasonable arguments regarding the crucial role of top management in achieving and maintaining the balance between exploration and exploitation, particularly in structural mode of ambidexterity.

In structural separation, coordination between exploration and exploitation depends much on the specific context of an organization. Not all companies will have similar challenges of separation, executive sponsorship and integration mechanisms. But most probably, all of them will have to face the questions of combination and the appropriate proportions of exploration and exploitation, because the pursuit of both activities is “the primary factor of survival” (March, 1991, p.71).

These questions will be particularly important in research-intensive and science-based organizations, as for example, our case, a technology-based service company. The reason is the fast obsolescence of their industrial and technological innovation. To innovate, such organizations will need to combine the activities and establish the relations between different units. Abernathy and Utterback (1978, p. 41) argue that in large science-based companies “what is a product innovation by a small, technology-based unit is often the process or the equipment adopted by a large unit to improve its high volume production of a standard product”.

It is also true for the case of our company, where the innovation unit is, in a sense, a supplier of the innovative projects for the divisional business lines. In technological innovation, the results from exploration are the inputs for exploitation. The exploratory unit or the research group applies an entrepreneurial act in order to create an innovation or a product change and satisfy market needs (Abernathy and Utterback, 1978). The goal of the large unit is to refine an innovation and to achieve the maximum benefits, whereas the small unit searches and experiments with new knowledge and technologies.

A research-intense organization that develops technological innovation, inevitably has to combine exploration and exploitation activities and search for their integration. In our

research, we reviewed the discussed above theoretical assumptions on ambidexterity and showed the practical evidence. The results from our multiplayer methodological research revealed a new perspective on ambidexterity, which is described in the next section.

5.2. Multilevel dimension of ambidexterity: The practical evidence from the case

To achieve ambidexterity, the company from our research uses structural separation. It explores and exploits in different organizational structures. The exploratory activity of the innovation unit is protected and sponsored by the top management.

5.2.1. Corporate level ambidexterity

The company from our research develops both radical and incremental innovations and devotes significant attention to exploitation. The R&D activity is represented mainly by the incremental improvements for the already existing on the markets technologies. It has strong exploitative capabilities and skills. In one of the interviews, the head of the innovation unit explained:

“Around 90% of our total R&D is incremental improvements. This is the major innovation we develop”

In other words, the organization is achieving ambidexterity by doing 90% of exploitative R&D to refine technologies and allocate the remaining 10% for the exploratory activities to create radical innovation. We crossed the levels of analysis in order to find out how the company organized and sustained ambidexterity with the described proportion of radical and incremental innovations and whether the intensity of activities changed over time. By making the analysis at the ***corporate level***, we received the following results:

The technology-based service company is an ambidextrous organization. Simultaneous exploration and exploitation and creation of radical and incremental innovation are organized in separate organizational structures. Research and experimentation occur at the innovation specialized unit, execution and refinement at the divisional business lines

Specialization, divisional of labor and separation of R&D activities and innovations were the means how the company explored and at the same time exploited in diverse structures. In an interview, the head of the innovation unit confirmed separation of processes and innovations:

“In our company, there are two different structures that support different types of innovations. Incremental innovation, where we improve the production and protect our market is organized at the divisional business lines. Radical innovation, where we change and re-frame technologies is concentrated at the innovation specialized unit”

Separation was necessary, because radical and incremental innovations need different development processes. The development of radical innovation had a high level of risk, uncertainty and required millions of investments, whereas the returns from such projects were not guaranteed. The head of the innovation unit argues that divisional business lines did not perform this activity because the management of divisions could not afford the R&D of research-intensive projects. The divisional structures did not support this type of processes. Their objective was to guarantee margins to the investors and stakeholders. They were efficient, profitable and short-term orientated.

The innovation unit, in contrast, had the capabilities to support entrepreneurial and risky types of development. It had innovation-oriented processes and activities. Moreover the unit got support and resources from the executives to perform the research for the long term projects. The objective of the unit was to do radical innovation and to develop strategically important technologies.

Although, the explorative and exploitative structures were structurally, functionally and culturally separate, they were not completely disconnected. The integration occurred at the stage-gated development process during the transition period. The unit was responsible for exploration of new ideas and proof of technical and business feasibility of innovations. Then, it transferred the project to the divisional business lines for exploitation, refinement and deployment.

During product development, different structures performed different roles and functions. The specialization of the innovation unit was to do early technology development phases (Technology readiness levels TRL 1 - TRL 5). The specialization of the divisional business lines was to take the existing technology, to test it, and to make refinement and production (TRL 6 - TRL 8). In other words, the unit did research and experiment with new

technological innovations, whereas the business lines improved already existing technological innovations.

However, the effectiveness of the existing in the company innovation process with separated activities was controversial. The process was organized in a linear fashion, as if there were no gates, decisions or emerging tensions between the different structures and their diverse interests. What happened in reality was that the innovation unit became a structure with high concentration of exploration and needed to pay the risks and costs for the research-intensive projects of radical innovation.

The divisional business lines were better positioned, because they needed only to take over the proven technological innovation from the unit, exploit it and receive all the market and technological success and profits. Our analysis of several innovative projects (Chapter 3) also showed that the divisional business lines had the ability to reject innovations in case when they were not convinced in their short term profitability or if a project needed additional research.

To manage the tensions and to improve the alignment between different activities, the company decided to put in place new creation process. It proposed the innovation unit and diverse divisional business lines to co-develop and allocate common resources for innovations. Another function to integrate the structures was the advisory role of the unit. The unit needed to identify the new exploratory opportunities and develop the proposals on potential exploration for the divisional business lines. Lastly, for a period, the top management continued to demonstrate strong interest in the exploratory activity, protect and sponsor the projects of the innovation unit.

Separation, specialization and integration are strongly linked with the company's growth and the evolution of the culture of innovation inside the organization. The relation between exploitative and exploratory structures can also be justified by historical and cultural specificities of the company.

Organizational evolution: Creation of the innovation unit and the emerging culture of innovation

Historically, the corporate R&D was unstructured and composed by multiple uncoordinated entities. Before the initiation of the innovation unit, the company did not have an independent structure, responsible for radical innovations. To innovate, the firm applied intensive mergers and acquisitions strategies. The goal was to acquire missing competences and capabilities and to integrate them into the existing organizational structure. As a result,

the company consisted of several independent business lines that were autonomous in decision-making and in the organization of their R&D and had an operational freedom.

Another reason for the differentiation of labor was the *culture* of the company. In general, the oil and gas industry is known as a traditional industry, where innovation refers more to a problem-solving or optimization approaches. In most cases the creation process has a focus on refinement of operations. Such an approach to innovation was supported by the company. Divisional business lines resist any types of change, because of high experimentation costs, high risks and chances of failures.

However, not all entities completely rejected innovative types of activities and change. In the divisional business lines, the resistance to new learning is different and depends on the context. For example, in the case of Business Line A the costs of the disorganized research and experimentation will not lead to dramatic consequences. In contrast, in Business Line B, the failure of experimentation can cost hundred millions of dollars. Business Line C will only invest in the new product, if it ensures selling hundred thousands of the products in the future. Acceptance of change also deals with the local culture of each business line.

Resistance to new learning and change existed not only in different structures at the corporate level, but also at the individual level. The mindsets of individuals in the company were more rational and gave the priority to exploitative types of activity. The decision-makers tend to follow the established and verified processes to decrease the probability of failure. The chief scientist of a business line explained his experience on the development of innovation and the tensions that emerged if an idea needs a non-routine approach:

“During the development, some people try not to be creative, but to prevent errors. They are very powerful and they like to impose the old way of doing things because it is proven. When you have a new idea, you have to fight for it with those people, whose role is to prevent catastrophes, but not to find the best results”

Resistance to change and avoidance of failure have created the “market follow-up” approach to do business. The company proposed similar products, but at a better price than competitors. The senior manager of a divisional business line explained that in one of the major business lines, the willingness to innovate was not appreciated by the divisional management. In the past, this business line used to experiment with new technologies. During a project, the team spent a lot of resources on studies and experimentation. But it was not successful and the project failed. This past and negative experience created a specific approach to do business - to make exactly what competitors are doing, but at a cheaper price.

After initiation of the innovation unit in 2009, the company started to change the old culture. When several projects that were initiated by the unit brought success, divisional business lines started to see the impact from exploratory activity and innovation. Managers realized that by using radically new technology to perform operations they could significantly increase their profits. They could sell more products and service to the clients at a better price, rather than selling similar solutions as competitors. From the start, the unit had an innovation-oriented culture. It encouraged the search for radically new technologies and experimentation with new ideas in the whole company.

The difference between the divisional business lines and the innovation unit is in the approach to R&D. In business lines, the approach to development is characterized as a follow up of what competitors are doing. The goal is to improve operational performance of the existing technology and produce a product at a competitive price. In the unit, the culture is focused on the technological innovations that have a strategic importance for the company.

The unit is driven by a visionary leader, strongly supported by the CEO and the general top management. The head of the unit is pushing and promoting new ideas of radical technologies within the firm and communicate them to an external audience. This type of work can be associated with technical entrepreneurship and the individuals, who suggest new ideas are technical entrepreneurs. In the interview, a senior manager, responsible for sales and operations showed his empathy to the visionary leader of the innovation unit and the type of work he did:

“I appreciate that the leader of the innovation unit is very passionate about new technologies he develops. He loves to share his ideas and to be asked questions. When he talks about innovative technologies, he is very compelling. That is probably the unique character if we are talking about the technical innovations in the company”

Indeed, the head of the unit showed strong interest to development of radically new technological innovation. He supported and promoted the culture of innovation at all levels of the company. Since his assignment in 2010, his goal was to foster the culture that promotes innovations in divisional business lines. He encouraged the employees of the unit and in other structures to search for new ideas, to experiment with new concepts and test the technical feasibility of a new concept. The manager fostered discovery-driven learning, creation of new knowledge and experimentation. He also demonstrated strong support towards cross-divisional collaboration and promoted an integrative approach to the development of innovations.

The innovation unit and its leader created the environment for innovation. As written by Hill et al., (2014, p. 45), “leaders of innovation create organizations where people are willing to do the work of innovation, where everyone has the opportunity to contribute his or her slice of genius to the collective genius of the whole”. The chief scientist of a business line, who works closely with the innovation unit, argues that people from divisional business line and innovation unit have different mindsets:

“Divisional business lines are managed by the operationally-minded people, who are only looking at the revenues. The breakthrough projects are only possible at the innovation specialized unit. Because there is a support and funding for innovation at the unit”

The different cultures of the structures are reflected by different metrics to evaluate new ideas. In divisional business lines, ideas must be certain, feasible and drive revenues in the short term. In the innovation unit, ideas could be less certain, they might need additional studies and tests before validation. To perform exploration for the initial research projects, the innovation unit relies on support from the top management of the company. Sponsorship from the executive is another important and probably a vital indicator for development of projects at the innovation unit. The project manager from the innovation unit explained about the role of the executives:

“To develop radical innovation, we need to have a support from our top management team. We invest a lot of resources into the development of the long term projects. That is why all projects of the innovation unit must be supported by the CEO of the company”

In spite of the fact that exploration was funded and promoted at the highest organizational level and that integration between the structures occurred during the product development process, the innovation unit got isolated from the divisional business lines. It is the phenomenon of the “*ivory tower*” syndrome where the innovation unit became isolated from the rest of the organization. In such a separation, the unit continued to do exploration, whereas the divisional business lines were not ready to accept the results and to continue their exploitation. A lack of linkage between the different structures and exploration and exploitation activities resulted in separation and isolation. The returns from exploration were not well utilized at the company’s structures.

Differences in cultures, process and activities were the reasons that created a gap between the structures. Weak awareness about the exploratory activity of the unit and lack of

communication between different structures and at the top management level were the motives that increased the distance between the unit and the divisional business lines. The project manager from the innovation unit described the weak awareness about the unit's activity:

“ There is a weak awareness about the activity of the innovation unit. People in divisional business lines do not know what we are doing. The innovation unit is a group of people who are doing not only research, but also manage the research in the whole company across the business lines. That is why we are closely linked to the top managers and supported by the executives ”

The localization of the activities demonstrates that at the corporate level exploration of new opportunities was entrusted to the innovation unit and exploitation of existing capabilities occurred at the divisional business lines. The comparison between these entities proves that they are different and separate structures, which have different types of activities, processes and functions and cultures. Few linking mechanisms were identified, such as an integration function of the unit, support and protection at the top management level and shared co-development process.

Although the integrating mechanisms were present at the corporate level, they were not sufficient to cope with tensions between the structures and to balance exploration and exploitation activities. The lack of integration led to the isolation of the innovation unit from the exploitative entities, low returns and weak efficiency of performance. To prove its legitimacy and credibility, the innovation unit started not only to explore for radical innovation, but also to exploit for projects of incremental improvements.

5.2.2. Project level ambidexterity

We made the analysis of exploration and exploitation at the projects level to find out about the actual activity of the innovation unit. After closer examination of the unit, we identified a combination of different activities. At the ***project level***, our analysis showed the following results:

The innovation unit switches its role from having an exclusive function of exploration to a combination of exploration and exploitation. Its activity includes the creation of radical innovation and development of incremental improvement for existing technologies. Over time, the innovation unit becomes itself ambidextrous

Our research showed the evolution of the exploratory structure and the dynamics of ambidexterity. After a period of time, the innovation unit is losing its exclusive role to manage only the projects on development of radically new technologies. To prove its credibility and efficiency, the unit starts to develop incremental improvements for existing technologies. The function of the unit switches from having a homogeneous type of exploration activity to a combination of both exploration and exploitation.

The shifting function from pure upstream research to more efficient and short term oriented projects was described in one of the interviews with a technology manager, who was a member of the innovation unit. He explained:

“Initially, the mission of the innovation specialized unit was to promote innovation. Now, it is a kind of a technology link between divisional business lines and sometimes external partners”

The change from exploration towards combination of exploration and exploitation is explained by the need to decrease the gap between the structures. The unit has become the “ivory tower” and needed to engage more in collaboration with divisional business lines. For the innovation unit, the reason to do incremental innovation is defined by the need to prove the credibility of its activity to the managers of the divisional business lines and to the executives of the company. Being focused only on radical innovation, the unit has become a cash-absorbing entity with weak performance. The returns from newly launched products showed little profits, others were distant in the future. To demonstrate the value from high investments into the new product development process of radical technological innovations, the unit started to do cross-divisional projects to develop incremental innovation. In such projects, the unit achieves divisional collaboration and succeeds to attract and share resources between multiple business lines.

Dynamics of the innovation unit: From exploration to combination of activities

The changing role of the exploratory structure is due to two main reasons: isolation of the innovation unit and decreasing support from the top management. The lack of sufficient integration between the activities led to isolation of the unit and low exploitability of its returns. Scholars in organizational learning already described the problem of separation of exploration in a specific unit. Levinthal and March (1993) argues the danger of segregating

exploration in a unit is modest returns, “and most likely outcome is not exploratory behavior, but a variety of uncoordinated exploitation” (p. 108).

Another serious concern has emerged, when the innovation unit started to experience the decreasing interests from the top management and steadily lost the previously strong support. Because of the pressure from the market, the company needed to re-consider the degree and localization of the exploration activity within the innovation unit. One of the possible ways was to decrease the amount of the allocated resources for long term strategic projects and to re-configure the investments to the activities with higher priorities.

The shift of the functions in the innovation unit shows that the behavior of an ambidextrous organization, as well as the positioning of exploration and exploitation in separate structures depends on the change of the environment and top management ability to allocate resources and to balance both. Our research demonstrates that the degree and localization of the activities can switch over time. Ambidexterity and its structural mode in particular, is a dynamic phenomenon. The intensity of exploration and exploitation can change depending on the state of the environment and internal organizational factors (e.g. managerial decision-making). The dynamics is also justified by the organizational need to protect and sustain the internal processes, especially those, which are essential for organizational survival in the short term.

The phenomenon of dynamic ambidexterity is represented by organizational ability to change the localization and proportion of exploration and exploitation (see Figure 5.2). In the company, ambidexterity was identified at the corporate level in separate exploratory and exploitative structures. Each of these structures was responsible for performance of specific activities and delivery of different types of innovation, such as radical and incremental ones. Only after careful consideration of the exploratory activity by means of analysis at the project level, we detected the presence of ambidexterity inside the exploratory structure. The innovation unit combined different activities and developed both radical and incremental innovation, whereas the activities of the divisional business lines remained focused only on exploitation.

This shift proves that ambidexterity is dynamic and the proportion of activities can change over time. The arising of exploration and exploitation inside the innovation unit is explained by the organizational ability to allocate resources for exploration and in particular, the top management interest to support the strategically important long term projects. It also deals with the growth cycle of the innovation unit and its ability to demonstrate effective performance and justify its credibility. In the case of the company, the newly created unit was fully sponsored and protected by the executives. But with time, it needed to prove that its

exploratory activity is effective and credible for the divisional leaders and the top management. To survive, the unit found a solution in addressing exploration and exploitation simultaneously.

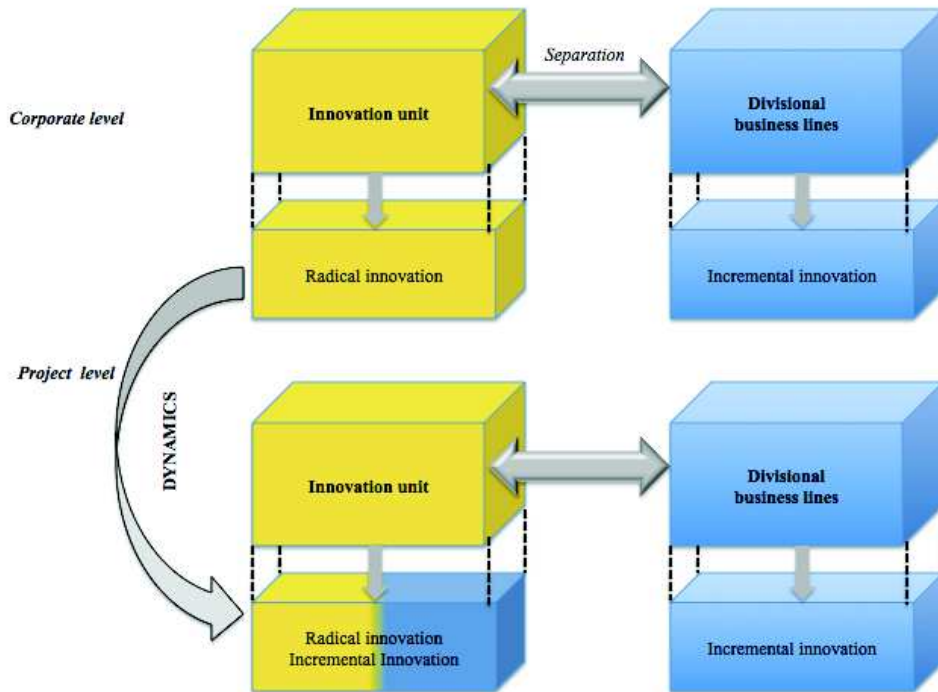


Figure 5.2. Dynamics of ambidexterity: The interplay between corporate and project levels

By crossing corporate and project levels of analysis our research shows the limitations of structural ambidexterity. It is indeed, a top management responsibility to integrate the activities and manage the emerging tensions of ambidexterity. But even more important, it is a managerial function to set and maintain the appropriate degrees of exploration and exploitation over time.

The evolution of the innovation specialized unit shows that the role of top management and the integration with the exploitative structures are critical for ambidexterity. First, the innovation unit is able to own the exclusive role on exploration unless it has the support and sponsorship from the top management of the company. Exploration without protection from the top levels would not be able to exist in the long term. Second, the executive managers and the unit must ensure sufficient linkage with the exploitative entities. Without integration, the innovation unit is more likely to suffer from isolation and

incapability to exploit the results from its activity. As in our case, the divisional business lines rejected innovative projects from the unit as immature or too distant from the market.

In the case of the technology-based company, the commitment of the executives to support exploration of the unit changed because of the market pressure followed by industry crises. To respond to market changes, the company took the decision to decrease the amount of resources for development of strategic innovation and long term projects.

By carrying out projects for radical and incremental innovations supported partially by the divisional business lines, the innovation unit becomes itself ambidextrous. Taking into account the observed dynamics, we argue that for the innovation unit and for the top management the main challenge would be to keep the proper proportions of exploration and exploitation activities, in order to avoid the complete shift towards incremental improvements, excluding creation of radical innovations.

Our research has shown the reasoning for the changing degree of exploration and exploitation at the corporate and project levels, which mainly occurred due to initially strong and then, steadily decreasing support from the top management. Let us now give a detail explanation of the ambidexterity at the executive level.

5.2.3. Executive level ambidexterity

During our research of the technology-based service company, we have seen that the top management, and in particular the CEO of the company is more likely to be ambidextrous. The managers archived structural ambidexterity by separating exploration and exploitation in different business units and by supporting and protecting the activity of the innovation unit, The critical role of the executives in patronizing the exploratory processes was specifically explicit during the initiation and early development of the innovation unit (described in Chapter 4). However, the observed shifts in the proportions of activities at the corporate and project levels, demonstrated the change in priorities of the board of directors. At the ***executive level***, our analysis received the following results:

In the analyzed company, the strategic priorities of the top management is more likely to switch from a combination of exploration and exploitation towards more exploitation-focused approach

The shift in company's strategic objectives is linked to the several factors: its history, conservative culture, strategy and top management ability to maintain the organizational

balance. We already discussed that the culture of the oil and gas industry is highly conservative, whereas the innovative development is based on the engineering problem-solving or technological obsolescence. Such a traditional approach to do business was also reflected by the corporate strategy. For the company, the strategy was more defined as a market “follow up” and track of progressing competition, rather than taking risks by being the industry pioneer. In the interview, the chief engineer explained:

“We don’t feel that we have to be necessarily first on the market, but we absolutely must not be the last on the market. We prefer to be the best on the market, because it is a lot of bleeding to be the first: you make all the mistakes, you take all the embarrassments and somebody comes later, take it over and makes money”

To execute the strategy, which established the path for the company to be “the best on the market”, the organization relied on the structural separation of activities and the division of labor. Execution of short term plans and fulfillment of the demands of the present markets was the job of the divisional business lines. Development of the technological innovation for the long term future was the task for the innovation unit. In the same way, the senior managers of the functionally separated structures had different objectives. The managers of the divisional business lines were responsible for quarterly results. Their priority was to demonstrate the operational efficiency to the stakeholders, because their work was rewarded based on their performance. In contrast, the innovation unit and its senior managers did not pass through any establish assessment of performance. They existed and were operational in the company only because of the strong support from the top management.

Our research identified a coordination problem between the separated structures and their activities, which also had a link to strategy. On the one hand, the efficiency-driven business lines were not as effective as they could be. On the other hand, they almost rejected the initiatives to work with the innovation unit on the new projects because it was not credible enough.

Dynamics in strategic choices

In 2014 the organization experienced a decreasing financial effectiveness, which was reflected by the drop of company’s share values. In the July’s interview, the chief scientists who has been previously responsible for strategy and integration partnership, described the existing difficult situation:

“Currently we are not doing well, because our largest divisional business line who has the best market technology is not doing enough money out of it. We are essentially not efficient in the company. Our shares drops and there is a threat of taking over”

The drop of company's value and emerging financial difficulties could be explained by the chosen strategic direction from the top and the inability to foresee the coming changes in the industry. Also, it might be the results from the too long prioritization of the short term needs and devoting too little attention to exploration. Similar is described in the existing studies (Levinthal and March, 1993; Tushman and O'Reilly, 1996) where scholars identify the trap of short term success and the necessity to prepare for the coming technological and market change.

In general, during the period of our research, we identified the prioritization of the short term operational effectiveness over the long term research. The exploratory activity was solely concentrated in the innovation unit. It was almost absent in the divisional business lines, which in addition, did not performed as effectively as expected. Referring to the exploitative-oriented approach, the chief scientist explained:

“Some of our divisional business lines are really respected and considered as the number one compare to our competitors. They do react very quickly to the current demands of the market, making incremental innovations. But they are not doing any research that allow them really make a step change and increase revenues in couple of years”

Taking a look back at the corporate level where there was a gap between the structures due to the lack of integration, and at the project level with the number of the rejected innovative projects to exploitation, we argue that these were the results of the managerial activity at the executive level. Previously we discuss the advisory role of the innovation unit, which supposed to develop innovative proposals to bring an exploitative activity to the divisional business lines. But, in reality the ideas and innovative projects were not well accepted at the exploitative structures. Even in spite of the top management protection, the innovation unit had low credibility among the entities and was seen as unprofitable structure by the divisional leaders and senior managers. For the innovation unit, it was difficult and almost impossible to convince people in divisions on the potential of innovation and the benefits from the exploratory activity. The chief scientist explained:

“The innovation unit is not enough influential at the moment. We can give advice, but we can’t steer things. We have no influence and no responsibility regarding the activity of the divisional business lines. Our role is just to be a polite supplier of new ideas”

The existing organizational situation created the increasing conflicts between the interests of different structures. On the one hand, the innovation unit had no contribution to the processes at the divisional structures, because of the lack of own efficiency and credibility. On the other hand, the business lines did not receive new directions from the top levels and continue to perform their business “as usual”, based on the profit and losses.

The top management of the company did not take attempts to influence divisional business line on the incorporating the exploratory activity inside the existing processes. Moreover, their power to support the innovation unit also decreased. Similarly to the divisional managers, the executives were no longer convinced at the effectiveness of the exploratory activity of the innovation unit. As the result, the unit has lost its capability to perform solely exploration and switched to combination of activities. The chief scientist explained:

“The only way to have the long term innovation in the company is when the top management put the tasks and targets on the responsible managers. In the existing company it will never happen, because the activity of our divisional business lines is only evaluated in the end of each year. To do innovation, we need to dedicate some time, promote and realize the results. It is not done at the moment at all”

The long term strategic innovation should be the task of the top management. As described in the management literature, the ambidextrous CEO should deal with the tensions at the higher levels and ensure the allocation of sufficient resources for exploration and exploitation (O’Reilly and Tushman, 2004; Tushman et al., 2011). In reality, not all managers and organizations are capable to do that. Particularly, when their companies are facing with the market pressure and significant industry change.

The senior and executive managers of the company from our research agreed on the importance of the long term innovation. They expressed their concern that even in times of the industry crises, they should not stop the exploratory activity. In the interview with the chief engineer, he explained his position concerning strategic innovation:

“It is a risk to do long term strategic innovation, but we should never run out of money to do that. If we want to be in the business, we have to stay ahead and seduce our clients or we are out”

The executive manager, responsible for the corporate strategy, who works closely with the CEO of the company, also expressed the support of strategic innovation. He explained:

“My personal opinion is that in difficult situation we should not stop the development of the breakthrough projects that can completely change our business in coming 4-5 years. But when you are in charge of the account of the company, its profit and losses, you can be more willing to decrease the resource for innovation for a certain period of time, when you are going through a bad kind, which is exactly the case right now”

In spite of the understanding of the importance of the exploratory activity and the long term strategic innovation, the top management of the company took a decision to decrease the funding for the unit and focus on the short term needs. The executive manager, responsible for strategy, explicitly described the switch in strategic priorities. In his interview (September, 2014), he explained:

“Our strategy is to deliver extra margin till 2016 by developing sales of our divisional business lines. Today we are not trying to diversify our portfolio and I don’t see any real innovation in the present strategy, because the company is passing through not a good times. This will change when our company will be in a better shape”

After validating the results from our corporate and project levels with the help of the executive level, it is becoming clear that overcoming the conflicts of exploration and exploitation is more likely to be the top management task. Ambidexterity is a managerial act of dealing with tensions and balancing of activities by different means, such as separated structures, allocation of resources and search for integration. In the company from our research, we saw the shift of strategic intent towards more exploitative type of doing business and significant decrease of resources for the long term innovative projects. The results of such activity is predictable and was already described by scholars in strategic management and organizational literature (see e.g. March, 1991; Porter, 1996; Raisch, 2008; Raisch et al., 2009; Tushman and O’Reilly, 1996)

Our case study shows that even in spite of the separated structures and presence of mechanisms for their synergies, the executive capability to maintain the balance over time would be essential for achieving ambidexterity. It also demonstrates that the top management priorities tend to change over time and cause the significant change in company's ability to support exploratory processes. Hence, the organizational ability to explore and exploit simultaneously is more likely to be formed from a combination of multiple factors, rather than just by means of a singular approach (e.g. as structural separation) to solve the challenge on balancing activities.

5.3. Fractal and dynamic ambidexterity: A new paradigm for sustainably innovative organizations

As we observed previously, organizational ambidexterity requires a combination of opposite and relatively incompatible activities. Performance includes not only their separation in different structures to deal with the emerging conflicts, but also their integration, which is a vitally important aspect to achieve synergies. Our research proposes that both separation and integration of activities is only one important pair of factors that build ambidexterity. Another one is the multilevel dimension of exploration and exploitation.

Based on the results from the multilayer methodology applied to the case of the company and also on the evidence in the existing literature on ambidexterity, our research argues that both exploration and exploitation have the ability to emerge simultaneously and change over time at the diverse organizational level. Earlier in our research, we demonstrated the replication of activities drawn from the practical evidence. In the next section we present the multidimensional perspective on ambidexterity based on the existing studies.

5.3.1. Simultaneous exploration and exploitation at multiple organizational levels

The existing literature describes at least five diverse levels where the activities of exploration and exploitation as well as their conflicts and tensions can emerge. We define these levels and further present their description. These are the following levels:

1. Organizational or corporate;
2. Managerial, leadership;
3. Project;
4. Individual;
5. Communities

Organizational or corporate level refers to a combination of contrasting activities within a single company by means of separation of exploration and exploitation in different organizational structures (structural ambidexterity). In an organization, the interplay between the explorative unit and exploitative entities may or may not exist. If there is no linkage between the two different structures, it would probably lead to isolation (Birkinshaw and Gibson, 2004) of the explorative unit and thus a company would lose the benefits from exploration. In contrast, a combination and integration between both structures will help a company benefit from their synergies.

For organizations, the most appropriate mode to achieve effective structural ambidexterity would be to separate exploration and exploitation and to integrate them at a specific level or through a specific mechanisms (e.g. Markides, 2013; O'Reilly and Tushman, 2004). Particularly important would be a top management capability to maintain the balance between the activities and support integration of structures (see also O'Reilly and Tushman, 2004). The level and degree of separation and integration are different and depend on the organizational context. Previous sections of our research provided an explicit description of structural ambidexterity, separation of different entities, integration and linking mechanisms.

Exploration and exploitation are present at the *managerial level* (e.g. senior and executive managers). The ambidextrous leaders are the executives (CEO) who are capable to cope with tensions between exploration and exploitation, between old and new business domains and solve these conflicts at the top (Tushman et al., 2011). However, not only executives, but also the senior managers must be ambidextrous. Ambidextrous senior and executive managers must “combine attributes of rigorous cost cutters and free thinking entrepreneurs while maintaining the objective required to make difficult trade-offs, such managers are rare but essential breed” (O'Reilly and Tushman, 2004, p. 9).

For executives it might be challenging to combine two contrasting mindsets and approaches to management and decision-making. To solve the problem, organization can also utilize different leadership styles. Transformational leadership fits into the management of the exploratory innovation (Jansen et al., 2009). The leaders encourage learning and exploratory thinking. For exploitative innovation, the appropriate what would be the transactional style. Transactional leadership encourages “improvement, refinement and routinization of existing competencies” (Jansen et al., 2009, p. 15).

Ambidexterity can be achieved at the *project level* when project teams need to engage in both exploration and exploitation. Liu et al. (2012) propose that ambidexterity is typical for large and complex engineering projects, where a team deals with innovations, uncertainty and specific requirements. In complex projects “the team has to identify solutions for unique

problems (often requiring exploration of new solutions) and construct or install the solution repeatedly (a repeat process requiring exploitative approaches such as improvement) over a limited project period” (Liu et al., 2012, p. 401). In large engineering projects, the innovations should be first identified, tested and then applied to mass production (Liu et al., 2012). Similarly, in our project level analysis, we were able to identify the presence of exploration and exploitation, separation of processes and integration at the stage of transition of an innovative project from exploration in the innovation unit, towards exploitation in the divisional business lines.

The longitudinal study of the bridge construction showed the presence of ambidexterity inside the complex engineering project (Liu et al., 2012; Liu and Leitner, 2012). To succeed in complex infrastructure projects, “both exploration and exploitation are needed” (Liu and Leitner, 2012, p. 97). Ambidexterity contributes to the project performance. The study showed that in the effective project, the two activities are organized in temporal cycling between separation and integration of exploration and exploitation (Liu and Leitner, 2012). Temporal separation between exploration and exploitation is necessary to allow teams “to engage in both innovation and project delivery within constraints” (Liu et al., 2012, p. 408). Then the integration is required to link exploration and exploitation within the time frames (Liu et al., 2012).

In contrast to organizational studies, structural separation does not lead to project ambidexterity (Liu et al., 2012; Liu and Leitner, 2012). In projects, managers should “avoid structural separation of teams”, but allow them to work closely together in collaboration (Liu and Leitner, 2012, p. 107). To achieve ambidexterity in projects, the management should choose the temporal separation strategy. Cycling between separation and integration of activities is justified by “the necessity of the natural progression from design to implementation, and project life cycle as it moves through the execution of project work packages” (Liu and Leitner, 2012, p. 107)

Combination of exploration and exploitation are present at the *individual level*. Contextual ambidexterity describes the ability of an individual both to explore and exploit at different periods of time. This concept introduces the term *ambidextrous individuals* (see e.g. Birkinshaw and Gibson, 2004; Gibson and Birkinshaw, 2004). The behavior of an ambidextrous individual can be characterized as 1) initiative-driven and opportunity seeking; 2) cooperative and co-creative; 3) willingness to build linkages; 4) multitask with the ability to wear multiple hats. Birkinshaw and Gibson, (2004,) suggest that in the specific organizational context, particularly in the ambidextrous structures “employees can use their

judgments on how to divide time between adaptation-oriented (exploration) and alignment-oriented (exploitation) activities” (p. 49).

For ambidexterity at the individual level, an organizational structure, e.g. a business unit, must be itself ambidextrous, because at the explorative or at the exploitative structures this concept will not exist: “in solely aligned or solely adaptive business units, employees have clear mandates and are rewarded accordingly” (Birkinshaw and Gibson, 2004, p. 49). Similarly, our research of the technology-based service company showed that in the exploitative structures (divisional business lines) individuals have the ability to explore, but they “do not have time” to explore new ideas and they are not rewarded and recognized for working on new technologies for the distant future.

At the same time, our research showed that contextual ambidexterity could be incorporated in the exploitative structures and obligatory should be present in the innovation unit. Particularly, few innovation-driven groups were identified in the divisional business lines. Even if they were not the members of the exploratory structure, those ambidextrous individuals were able to work on the improvement of existing products and services and devote some part of their time to the search for radically new operational concepts and technological innovation.

Because of the fact that those ambidextrous individuals were not a part of the innovation unit, created constraints for the implementation of their innovative ideas. Divisional business lines were not interested in allocation of resources for radical innovations and did not support complex development process for projects of radically new technologies. Any radical idea, emerging in the business line was transferred to the innovation specialized unit for further decision-making and development.

In general, this means that an ambidextrous organization or an ambidextrous structure is an indispensable component for exploration and exploitation at the individual level. Studies from the literature also showed that in ambidextrous organizations, structural, contextual and managerial issues “co-exist and are deeply linked in developing and sustaining ambidexterity” (Cantarello et al., 2012, p. 45).

At the borders between ambidexterity, at the corporate and at the individual levels, there are studies on exploration and exploitation and the role of communities. The *community level* is the intermediate level that is considered “as the result of the permanent interaction between the individual and organizational levels, where routines are shaped” (Cohendet and Llerena, 2003, p. 273). In the company, communities are functional groups (traditional homogeneous teams), communities of practices (individuals engaged at the same practice)

and epistemic communities (individuals with a common goal of knowledge creation and framework) (Cohendet and Llerena, 2003).

The case of a videogame firm showed that communities focused both on the exploration and exploitation of knowledge (Cohendet and Simon, 2007). Each community was specialized in a specific domain of knowledge. Integration between different communities occurred at the collective level (e.g. in shared projects) and guaranteed a systematic coordination of processes and goals between different groups. In the company, managers created a hybrid forms of projects, where they combined decentralized structures and integrate them by creating space for informal interactions (Cohendet and Simon, 2007).

The community level is the alternative mode to approach the question of organizational ambidexterity. Exploration in communities and exploitation in projects (see Cohendet et al., 2012) can be an approach how companies can achieve ambidexterity. Inter-organizational sharing sessions and communication, e.g. made by “craft “directors (Cohendet et al., 2012) is a mechanism to coordinate and benefit from both exploration and exploitation at the communities level. Individuals can “bring creative ideas to the company by searching for and exploring the best practices and knowledge outside of the firm” and then exploiting them in the specific organizational domain (p. 15).

An alternative approach to co-organizing exploration and exploitation is through *organizational vacillation* that is defined as dynamic approach to maximize simultaneously exploration and exploitation (Boumgarden et al., 2012). The high organizational performance can be obtained by “dynamic vacillating between structures to achieve high level of exploration and exploitation on average” (Boumgarden et al., 2012, p. 588). In addition, scholars propose to use alternative modes, as the *innovative systems* to manage human resources in a company (Un, 2007), or finding a balance in *partnerships and alliances* (Lavie and Rosenkopf, 2006) to engage simultaneously in exploration and exploitation.

Therefore, the existing literature shows that there are multiple approaches to achieve ambidexterity, such as structural, sequential and contextual modes. Studies prove that exploration and exploitation occur at different organizational levels. Drawing conclusions from the literature, we propose that an organization, a business unit, a manager (a leader) and an individual (employee) – all can be ambidextrous and able both to explore and exploit. If exploration and exploitation can exist at different levels, then our research argues that exploration and exploitation have the ability to replicate and be present at the different organizational levels at the same time. In other words, organizational ambidexterity has fractal patterns and ability to replicate itself.

5.3.2. *Fractal ambidexterity at multilevel organizational systems*

Our research raises a question on fractal ambidexterity. Based on the results from the case of the technology-based service company and knowledge from the existing literature, we argue on the existence of fractal patterns of ambidexterity and define it as a fractal ambidexterity. For this term, we develop the following definition:

Fractal ambidexterity – the ability to simultaneously replicate exploration and exploitation at different organizational levels

Our research on the ambidextrous company demonstrated that exploration and exploitation emerge and change at different organizational levels. First, at the *corporate level*, the company uses structural separation of activities. The innovation unit explores and the divisional business lines exploit. Second, at the *project level*, the innovation unit, that is supposed to focus only on exploration, in fact combines both exploration and exploitation activities. After some periods of time, the unit becomes ambidextrous by engaging in the development of projects on radical technological innovations and also incremental improvements of existing technologies. The unit combines the search for new opportunities with the advancement of current capabilities, creation of new knowledge with the refinement of existing ones, building of new technological innovations with the improvement of existing solutions. Finally, at the *executive level*, we determined a presence of ambidexterity and a shift in strategic priorities of the top management. It was initially characterized as more of a combination of exploration and exploitation, and followed up by an increasing proportion of exploitation and almost a complete focus on the short term business needs.

Moreover, in our research, the ability to combine exploration and exploitation was also identified at the individual level. The interviews with project teams, managers in senior and executive positions demonstrated that some individuals were able to combine contrasting mindsets, to be both effective and innovative, to initiate and/or to develop radical and incremental types of innovation etc.

Ambidextrous individuals were found in both exploratory and exploitative structures. However, the difference was in the intensity and ability to explore or exploit inside a specific structure. Particularly, at the divisional business lines only those who had a power or a leading positions were able to devote time, efforts and resources to creative problem-solving

and development of radically new solutions. Those who held the regular functions and roles within the business lines, were only responsible for delivery of the short term results.

The innovation specialized unit, in contrast, had a high concentration of ambidextrous individuals who could devote the majority of their time to exploration. Although their main function was to explore, on a regular basis the members of the unit were involved also in exploitation. They held brainstorming and working sessions devoted to new technologies, participated in the decision making process related to the activity of the business lines, provided consultancy and advisory roles for R&D groups from the divisional structures. Then the unit started to combine exploration and exploitation, and to work not only on R&D of new technologies, but also on improvement of existing ones. This dual activity required a combination of different types of knowledge, different new product development processes and project management practices and procedures. With time, the innovation unit and its individuals acquired a new ability - to be ambidextrous.

The innovation unit, as a young organizational structure was introduced to fulfill the function of exploration, which was the search for radically new technologies. Although its main focus was devoted to exploration, with time, it started to acquire roles on exploitation. In fact, the exploitation activity was incorporated into the exploration structure. Divisional business lines, in contrast, had a focus on exploitation, but they resisted accepting any exploratory processes. Exploration was out of the scope of their ordinary activities.

In the business lines, exploration, such as the search for new solution to increase the efficiency and performance of the existing market products (meaning incremental improvement), was highly appreciated. But divisional management did not support exploration with a purpose of searching for a new solution that could radically change a concept and re-invent a technology (meaning radical innovation). Only a small number of individuals in the divisional business lines were able to combine both types of activities, whereas, in the innovation unit, individuals were able to perform both roles for different projects simultaneously.

The case study of the technology-based service company showed that structural separation of exploration and exploitation was a solution to achieve ambidexterity at the corporate level. However, over time, the innovation unit switched from solely exploration to combination of activities. Without support and funding from the executives, the innovation unite started to develop radical and incremental technological innovations. It was also the result of the changes in strategic focus of the company and re-orientation towards more exploitative approach.

The observed dynamics of exploration and exploitation within the structurally separated units put under the question the concept of structural ambidexterity, and in particular, its ability to be an organizational solution to manage the balance of activities over time. This mode of ambidexterity is more likely to be a temporal resolution to the question of simultaneous exploration and exploitation, rather than a sustainable and a long lasting one.

Our research showed, that structural separation was effective as long as there was no important or radical change on the market and in the industry, and as long as the top management remained a sponsor and protector for the exploratory activity of the innovation unit. Then, the emerging critical and yet unexplored question is to what extent can structural ambidexterity be sustainable and can it exist without the ambidextrous top managers?

The ability of exploration and exploitation to be dynamic is not the only one vitally important characteristic for ambidexterity. Another one is its ability for simultaneous replication at multiple levels. Achieving of ambidexterity is a particularly difficult task, because an organization needs to deal with continually changing proportions of exploration and exploitation and at the same time, maintain and control them at diverse organizational levels. Moreover, the proportions and intensity of activities depend on the combination of internal and external organizational capabilities and factors. In the next section we present the arguments of the replication and dynamics of exploration and exploitation.

5.3.3. Fractal and dynamic model of ambidexterity

Our research demonstrates that, in fact, exploration and exploitation do not occur solely at the corporate, at the project or at the executive levels. To be an ambidextrous company, it is not sufficient for an organization just to separate activities and to deal with conflicts between exploration and exploitation. But what is more important is to find the appropriate mechanisms to create linkage and achieve integration between both.

The in-depth analysis of the technology based-service company and our multiplayer methodology showed that exploration and exploitation end up to occur always together in order to remain sustainable. They proceed in continuous process. Structural separation between exploration and exploitation can only be temporal solution to fulfill the specific tasks or needs. Exploration and exploitation will inevitably emerge and merge to create a new state. But when and how will depend on the context and factors (such as internal capabilities, time and change in the environment).

We argue, organizational ambidexterity is fractal; exploration and exploitation emerge at multiple organizational levels at the same time. Figure 5.3. illustrates our model of fractal

and dynamic ambidexterity on the case of the technology-based service company. Ambidexterity is built from different levels where both exploration and exploitation emerge. The clarifications on the processes are presented below.

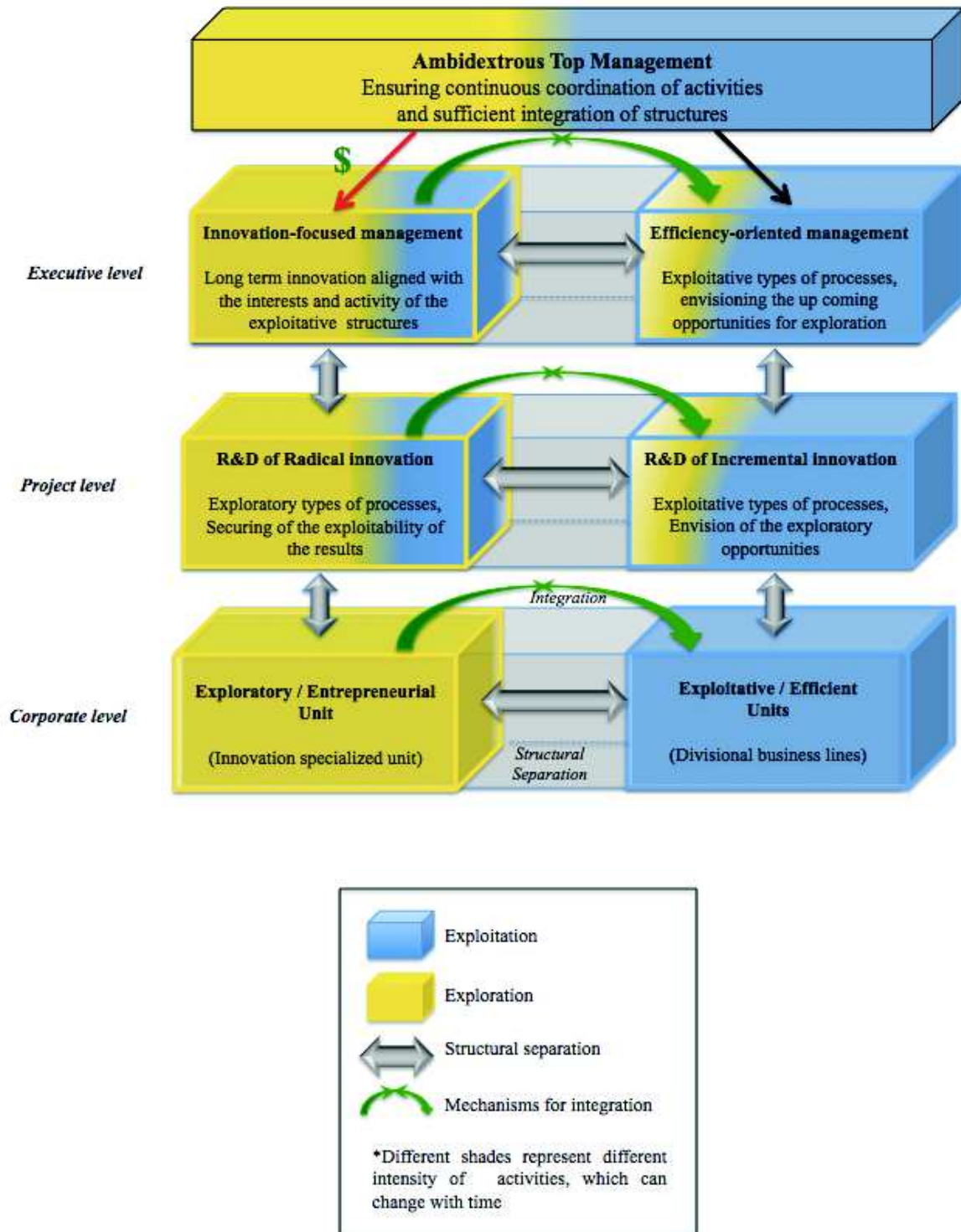


Figure 5.3. Fractal and dynamic model of ambidexterity

(Representation of the model based on a case of the technology-based service company)

In the model of fractal and dynamic ambidexterity, there are three interrelated organizational levels of exploration and exploitation. At the *corporate level*, exploration and exploitation are organized in separate entities, where for example, divisional business lines are responsible for exploitation and the existing business, and the innovation specialized unit for exploration and emerging new business opportunities.

In the representation of our model, these structures have no additional color, compare to other elements. The reason is that they are the structural basis for our ambidexterity. Units should have a focus on a specific type of activity, but their processes can be diversified at the following two levels. An organization and the managers should have a clear distinction between structures and their activities. Particularly, when a company will use metrics to assess the performance of different units.

At the *project level*, exploration and exploitation are present in projects and in processes, such as new product development. Both activities are incorporated inside the separate structures, but in different proportions and with different intensity. The exploitative structures (e.g. divisional business lines) do incremental innovations and prioritize exploitative approaches to do business. But they also envision the up coming opportunities for exploration and can switch to a specific portion of exploitative type of processes when it is needed. The exploratory unit, in contrast, is more focused on the long term innovations. Its exploration processes must be organized in a way that ensure their exploitability in the divisional business lines, which can be done with the help of managers at the next level.

At the *executive level*, senior managers of both structures should work in close relation with the top management teams, because the managers and leaders of the separate unit must support the incorporated combination of processes. Such an approach will help to facilitate the coordination of processes at the managerial level. Nevertheless, each group of managers will have their focus and tasks. Managers of the innovation unit should organize exploration but at the same time, align it with the interest and activities of the exploitative structures. Managers of the divisional business lines should exploit but also be ready to envision the up coming opportunities for exploration.

Finally, the top management of the company should act as an ambidextrous team. Their commitment to balancing exploration and exploitation would be critical to sustain ambidexterity over time. The first important role for the executives would be to ensure continuous coordination of activities, sufficient integration of structures and allocation of resources. Second important role would be re-location and re-coordination of exploration and exploitation in different forms: funding, structures, processes and even individuals and teams

when it is needed in order to find the best match of processes to achieve the overall ambidexterity.

One of the approaches to justify the incorporated activities inside the different structures is that, in a sense, ambidexterity can naturally emerge in different organizational forms and formats and can be reflected by behavior of individuals to be innovative and effective. For example, the interviews with senior and executive managers showed that ambidextrous individuals, who were able to explore and exploit, were identified in both structures – in the divisional business lines and in the innovation unit. Both units had efficiency-oriented and innovation-oriented individuals, but in different proportions. In the innovation unit, the majority of employees had innovation-driven mindsets, whereas in the business lines, a larger number of managers were efficiency-driven and short-term focused. The concentration of individuals (and even processes) with different types of mindsets is justified by the company's history and culture, by specificities of the processes organization inside structures and by the applied management style.

In general, the R&D activity in the divisional business lines and in the innovation unit includes both exploration and exploitation. Even during the development of projects on incremental improvement of existing products, business lines perform research and experimentation. However, these exploratory activities were less complex and costly than during the projects of radically new innovations.

A similar mix of activities happens at the innovation unit, particularly, during the phase when radically new technologies must be tested and improved. In the case of our company, both structures combine exploration and exploitation during the R&D activity on creation of new technologies or refinement of existing one. The difference is in the degree and proportions of exploration and exploitation in a particular context, such as in an organizational structure, or during the phases of the development process. But even these proportions have a tendency to change over time.

5.3.4. Concept of fractal and dynamic ambidextrous organizations

We previously demonstrated the dynamics of the activity of the innovation unit, which shifts from having an exclusive role on exploration to a combination of activities because of the change in the priorities at the top management level due to market decline. However, the environmental turbulence and the decreasing managerial commitment to be a sponsor of exploration is not only the reason why exploration and exploitation emerge at different organizational levels and why ambidexterity is dynamic phenomenon. The explanation is

given in the knowledge management literature. This stream of literature explains that in reality, an organization is a “*dynamic fractal organization*” (Nonaka et al., 2014).

Through the lenses of the knowledge-creation theory, exploration and exploitation are contrasting but not opposite activities. Both of them rather “lie in a continuum and interact in a spiraling continuity” (Nonaka et al., 2014, p. 139). Tacit knowledge becomes explicit, and when merged with another explicit knowledge, they become new explicit knowledge and so on. This process is continuous. The same is true for the concept of ambidexterity. The authors argue:

“The separation between exploration and exploitation is merely artificial and does not exist in actual practice. There are no pure forms of exploration and exploitation, just as there are no pure forms of tacit and explicit knowledge and knowing” (Nonaka et al., 2014, p. 139)

Scholars explain that tacit knowledge is the basis of all knowledge. Even the most explicit knowledge contains parts of tacit knowledge. In other words, decomposition and separation between tacit and explicit knowledge or between exploration and exploitation is hardly possible: each separate part contains another element. Companies cannot do only exploration or only exploitation, but always will perform both:

“Companies will inevitably always do both at the same time. It is just a matter of degree whether there is more exploration or exploitation in a specific context” (Nonaka et al., 2014, p. 139)

The knowledge creation process takes place at all organizational levels: individual, communities, unit and organizational. The same happens with exploration and exploitation. In an organization, the process of interaction and synergies between exploration and exploitation is complex. It occurs vertically and horizontally, at different levels, with different degrees of intensity and involves diverse agents. It is not effective to separate exploration and exploitation, because they always search for synergies, and even more “they are inseparable” (Nonaka et al., 2014, p. 140).

According to the study by Nonaka et al., (2014) *dynamic fractal organization* is a new organizational model to foster innovation through “sustained knowledge creation” (p. 142). It contains multilayered, organizational and fractal characteristics that are present at different levels. The interplay between exploration and exploitation is crucial, if an organization wants to be *sustainably innovative*. It is a job and the responsibility of the

leadership to demonstrate synthesizing capabilities, to drive interaction between exploration and exploitation and to promote synergies and conversation between exploration and exploitation (see Nonaka et al., 2014, p. 142) if a company wants to be sustainably innovative. Such a model allows an organization to capture change and to respond quickly to the environment, remaining effective and at the same time innovative.

A careful reader might find the similar logic on the multiple levels and on a notion of fractal in March's paper (1991) on organizational learning. The author describes organization as a nested system that consists of different levels, where choice and selection between exploration and exploitation can take place at any level. The scholar argued that the balance is hard to find 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" (p. 72).

Evolution of the organization would depend much on the competitive advantage, internal capabilities and rate of change in the environment. The continuous interaction between exploration and exploitation is mandatory. They always occur together, because none of the strategy, focused either on exploration or on exploitation would be effective in the long term. Exclusive exploration will have weak returns; same way as exclusive exploitation will suffer from obsolescence (Levinthal and March, 1993; March, 1991).

So, why do so many organizations tend to give priority to exploitation? This organizational and managerial tendency is also described and proven by scholars in the existing management and organizational literature. The reason is not the ambidexterity itself, but the inability of organizations to sustain sufficient exploration. With time, an organization decreases the level of exploration by giving much of the focus to exploitation-oriented processes. Sustaining exploration is difficult, because "an organization cannot survive in the long run unless it survives in each of the short runs along the way" (Levinthal and March, 1993, p. 110). It is also a reason why the top management of the company from our research significantly cut the funding for the long term strategic innovation. It also indicates that the degrees of exploration depend on the decision-making by the managers of an organization. The managerial choices rely much on the factors in hand, such as available resources, state of the environment, degree of risk, uncertainty and ambiguity, etc.

Taking all into consideration, we might conclude that the question on balance between exploration and exploitation is in the hands of the decision makers. Senior and executive

managers search for balance at the corporate level. At the individual level, people search how to divide best their time between exploration and exploitation. But whatever choice is made to achieve ambidexterity, it is not fixed and will not be sustainable in time. Because of the replication and dynamics of exploration and exploitation, environment change and overall evolution structures and organizations, managers will have to search for new combinations and re-define the proportion of exploration and proportion of exploitation at diverse organizational levels.

Another reason why the selected choices on balance is not sustainable is the ambiguity, uncertainty and instability (see also Levinthal and March, 1993; March, 1991) of the systems. “Individuals tend to plan their lives as if they were part of a predictable world” (Farjoun and Levin, 2011, p. 845). But in reality, the behavior of the environment is unstable and sometimes hard to predict. “Complexity research makes us keenly aware of surprises and unpredictability and provides a lens to industries as complex dynamic phenomenon that features nonlinearity and hidden order” (p. 845). This means that the balance and the decision-making also depend on the behavior of the environment (e.g. industry, markets).

Conventional wisdom is that for organizational sustainability “maintaining the balance between exploration and exploitation is a primary factor” (March, 1991, p. 71). However, it is not the question of balance as such, between activities of exploration and exploitation, but more, the question of the proportions and degrees of intensity between them at every organizational level.

The basic problem for organizations is not how to find the balance, but how to keep balancing between exploration and exploitation in the long term. The real organizational challenge is “to engage in sufficient exploitation to ensure current viability and at the same time, to devote enough energy to exploration to ensure future viability” (Levinthal and March, 1993, p. 105). Sustainability requires the precise mix of exploration and exploitation, but “what is optimal is hard to specify” (p. 105).

To be sustainably innovative, the ambidextrous organizations should not ignore the existence of fractal and dynamics characteristics of exploration and exploitation. Managers should wisely allocate resources and ensure the sufficient degree of each activity that can also be pre-defined by historical, cultural and organizational capabilities to explore and exploit. Also, managers should be capable to envision change and be ready to re-consider the proportions and to re-locate activities to meet the best fit for the organizational processes. It is a multilevel necessity, emerging from a dynamic process of multidimensional optimization process.

Overview and conclusion

This chapter observed the results from our multilayer methodology, which was applied to analyze the question of simultaneous exploration and exploitation on a case of the technology-based service company. Our research showed that organizational ambidexterity is a dynamic and fractal phenomenon that can evolve and change over time. The ability to replicate exploration and exploitation at different organizational levels demonstrates that ambidexterity has fractal patterns.

So far, organizational ambidexterity was perceived as a static phenomenon, whereas suggested organizational solutions to explore and to exploit were actionable, but not durable. As it was found, structural ambidexterity, which is one of the most popular solutions for simultaneous exploration and exploitation, cannot provide a long lasting approach to balancing both activities.

The answer to the “why” question is the dynamic and fractal characteristics of organizational ambidexterity. Ambidexterity is *dynamic* because the balance depends on the proportion of exploration and exploitation, which relies much on factors in hands and which might change over time. Ambidexterity is *fractal* because the choices and selection between exploration and exploitation can emerge simultaneously at different organizational levels (e.g. corporate, business unit, project, individual etc.).

Our view is that the existing literature provides only a static representation of structural ambidexterity and describes an organizational solution to achieve simultaneous exploration and exploitation only at a specific period of time. In this model, activities are differentiated in the diverse organizational structures. Each structure has a specialization and performs a set of activities and processes, devoted either to a function of exploration or to exploitation. The integration between them can be done at the management level, where senior and executive managers must share similar commitments, protect and legitimize the exploratory activity of the young entrepreneurial unit.

Indeed, structural separation can help companies achieve ambidexterity. However, separation and protection of exploration by the top management are important, but not sufficient. First, without appropriate channels to integrate and to link structures, both activities will suffer from a *lack of integration*. For the exploratory structure it might lead to high experimentation costs, low returns from research and experimentation and finally to complete isolation from the rest of the company. For exploitative structures it leads to inability to use and to apply the results from exploration. Second, even if the balance is found, the model of structural ambidexterity will not be effective in the long term due to the dynamic

characteristics of activities. An organization is forced to re-organize and re-configure exploration and exploitation activities under the pressure of internal and external organizational change.

The case of the technology-based service company proves that organizational ambidexterity is dynamic and fractal phenomenon that evolves over time. To achieve simultaneous exploration and exploitation, our company uses a ***structural approach***. It separates activities and entrusts *exploration* to the innovation specialized unit and *exploitation* to the divisional business lines.

The detailed analysis of the activity in the exploratory structure showed, that with time, the innovation unit loses its exclusive role on exploration, research and experimentation and is more likely to *combine* exploration and exploitation and operate as an ambidextrous structure. Over time, the unit switches from solely research and development of radically new technological innovations, and starts to combine projects for radically new and incrementally improved existing technologies. To survive without initially strong support from the executives and to demonstrate credibility and efficiency in times of market decrease, the innovation unit ***becomes*** itself ***ambidextrous***.

By and large, our research of the technology-based service company demonstrates that co-organization of activities and the balance between exploration and exploitation have more than one solution. Structural separation is only a temporal approach to ambidexterity. Moreover, it does not last if there is no coordination and integration between structures and activities and if the top management strong support is absent. Lack of linkage between exploration and exploitation leads to low returns from search and experimentation and inability to exploit its results.

We argue, sustainable and lasting solution to simultaneous exploration and exploitation can be found in ***dynamic and fractal ambidexterity***. In fractal ambidexterity, exploration and exploitation emerge simultaneously at different organizational levels, in order to assure an overall level of sustainable ambidexterity. In the case of our company - the decrease of ambidexterity and support of at the top management level is in a way, compensated by the development of a fractal ambidexterity at the corporate and at the project levels.

The question of ambidexterity is usually discussed in the context of large incumbent companies. However, it might emerge in any other organizational forms. A company, a business unit and even an individual need to select between exploration and exploitation and will search for balance between the two. Decisions on how to divide time and allocate

resources between exploration and exploitation inevitably emerge at any organizational level: at the corporate, business unit, project and at the individual level.

As proposed by Nonaka et al., (2014), separation between exploration and exploitation is artificial, as there is no pure forms of exploration or pure forms of exploitation. And thus, the question of choice and selection between exploration and exploitation will inevitably emerge at any level and in any organization.

The key to find the balance and to keep balancing between both is in the appropriate proportion of exploration and exploitation at every organizational level and at a given period of time. A sustainable solution for exploration and exploitation is in dynamic and fractal ambidexterity, which is defined as the ability to replicate the activities at different levels in a simultaneous fashion, to assure a multidimensional level of ambidexterity in an organization.

GENERAL CONCLUSION

In our dissertation, we raised the question on the balancing of exploration and exploitation and in particular, we searched for a solution on how to simultaneously co-organize and manage these activities to ensure a sustainable and successful organizational performance in the long term. These are the inconsistent activities that compete for limited organizational resources. Nevertheless, the company's ability to combine and manage them in a simultaneous fashion is a critical factor for a successful and sustainable innovative performance.

The answer to our research question is in the concept of *fractal and dynamic ambidexterity*. To remain sustainably innovative and effective, a successful organization should develop the ability to co-organize the replicated exploration and exploitation simultaneously at different organizational levels, and at the same time, it should be able to re-consider the intensity of activities and to re-locate them, when it is needed (e.g. due to internal and external change).

Our research showed the existence of the multidimensional perspective on organizational ambidexterity and demonstrated its fractal and dynamic characteristics. Exploration and exploitation are *fractal* and have the ability to emerge and replicate at multiple organizational levels at the same time. Moreover, these activities are *dynamic*, because their degrees and intensity can change over time. To achieve the balance, an organization should determine the appropriate proportions of exploration and exploitation at each of the organizational levels (e.g. corporate, business unit, project, process, managerial) and at the same time, be ready to re-configure their degrees, depending on the available organizational factors.

The demonstration of our results on fractal and dynamic exploration and exploitation was possible due to our multilayer methodology. This method allowed us to cross three levels of analysis and simultaneously observe the activities at the corporate, at the project and at the executive levels. In addition, our methodology took into account the time factor and made it possible to investigate the evolution of exploration inside the ambidextrous company, and its changing functions due to the growth of the exploratory structure.

Regardless of an organizational level, we observed the replication of exploration and exploitation and their dynamics, which were reflected in the following formats. At the *corporate level*, ambidexterity was identified in exploratory and exploitative structures. The corporate division of labor was organized in structurally separate units, which were responsible for different innovative activities, R&D functions, had different objectives, working processes and cultures. However, they were not completely disconnected. They were sharing the stage-gated innovation process. During technological development, the innovation

unit performed the exploratory activities for an innovation. The job of the divisional business lines was to exploit it. The dynamics occurred when there was a need to decrease the existing gap between the structures and improve their linkage. To increase integration, the innovation unit first, initiated the co-development of innovative projects together with the divisional business lines and second, prepared plans and suggestions on exploratory opportunities for divisional R&D.

At the *project level*, exploration and exploitation were represented in the form of different innovative projects and necessary R&D activities. The innovation unit aimed to search for and experiment with new ideas and concepts. Its activity was focused on the development of radical technological innovation. In the divisional business lines, projects had incremental nature and R&D activities were oriented on reconfiguration, re-design and operational improvement of the technology. The dynamics was represented by the shift in the functions of the exploratory unit. With time, the innovation unit switched from having a high intensity of exploration and started to combine both exploration and exploitation. By doing radical and incremental innovative projects, and by performing in parallel such activities as research, experimentation and also prototyping, re-designing and tests, the unit became itself ambidextrous. The combination of activities inside the innovation unit was an approach to demonstrate legitimacy, credibility and efficiency to the leaders and managers in the divisional structures and to the top management of the company.

The results and dynamics at the corporate and project levels was justified by our third level. At the *executive level*, we identified that the company had an ambidextrous type of top management team and CEO, who were capable to manage the tensions between exploratory and exploitative structures and their activities. They supported and protected the activity of the innovation unit, provided a sponsorship for development of radical technological innovation in the unit. At this level, we observed the dynamic in strategic choices, when the top management shifted from having the ambidextrous types of commitments towards more exploitation-oriented approach. Because of the market pressure and the industry crises, the executives took a decision to decrease the amount of resources, allocated for the long term strategic projects from the innovation unit and to prioritize the short term needs of the company. Which, in more global terms means that the organization needed to re-consider the structural localization and intensity of exploration and exploitation.

Our concept of fractal and dynamic ambidexterity is the result of the dissertation research that consists from five chapters. In **Chapter 1** we introduced the context of our case study and presented the technology-based service company, its internal and external characteristics as an innovative and ambidextrous company. This firm is a large oilfield

service provider, with established business operations and long history. It is a science-based and a research-intense organization that performs R&D activities to create radical and incremental technologies, products and services for geological and geophysical exploration of natural resources for oil and gas companies.

The internal and external characteristics of the company demonstrate that it is an ambidextrous organization. It combines the exploration and exploitation capabilities and develops both radical and incremental technological innovation. The major organizational focus is on the incremental types of innovation. This R&D activity is organized in the *divisional business lines*, which are well-established, efficient and market-specialized structures. Their processes are routine, incrementally-focused and short term oriented. The effectiveness of R&D and operational performance of these entities is controlled by the divisional management. Radical innovation is concentrated in the *innovation specialized unit*. It is an exploratory structure, characterized as young, entrepreneurial, research-driven unit with high intensity of risks, uncertainty and costs for R&D activities. Top management of the company controls and protects the activity of this unit.

Chapter 2 consisted of three parts and observed the theoretical background on the exploration and exploitation, the concept of organizational ambidexterity and presented our multilayer methodology. The analysis of the literature on *exploration and exploitation* showed that these were contrasting and competing activities with different characteristics. They differ in terms of rationality, search space, search process and environment. For exploitation, the time frames and returns are proximate, for exploration they are in distant future. In spite of the rival nature due to the competition for organizational resources, these activities are more likely to be complementary, rather than contradictory. The balance between both is essential for survival and long term organizational performance. What is the balance is hard to specify and to achieve because of the conflicts and tensions that emerge at multiple levels. The allocation of resources between the activities depends much on the existing capabilities of an organization and the external factors as change in the environment. Moreover, past experience, avoidance of failure, ambiguity are the reasons that can influence the decisions of the individuals on how to allocate resources.

Organizational ambidexterity literature proposes to solve the question of balance by providing several alternative solutions both to explore and exploit: by shifting between the periods of exploration and exploitation (sequential), by addressing the activities simultaneously in separate units (structural) or by creating a specific organizational context that supports the activity of individuals to be ambidextrous (contextual). But none of the existing solutions provide a well-defined and sustainable approach to achieve the balance.

In our analysis of the literature, we conclude that the concept of organizational ambidexterity is currently at the intermediate stage of the development, with multiple open questions and critical issues to explore. To expand the existing knowledge we proposed an original method, presented in our research as the “*multilayer methodology*” and described in the final part of the chapter. We applied this research method to the *model of structural ambidexterity*, which we build from the exiting literature. This type of ambidexterity proposes to separate activities in exploratory (usually young entrepreneurial unit) and exploitative structures (usually large efficient entities) and to coordinate them at the executive level. Another important factor for this model is that top management should protect, support and legitimize the activity of the entrepreneurial unit to avoid rejection of ideas at their early maturation stages. We tested this model by using our research method and practical evidence from the case of the ambidextrous company.

The multilayer methodology is a multilevel analysis of exploration and exploitation. At the corporate level, it observes different organizational structures, R&D activities, innovation and product development functions and roles by means of actual presence of the researcher in the company (half a year in the innovation unit), observations and internal data collection. At the project level, it includes the in-depth study of 6 innovative projects of radical and incremental technologies from the innovation unit. We studied their initiation, maturation and engineering development by means of interviews with project teams, who were the members from diverse R&D departments and represented both explorative and exploitative structures. At the executive level, we interviewed senior and executive managers on their selection practices, separation, coordination and integration of structures, processes related to exploration and exploitation, projects of radical and incremental technological innovation.

Chapter 3 observed exploration and exploitation at the corporate and project levels and prepared the results to be tested at the executive level in the next chapter. At the corporate level we identified that indeed, the company from our study used *structural separation* to achieve ambidexterity. Exploitation and development of incremental innovation was dedicated to the divisional business lines. Exploration and creation of radical innovation occurred at the innovation unit. These structures were independent and separate in terms of processes, activities, functions and even cultures. They were different in terms of their objectives, performance and returns from R&D. Moreover, the innovation unit was empowered by the top management to perform exploratory activity and received financial support for the development of projects on strategic and radically new technologies.

Although these were structurally different units, their activities were not fully separate. The *integration* occurred through the shared innovation process, where the unit explored the technological concept and the divisional business lines supposed to exploit a technological innovation to match the market needs. However, this process experienced a lack of coordination between the structures. Very often, the business lines rejected or forwarded back the innovative projects from the unit as not enough mature one, for exploitation and technological implementation.

Our next step was the project level analysis where we observed the actual activities of the innovation unit and made the in-depth study of 6 innovative projects. The analysis showed that there was a *mix* of activities inside the innovation unit and a combination of different innovative projects. The unit, which supposed to concentrate its function only on exploration, developed both radical and incremental technological innovation and engaged not only in exploratory (research, experimentation, creation), but also in exploitative activities (prototyping, re-designing and environmental tests). With time, this unit of the company acquired the ability to explore and in parallel to exploit and became itself ambidextrous.

Chapter 4 integrated the results from our three levels, provided the reasoning for the emerging ambidexterity inside the innovation unit and presented the interpretation of dynamics of exploration and exploitation. At the corporate level, ambidexterity was organized in separate structures. Innovation unit has a high concentration of exploratory activity and worked mainly on the ideation and conceptualization phases to prove the technical and business feasibility for radically new technologies. Its focus was given to future business needs and long term strategic projects. The divisional business lines, in contrast, gave the priority to exploitative activities and worked on prototyping, improvement of the design and production of technologies. Their main objectives were the execution of the short term needs and improvement of the existing business. We identified several mechanisms for integration between structures and process. To decrease the gap identified during the transition period in the stage-gated innovation process and to avoid isolation of exploration, the innovation unit first, initiated a co-development of innovative projects together with divisional structures and second, had an advisory role for exploratory opportunities in the divisional business lines.

In this part of our research, we presented the *history* of creation and *evolution* of the exploratory structure. The growth cycle of the innovation unit included four main phases: first, initiation of the unit by the top management as an internal entity for the development of radically new technologies and in particular for the top-down innovation; second, re-organization of corporate R&D activity, where the unit had a role of coordinator and advisor for the divisional innovation-related activities; third, isolation of the unit from the divisional

structures due to insufficient linkage, becoming an “ivory tower” of the company, decreasing creditability and lowering of the support from the executives; forth, the need to prove legitimacy and demonstrate efficiency and taking the direction towards integration and co-development with the divisional business lines.

At the project level, we defined that the innovation unit started to combine different types of innovative projects. Ambidexterity at the unit was presented as a combination of activities. The unit performed exploration by creating new technologies and in parallel, it managed the R&D projects for incremental improvements of the existing technologies. The switch from having a strong focus on exploration towards ambidexterity was justified by the decreasing support and funding from the top management and by the need to demonstrate legitimacy and credibility to the company’s leaders.

Our analysis at the executive level, proved that the dynamics of activities had an evolutionary perspectives. Historically, the processes were separated in different structures, but when the company became larger and older, there was a need to have a structured and coordinated activities and integrated processes. Besides, the existing linking mechanisms between the exploratory unit and exploitative structures were not sufficient enough to achieve the synergies. As the result, the projects of the unit were rejected to exploitation and this structure suffered from high experimentation costs and low returns. To survive without previously strong support from the executives, the innovation unit started to explore and exploit.

Chapter 5 concluded our research and defined results and implications from our multilayer methodology. It presented the arguments on our main findings on fractal and dynamic ambidexterity. Our first group of findings is that by using the case of the technology-based service company together with the multilayer methodology, we showed that the existing model of structural ambidexterity has only a *static* representation. In reality, it is particularly difficult for organizations to sustain the balance between exploration and exploitation if it organized in separate structures. The first limitation for the existing in the theory, model is the need for sufficient coordination. Separation of activities is as important, as their integration. Without sufficient linkage the exploratory unit is more likely to suffer from the isolation and inability to exploit the returns. Moreover, the managers have crucial role in sustaining structural ambidexterity. The innovation unit and its capability to explore exist as long as it is supported and sponsored by the top management. Without the executive support, the unit will need to demonstrate legitimacy and credibility, e.g. by addressing both exploration and exploitation in parallel.

Our second group of findings is on the *multilevel dimension* of ambidexterity. Our practical evidence from the case of the company showed that exploration and exploitation can emerge at diverse levels simultaneously and their intensity and proportions can change over time. The activities can take different formats, and in our case they had the following representation. At the corporate level, ambidexterity was organized in different and separate structures and the dynamics occurred due to the organizational growth and evolution of corporate R&D. At the project level, it was organized inside the innovation unit and took a form of radical and incremental projects as well as different processes and R&D activities, necessary for their development. The dynamics was caused by the unit's need to demonstrate efficiency and legitimacy and to survive without the top management protection. At the executive level, ambidexterity was present as the ability of managers to deal with the tensions between exploration and exploitation. The dynamics in strategic choices occurred when the managers took a decision to timely decrease the proportion of exploration and prioritize the exploitative approach to business. It was mainly the response to the change in the company's environment, which was caused by the market pressure and crises in oil and gas industry.

Our final part of the chapter described the new paradigm for the sustainably innovative organizations, which we defined as the concept of *fractal and dynamic ambidexterity*. The fractal indicates the organizational ability to replicate exploration and exploitation simultaneously at multiple organizational levels, whereas dynamic factor indicates the ability to change the intensity and proportions of both activities over time. In this section, we presented both the theoretical and practical evidence about the existence of replicated and dynamic ambidexterity and described our model of fractal and dynamic solution. In this model, exploration and exploitation are incorporated inside the activities and processes. They are present at multiple levels and integrated by the diverse linking mechanisms. An organization and its managers can set the degrees and proportions of activities, depending on the internal and external factors and can change them over time.

To summarize our research, we define a solution to co-organize and manage exploration and exploitation for successful and sustainable organizational performance as fractal and dynamic ambidexterity. Organizations are the nested systems and the question of balance between activities can emerge at multiple levels. Although, we agree on the fact that there are no exact proportions of exploration and exploitation to achieve ambidexterity, our multidimensional representation shows that there is a critical need to distribute activities among the diverse levels.

Ambidexterity through structural separation is only a temporal solution and does not allow companies to keep balancing over time. It needs to have a constant top management

support and unchangeable commitments of the executives to act as ambidextrous managers, whatever is occurring in the company. Without this condition, exploration is more likely to shrink and with time, disappear as costly and unprofitable activity.

There is a global need for organizations to be able to explore and at the same time, to exploit, which also would depend on its history and culture. It is hard to specify the proportions of activities to achieve the balance and to sustain it. But even if they are found, it will be hard to determine the exact localization of exploration, its degree and intensity that would be possible to sustain in time. Most probably, all levels must be ambidextrous. The balance could be distributed all over the company and simultaneously at its multiple levels.

Theoretical implications

Our research showed that exploration and exploitation should be present together. The applied multilayer methodology identified that the activities emerge and mix at different levels, not only at the corporate level, but also at the business unit level and in projects.

By crossing three levels of analysis and by taking into account the time factor, our research demonstrated that these are the complementary and continuous activities. Separation of the activities is only a solution for a limited period of time. Exploration and exploitation will inevitably emerge and mix at multiple organizational levels and in different structures. Neither a company, nor a business unit can remain focused only on one activity, if it wants to survive in the long term. The approach, oriented either on exploration or on exploitation can be effective in the short term, but would lead to a failure in the future. An organization, a structure and even an individual searches for balance between creation of new opportunities and improvement of existing certainties. This balance can be found in defining an appropriate degree of exploration and exploitation at a given period in time.

Our research expanded the knowledge on exploration, exploitation and organizational ambidexterity. We clarified that the activities are different in their processes and characteristics. They differ in rationality, search space, search process and environment. Exploration and exploitation can have diverse forms and formats (such as activities, structures, processes, procedures, projects, behavior and decision-making of the individuals).

Another important theoretical contribution is the clarification of the structural approach to achieve ambidexterity. We confirmed that structural ambidexterity is only a *temporal solution* to execute activities simultaneously. Separation of exploration and exploitation in different structures might solve the question of the mutual presence of activities only at the corporate level. At the business unit level, the conflicts and tensions

between exploration and exploitation remain unsolved, even if the integration is done at the senior and executive management level.

This study showed that the solely separation of activities in different structures is not sufficient to achieve the balance. Exploration, separated from exploitation suffers from high costs and has low returns. Moreover, the exploration-oriented structure exists only if the top management continually provides it with strong support and sponsorship.

The lack of *integration* with exploitative-oriented structures leads to the inability to use and to apply the results from the explorative unit. With time, both exploration and exploitation start to experience lack of linkages and suffer from the weak synergies. Under such conditions, the explorative unit gets isolated from the rest of the organization. However, without integration with exploitation, with time the explorative unit might be restructured or liquidated as inefficient and unprofitable organizational structure.

This study contributed to clarifying the meaning of an organizational ambidexterity. The existing literature suggested multiple options for its definition. But most of them are vast, rather general and do not respond to the question of balancing exploration and exploitation. In our research we tried to stay focused on the problem from the March's study (1991). Following his approach, we observed a company as a "nested system" that consists of multiple levels and where both activities can emerge. If the term is a solution to the problem of balance, then the meaning and essence of *ambidexterity* is in balancing the appropriate proportions of exploration and exploitation at each of the multiple levels of an organizational system.

Managerial implications

Our research developed managerial implications. Managers, willing to turn a company into an ambidextrous one, should consider that creation of an exploration-oriented structure and separating it from the rest of the organization, is *not sufficient* to be a sustainably innovative and at the same time effective organization in a long term. At the early initiation phase, the newly created unit can perform well its exploratory function, mainly because of the support and allocated resources from the top management. However, in the long term and without appropriate coordination, the separate unit may turn into an unprofitable structure, suffer from high costs, while managers will patiently expect to harvest the returns from their investments.

The reasoning is that, in structurally separated activities, each unit remains focused only on one function. Separation of structures and activities, without integration leads to

isolation of the unit. At the process level, it means that the returns from research and experimentation are not utilized by the explorative entities. While exploitative structures continue to be efficient and profitable, the explorative one, will verb because cash-absorbing and unprofitable.

Moreover, a conflict of interest might emerge between two different structures. The exploration unit experiences increasing costs for experimentation, whereas the exploitation structures are unable to accept, to improve and refine new ideas, products, services, received from the unit because of the lack of linkage to the current business needs and market demands. In general, structures and activities of exploration and exploitation suffer from the lack of coordination.

For the exploration-oriented structure, another danger is the high dependence on the *top management* of a company. The activity of the unit relies extensively on the decisions at the higher level and depends on the managerial ability to allocate resources for research and experimentation in parallel to current business needs. Any internal and external turbulence, for example, rotation of managers, market pressure, industry crises etc. will result immediately on the amount of allocated resources for exploration.

In an organization, the exploration unit exists as long as it has the support and protection from the top management. Without integration with the exploitative structures and without top management support, the explorative unit is more likely to search for alternative strategies, rather than to remain focused exclusively on exploration (as suggested by the model of structural ambidexterity). Struggling to survive, the unit starts to combine and mix exploration and exploitation activities. Manager should understand, that to assess the performance, exploration and exploitation need *different metrics*. They should always use distinct measurements to evaluate the activities and take decisions on allocation of resources for the unit, based on their growth cycle and actual innovative activity. Otherwise, the exploratory unit will always be in disadvantage, compare to efficient entities and with time, it might be liquidated as unprofitable and cash-absorbing unit.

Limitations and future research directions

Our research has some limitations. The first limitation is that the dynamics and replication of exploration and exploitation were observed only on the case of an organization that uses structural separation of activities. It is necessary to understand whether similar phenomenon emerge, if a company uses an alternative approach to achieve ambidexterity, such as sequential or contextual.

The second limitation is the critical role of senior and executive managers. Further studies, should pay more attention to the role of managers, their behaviors, choices and decisions on the allocation of resources for exploration and exploitation.

The third limitation is that our analysis is a single case research. To confirm the dynamics and replication of ambidexterity, future studies should enlarge the number of organizations. To ensure our findings, scholars should apply relevant research methods, e.g. as our multilayer methodology, in order to find out, if similar results emerge in cases of other companies.

Future studies should observe an organization as a system that consists of multiple levels, where exploration and exploitation can emerge and mix. What makes an organization truly ambidextrous is something that helps it continually and constantly keep balancing between exploration and exploitation at different levels. What is the priority of these levels, what are their characteristics and what are the appropriate proportions of exploration and exploitation at each of these levels are some of the questions to be addressed in future research.

We insist on the fact that fractal and dynamic ambidexterity is a new and promising concept that has emerged during the processing of only one case study. What is still missing is a systematic test for our theory, which could demonstrate that the similar phenomenon on repeating and dynamic activities is general to all companies that want to achieve ambidexterity. Nothing, but the new evidence and the reasoning from organizations, can reassure that the fractal and dynamic ambidexterity is the concept to achieve a sustainably innovative performance for successful organizations.

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**AMBIDEXTRIE ORGANISATIONNELLE: LE CAS FRACTAL ET
DYNAMIQUE**

INTRODUCTION GENERALE

Une performance soutenable et importante est l'objectif principal du management de toute organisation. La viabilité d'une entreprise dépend de sa capacité à trouver un équilibre entre deux activités très différentes: l'exploration et l'exploitation. L'exploitation est nécessaire pour garantir l'efficacité, l'efficacite et/ou la réussite des opérations courantes. L'exploration par contre, est importante pour assurer la détection en temps voulu et la mise en œuvre rapide des nouvelles opportunités qui garantissent l'avenir de l'organisation.

Notre recherche porte sur la capacité d'organiser, de gérer et de mener de front des activités d'exploration et d'exploitation. Le but de l'exploration est la recherche de nouvelles capacités, la création de connaissances et de technologies nouvelles et le développement d'expériences dans de nouveaux domaines. Le but de l'exploitation est d'améliorer les activités existantes, de raffiner les connaissances et les technologies déjà maîtrisées et d'étendre les domaines courants des affaires. Ces deux activités sont très différentes, elles sont en compétition et au moins partiellement en contradiction. De façon paradoxale, ces deux activités sont en même temps complémentaires et essentielles à la survie à long terme d'une organisation.

La croyance commune est que les organisations s'améliorent et sont plus performantes dans leur activité d'exploitation que dans leur activité d'exploration. L'exploitation exige des ressources moindres et surtout mieux définies, elle affiche des objectifs précis et induisent des retours sur investissements dans le court terme. L'activité d'exploration, à l'inverse, nécessite des investissements plus importants en termes de temps et des ressources, elle présente un degré de risque élevé et une incertitude sur les résultats à long terme. Du fait de ces caractéristiques, les managers au sein des organisations tendent à investir davantage dans l'exploitation de certitudes existantes et consacrent moins d'attention à l'exploration de nouvelles opportunités.

Sur le long terme, le déséquilibre entre exploration et exploitation peut devenir dramatique pour une organisation. Trop d'exploitation entraînera une incapacité à saisir l'avenir, à s'adapter aux changements de l'environnement et à envisager les changements sur les marchés. Trop d'exploration entraînera une augmentation des coûts d'expérimentation et de faibles retours. Une organisation performante devrait co-organiser et gérer ces deux activités : la recherche et l'expérimentation de nouvelles capacités et simultanément l'amélioration et le perfectionnement des capacités existantes.

L'objectif de notre recherche est d'étudier l'aptitude organisationnelle à co-organiser et gérer simultanément ces deux activités opposées. Les organisations qui réussissent, celles qui sont capables de traiter ces deux activités correctement, sont connues dans la littérature sous la dénomination d'organisations ambidextres. L'ambidextrie est la capacité organisationnelle de gérer simultanément les activités d'exploration et d'exploitation et de développer différents types d'innovations, telles que des innovations radicalement nouvelles (ou discontinues) et des innovations incrémentales.

Une des solutions pour atteindre l'ambidextrie est de séparer l'exploration de l'exploitation dans des structures organisationnelles différentes. Cette approche est connue sous le nom d'ambidextrie structurelle. A la recherche de nouvelles idées, les organisations tendent à créer une unité centrée sur l'innovation et à la séparer des structures chargées de l'exploitation. Une telle séparation structurelle des activités répond à deux besoins organisationnels. D'un côté, la séparation résout les conflits et les tensions qui émergent entre exploitation et exploration ; d'un autre côté elle aide à exécuter ces activités de façon simultanée.

Dans cette situation, la question importante est de savoir comment trouver un équilibre entre exploration et exploitation pour permettre des performances organisationnelles soutenables sur le long terme. Toutefois la littérature ni sur l'apprentissage organisationnel ni sur l'ambidextrie ne fournissent une réponse explicite ou une solution organisationnelle pour la mise en œuvre efficace des deux activités. Pendant plus de 20 ans, les chercheurs ont accumulé une quantité de savoir assez considérable. Toutefois la réponse à une question aussi centrale, autant pour la littérature que pour les organisations, n'a pas encore été trouvée. A la recherche d'une telle solution, cette étude se pose les questions de recherche suivantes :

Comment co-organiser et gérer simultanément des activités d'exploration et d'exploitation pour assurer des performances organisationnelles réussies et soutenables sur le long terme ?

Pour répondre à cette question notre recherche développe et utilise une méthodologie particulière que nous appellerons "méthodologie multi-niveaux" pour analyser une entreprise ambidextre. Cette méthodologie est une approche originale d'appréhender l'exploration et l'exploitation. Elle consiste en une combinaison de méthodes et de techniques de recherche. L'avantage principal de cette méthodologie est qu'elle traverse deux niveaux d'analyse et qu'elle tient compte du facteur temps. Il s'agit d'analyser les activités au niveau de la compagnie et au niveau du projet et de tenir compte de l'évolution et de la maturité de l'unité

d'exploration. En complément, elle inclut les visions et les choix d'exploration - d'exploitation des dirigeants de l'entreprise.

Notre recherche s'organise autour de cinq chapitres.

Le **Chapitre 1** introduit le cas de l'entreprise de services basés sur la technologie. Il décrit les caractéristiques organisationnelles, l'environnement et la structuration de la compagnie.

Le **Chapitre 2** est consacré à l'analyse des concepts existants et de la méthodologie multi-niveaux. En s'appuyant sur les diverses perspectives de l'apprentissage organisationnel et de la littérature sur le management, il explique les fondements théoriques de l'exploration et de l'exploitation. Il présente ensuite les différents concepts de l'ambidextrie organisationnelle. Finalement il expose les principes de la méthodologie multi-niveaux, les trois niveaux d'analyse et les étapes du processus de collecte des données.

Le **Chapitre 3** décrit la façon dont l'entreprise de notre étude de cas réussit l'ambidextrie en utilisant une séparation structurelle des activités. Il analyse les caractéristiques des structures organisationnelles séparées centrées sur l'exploration ou orientées vers l'exploitation, leurs activités, leur processus et leurs cultures. Il fournit une description de l'activité de l'unité spécialisée dans l'innovation et une analyses approfondie de six projets innovants.

Le **Chapitre 4** explique l'évolution et la dynamique de l'ambidextrie organisationnelle. Cette partie de l'étude analyse les observations au niveau de l'entreprise, du projet et de la direction générale. Elle identifie les activités d'exploration et d'exploitation à différents niveaux organisationnels ainsi que leur évolution à chaque niveau.

Enfin le **Chapitre 5** conclue cette étude en introduisant un nouveau concept, celui de l'ambidextrie fractale et dynamique, permettant une compréhension analytique des phénomènes observés. Il suggère que la littérature existante n'offre qu'une représentation statique de l'ambidextrie structurelle et introduit le concept d'ambidextrie dynamique et fractale, dans lequel l'exploration et l'exploitation sont des activités continues qui émergent à différents niveaux organisationnels.

CHAPITRE 1. CARACTERISTIQUES DE L'ETUDE DE CAS :

L'ENTREPRISE ET L'ENVIRONNEMENT

Le Chapitre 1 a pour but de caractériser l'entreprise sur laquelle repose l'étude de cas, son environnement et ses capacités à être une organisation innovante. Cette société de services basés sur la technologie est un grand groupe, établi, avec une histoire de plus de 80 ans. C'est un des leaders dans le domaine de l'acquisition et de l'interprétation des données sismiques offshore et onshore. Elle fournit ses études à ses clients à travers le monde. C'est une compagnie totalement intégrée qui s'appuie sur la science. Elle possède d'importantes capacités en termes de ressources, de personnel et de structures organisationnelles spécialement destinées à la création, la recherche, l'expérimentation, le développement et la mise en œuvre de nouvelles technologies à destination des marchés existants et de futur domaines d'activités. Il s'agit d'une organisation orientée vers l'innovation, qui promeut la culture de l'innovation au sein de ses structures organisationnelles et de ses employés à différents niveaux. Elle comprend une unité spécialisée pour l'innovation dont la mission est la création et le développement d'innovations technologiques radicalement nouvelles. L'unité d'innovation développe des projets innovants complexes qui ont pour but le remplacement des anciennes technologies, des approches existantes et de mener des opérations pour l'exploration de ressources nouvelles.

Les processus et les activités de la compagnie se concentrent sur trois *domaines principaux* : 1) la conception et la construction d'équipements; 2) la mise en œuvre de recueil de données sismiques et 3) l'interprétation des données, l'analyse des réservoirs et la consultance. De plus, la compagnie gère un large portefeuille de produits qui consiste en de multiples solutions, services et consultances dans le domaine de l'exploration du gaz et du pétrole. Les procédés se regroupent autour de deux activités : a) la R&D et le développement de nouveaux produits (NPD) dans le secteur des technologies de l'équipement, du hardware et du software et des services pour l'exploration des champs pétrolifères et b) les opérations et les services de terrain pour les clients principaux, souvent de grandes compagnies pétrolières.

La structure organisationnelle de la compagnie basée sur la technologie est de type divisionnelle (Henry Mintzberg, 1979). Elle comporte trois divisions offrant une spécialisation fonctionnelle. Elles se différencient selon leur domaine d'activité : 1) les équipements, 2) l'acquisition de données sismiques et 3) la traitement et l'analyse des données sismiques. Chaque division comprend plusieurs secteurs commerciaux spécialisés sur des segments spécifiques du marché. Ce sont de entités sont indépendantes et autonomes

jouissant d'une liberté financière, opérationnelle et décisionnelle. La direction du groupe définit les objectifs et les plans et contrôle l'efficacité et les performances des divisions.

Les secteurs commerciaux divisionnels sont structurés sous forme d'une bureaucratie professionnelle. Il s'agit d'entités de grande taille, bien établies et efficaces. L'objectif des secteurs commerciaux est de garantir la compétitivité sur les marchés existants et les performances des opérations commerciales en cours. Les secteurs commerciaux ont des départements de R&D qui réalisent des activités relevant de l'exploitation : elles améliorent les technologies, les produits et les services existants et affinent les opérations en cours. Les secteurs commerciaux ont un mode d'opération conservateur : ils présentent des procédures standardisées, des activités de routine et une résistance au changement. Le management divisionnel définit les objectifs du marché et les plans des secteurs commerciaux et ensuite vérifient leurs performances.

L'unité spécialisée dans l'innovation a pour mission de développer des innovations technologiques radicalement nouvelles et avancées. Il s'agit d'une structure organisationnelle séparée, autonome et indépendante. L'activité de l'unité est protégée et contrôlée directement par la direction de la compagnie. Elle a une structuration semblable à celle de l'adhocratie. Par opposition avec les secteurs commerciaux divisionnels, l'unité d'innovation est jeune, centrée sur l'innovation et axée sur l'entrepreneuriat. Son activité est peu structurée et pas très précisément définie. L'unité rassemble des idées totalement nouvelles et sélectionne les meilleures pour les développer. Par la recherche et l'expérimentation, l'unité acquiert de nouvelles connaissances. Elle incube les idées nouvelles, les fait arriver à maturation et ensuite, en accord avec les équipes de direction, prend la décision de continuer ou pas. Pour le développement de projets d'innovation totalement nouveaux, l'unité doit chercher des ressources : des individus ou équipes au sein des divisions ou des secteurs commerciaux, du financement ou des parrainages parmi les dirigeants, des partenaires pour du co-développement. Elle offre aux équipes de projet et au personnel de R&D dans les structures divisionnelles de la formation, de l'apprentissage et des conseils sur les différents thèmes.

CHAPITRE 2. AMBIDEXTRIE ORGANISATIONNELLE: CADRE CONCEPTUEL ET ANALYTIQUE

Ce chapitre se compose de trois parties : une analyse de la littérature existante sur l'exploration et l'exploitation, l'analyse des études sur l'ambidextrie organisationnelle et la description de la méthodologie multi-niveaux.

Contexte théorique

L'exploration couvre des activités comme la recherche et l'expérimentation. Le but de ces activités est de créer de l'innovation, de nouvelles connaissances, de nouvelles technologies et de nouveaux produits, etc. L'exploitation, par opposition, s'occupe de sélection, de production et d'efficacité. Son objectif est d'améliorer et d'affiner les connaissances, les technologies et les produits actuels, etc. Il s'agit là d'activités contrastées, voire contradictoires, de nature différente, qui sont en compétition pour obtenir des ressources organisationnelles. Les activités divergent en termes de rationalité, d'espace de recherche, de procédés de recherche, d'environnement. Elles ont des cadres temporels différents et différents retours sur investissement. Bien qu'elles soient en compétition pour des ressources rares, l'exploration et l'exploitation sont des activités complémentaires et nécessaires pour les performances organisationnelles à long terme.

Combiner exploration et exploitation est essentiel à la survie organisationnelle. L'équilibre entre les deux activités mène à la prospérité et des performances soutenables. Cependant cet équilibre est difficile à atteindre du fait des conflits et des compromis qui émergent entre exploration et exploitation à de multiples niveaux.

Au cours des 20 dernières années, les chercheurs ont accumulé bon nombre de connaissances sur l'exploration et l'exploitation. Cependant la question de savoir comment trouver le bon équilibre entre exploration et exploitation reste ouverte. Le concept d'ambidextrie organisationnelle a pour but d'expliquer les approches spécifiques que les compagnies peuvent appliquer pour combiner exploration et exploitation au sein de leurs structures. Le terme *ambidextrie organisationnelle* correspond à la capacité de poursuivre simultanément des innovations incrémentales (exploitation) et de rupture (exploration) (O'Reilly and Tushman, 2004, 2013). Elle fait référence également à la capacité à co-organiser des structures, des procédés et des cultures divergentes au sein de la société qui sont nécessaires à sa survie (O'Reilly and Tushman, 2013; Tushman and O'Reilly, 1996, p. 19).

L'une des solutions qui permettent d'atteindre l'ambidextrie est la séparation structurelle de l'exploration et de l'exploitation dans des entités différentes. ***Le modèle d'ambidextrie structurelle***, que l'on trouve dans la littérature (pour plus de détails voir Tushman and O'Reilly, 2002, p. 171) peut être décrit de la façon suivante : l'exploitation est déléguée aux entités « efficaces ». Ces structures sont grandes, rentables et orientées vers l'efficacité. Leur but est l'amélioration continue et la réponse aux besoins à court terme. L'exploration doit être confiée à une « jeune unité entrepreneuriale ». Cette unité est chargée d'opération de type entrepreneurial ; son activité est risquée et consommatrice de fonds. Son

objectif est de faire de la recherche et d'expérimenter, de créer de nouvelles connaissances et des innovations pour l'avenir.

Le modèle d'ambidextrie organisationnelle devrait remplir deux *conditions* importantes : 1) une compagnie devrait combiner structures d'exploration et d'exploitation au niveau des cadres supérieurs et dirigeants afin de bénéficier des synergies entre ces deux activités (cf également O'Reilly and Tushman, 2004); 2) l'unité d'exploration doit être séparée (physiquement, culturellement et structurellement) du reste de l'organisation et les dirigeants doivent légitimer et protéger l'activité de cette unité (cf. Tushman and O'Reilly, 2002). La séparation se justifie par la nécessité de faire face aux oppositions et aux conflits entre ces activités. Elle est aussi nécessaire pour traiter avec les différentes structures et configurations qu'exigent différents types d'innovations, qu'elles incrémentales ou de rupture (Tushman and O'Reilly, 2002).

En même temps, la séparation structurelle peut avoir des effets secondaires et se traduire par un *isolement* de l'unité d'exploration du reste de la compagnie. L'unité d'exploration, séparée et protégée par la direction risque de souffrir d'un « manque de liens avec le cœur des activités de l'entreprise » (Birkinshaw and Gibson, 2004, p. 49). L'isolement risque d'entraîner un échec de la R&D. En d'autres termes, les idées, les concepts et les innovations sur lesquels travaille l'unité d'exploration ne seront pas acceptés pour être développés et affinés par les entités d'exploitation (Birkinshaw and Gibson, 2004, p. 49). Ainsi dans l'ambidextrie structurelle, un autre conflit émerge entre l'unité d'exploration et les entités d'exploitation. Afin d'assurer une coordination sans accroc entre différents types de structures, de procédés et d'innovations, ces entités doivent être à la fois séparées et intégrées.

Pour comprendre comment arriver à une exploration et une exploitation simultanées dans une séparation structurelle, notre recherche offre une analyse approfondie de l'ambidextrie en s'appuyant sur une entreprise basée sur la technologie. Il s'agit d'une entreprise qui s'appuie sur les connaissances scientifiques. Nous ferons une analyse détaillée des activités, de leur séparation et de leur coordination. A cette fin, nous faisons appel à une méthodologie multi-niveaux.

Méthodologie multi-niveaux: Design et mise en œuvre

La présente étude propose une approche holistique pour analyser le phénomène de l'ambidextrie organisationnelle. Elle développe une méthodologie multi-niveaux et l'applique au cas d'une société de services basés sur la technologie. La méthodologie multi-niveaux (i)

observe simultanément trois niveaux organisationnels et (ii) prend en compte le facteur temps et l'évolution de l'ambidextrie dans la durée.

La méthodologie multi-niveaux comporte *trois niveaux* : l'entreprise, le projet et la direction générale. Pour l'entreprise, l'analyse inclut la description des activités d'exploration et d'exploitation, la spécialisation des structures de R&D d'exploration et d'exploitation, les procédés, les procédures, les outils et les approches utilisées pour développer des types d'innovations aux améliorations incrémentales et/ou radicalement nouvelles. Au niveau du projet, l'analyse inclut l'étude de 6 projets innovants (3 solutions radicales et 3 solutions d'amélioration incrémentale) ainsi que leur processus de développement de produits. La description détaillée de ces projets couvre les phases de lancement, de recherche, d'expérimentation, de développement et de mise en œuvre. Elle montre également la relation et la coordination qui existent entre les activités et les structures d'exploration et d'exploitation au sein du processus de développement. Le niveau de la direction générale est un niveau complémentaire qui décrit les visions, les opinions et les vues de la direction générale, impliquée dans la structuration, l'organisation et la coordination de l'exploration et de l'exploitation et chargée de traiter des conflits entre les activités au niveau du projet et de la compagnie. De plus, la méthodologie multi-niveaux comprend l'histoire et l'évolution de l'unité spécialisée dans l'innovation, les incitations à la création, la protection et le parrainage de la direction et le rôle dans l'équilibre entre les deux activités.

Les données concernant la méthodologie ont été collectées en trois étapes. Au cours de *la première étape*, l'attention s'est portée surtout sur le niveau de l'entreprise. A ce niveau le but était d'identifier la présence et l'interrelation entre différentes structures séparées de l'organisation. Elle a commencé au début de 2013 avec la présence du chercheur dans l'entreprise. Pendant 6 mois le chercheur a été intégré dans l'unité spécialisée dans l'innovation et a travaillé de façon étroite avec les membres de l'équipe qui se consacre au management de l'innovation. La collecte de données incluait des observations, l'identification et la documentation des structures d'exploration et d'exploitation, des procédés, des procédures, des cultures et des différents types d'activité, les relations et la coordination entre les différentes structures d'exploration et d'exploitation de R&D. Au niveau de l'entreprise, l'analyse a identifié 'existence d'entités d'exploration et d'exploitation, qui sont structurellement séparées et opérationnellement indépendantes.

La deuxième étape a commencé en 2014 et s'est concentrée sur les projets. L'objectif de cette étape était de réaliser une étude approfondie de l'unité d'exploration, structurellement séparée, indépendante et soutenue par la direction générale. Afin d'étudier l'activité d'exploration de l'unité d'innovation, le chercheur avec l'aide d'un des dirigeants de

l'innovation, a sélectionné 6 projets pour une analyse approfondie. Les projets représentaient 3 solutions radicalement nouvelles et 3 solutions d'amélioration incrémentale (y compris des services technologiques, de l'équipement d'ingénierie et des services informatiques). La typologie des projets (radicaux ou incrémentaux) a été établie en fonction du degré de nouveauté de chaque innovation technologique, y compris la nouveauté d'un composant, le design architectural et le modèle opérationnel.

L'étude approfondie du processus de développement de nouveaux produits (NPD) de chaque projet a été réalisée au moyen d'entretiens avec les initiateurs, les leaders et divers membres de l'équipe de projet. Les entretiens ont couvert l'ensemble du processus de développement : depuis la phase de sélection jusqu'aux phases de commercialisation et de production. Parmi les personnes interviewées se trouvent des membres de différentes structures de R&D avec leurs profils divers, notamment des initiateurs, des chefs de projet, des scientifiques, des développeurs et des spécialistes de R&D, des membres du soutien technique, de la vente et du marketing, des groupes et des départements opérationnels. Certaines des personnes interviewées étaient impliquées dans plus d'un projet et/ou participaient à différentes phases NPD.

La troisième et dernière étape a été réalisée pendant cette même période (2014). Le but de l'étude au niveau de la direction générale était de vérifier et de valider les hypothèses qui étaient ressorties des données au niveau de l'entreprise et des projets. Cette étape comprenait des interviews avec les responsables des entités d'exploitation et de l'unité d'exploration, les dirigeants dans différentes fonctions et quelques cadres supérieurs responsables du développement stratégique. Au total 24 interviews ont été réalisés, notamment des discussions avec des membres des équipes de projets, des cadres supérieurs et des dirigeants de l'entreprise. Les interviews ont été enregistrés, transcrits, analysés et utilisés pour en extraire les éléments constitutifs de notre démonstration dans cette thèse.

CHAPITRE 3. AMBIDEXTRIE STRUCTURELLE: L'EVIDENCE DE L'ETUDE DE CAS

Ce chapitre observe l'exploration et l'exploitation au sein de la compagnie et de ses projets. Il décrit l'ambidextrie au niveau de l'entreprise, présente trois projets d'innovation radicalement nouveaux et trois projets d'amélioration incrémentale et propose une analyse de l'ambidextrie au niveau des projets.

Dans le cas d'une compagnie de services basés sur la technologie, l'exploration et l'exploitation simultanée sont organisées dans une approche structurelle de l'ambidextrie et

présente le format suivant : l'exploitation se produit au sein des secteurs divisionnels, l'exploration est confiée à l'unité spécialisée dans l'innovation. L'unité d'innovation explore les opportunités nouvelles, sélectionne les idées, s'informe sur des nouveaux domaines, acquiert de nouvelles connaissances et expérimente des technologies nouvelles. Le travail des unités divisionnelles est « d'exploiter » les idées. Ils servent des connaissances et des compétences existantes pour redéfinir les concepts, repenser le design des systèmes technologiques existants et les affiner afin d'améliorer et de développer les performances opérationnelles des technologies, des produits et des services existants.

Ces structures se différencient non seulement par leurs activités mais aussi par leurs caractéristiques et comportements. *L'unité d'innovation* est petite, jeune et entrepreneuriale. Elle est tirée par l'innovation et absorbe beaucoup de ressources. Les projets de R&D ont pour but de développer des innovations technologiques radicales, ils ont une importance stratégique et une orientation à long terme. Par opposition, *les secteurs commerciaux divisionnels* sont de grande taille, bien établis, efficaces et rentables. Leur culture est centrée sur l'efficacité opérationnelle. Les projets de R&D y ont pour but de réaliser des améliorations incrémentales des technologies existantes pour protéger leur part de marché et générer des revenus à court terme.

L'intégration/coordination de l'exploration et de l'exploitation se produit au niveau de la direction générale. La direction générale soutient et protège l'activité d'exploration de l'unité d'innovation. L'unité elle-même n'a qu'une petite partie de la fonction d'intégration, elle doit détecter les menaces sur les marchés et définir les futures opportunités pour les divisions. Elle exerce aussi une fonction de conseil et développe des propositions pour les divisions opérationnelles pour l'exploration d'innovations technologiques.

Le processus de développement d'innovations se partage entre les structures d'exploration et d'exploitation. Le développement d'une nouvelle technologie part de l'exploration au sein de l'unité d'innovation. À l'aide de différentes techniques de brainstorming, l'unité d'innovation définit un nouveau concept. Par l'apprentissage et l'expérimentation, elle démontre la faisabilité technique et commerciale de la technologie innovante. Dans certains cas elle développe un premier prototype. À ce stade, le travail « d'exploration » de l'unité d'innovation se termine et le projet est transféré aux ou à une division pour poursuivre son développement, son industrialisation et sa commercialisation.

Le travail des divisions est « d'exploiter » l'innovation technologique. Quand les secteurs commerciaux reçoivent un projet de l'unité d'innovation, ils commencent à le développer en partant d'un nouveau design et d'un affinement de la version de travail de la

nouvelle technologie. Puis ils commercialisent cette technologie en l'intégrant dans leur offre de produits et de services.

Un tel processus de développement d'une innovation technologique, où l'exploration revient à l'unité d'innovation et l'exploitation aux divisions, présente un format linéaire. Il est organisé comme si des barrières, des décisions et des tensions n'existaient pas et ne pouvaient pas apparaître entre les processus et les phases multiples. Le processus de développement de produit est également organisé de façon simple, comme s'il n'y avait ni conflit d'intérêt ni opposition dans les objectifs des structures d'exploration et d'exploitation.

Au niveau de l'organisation, l'entreprise structure donc les activités, les procédés et les projets dans des entités séparées. Dans les divisions, les projets de R&D sont de courte durée, nécessitent des financements modérés (relativement à leur taille) et sont souvent centrés sur un ensemble spécifique de capacités, comme l'optimisation technologique. Les projets de R&D de l'unité d'innovation sont à plus long terme surtout parce qu'ils demandent de l'apprentissage et des connaissances dans les phases initiales ; ils ont besoin de ressources importantes pour le développement et leur rentabilité est lointaine.

Bien que la compagnie différencie les procédés et les fonctions selon les structures, le processus d'intégration entre exploration et exploitation reste à clarifier. Dans les processus de développement, l'intégration se passe au moment où un projet est transféré de l'exploration dans l'unité d'innovation à l'exploitation dans les divisions. Cependant les interviews des 6 projets ont montré l'existence de tensions et de conflits non résolus entre exploration et exploitation. Les personnes interrogées dans certains projets ont notamment fait référence au fait que les divisions n'étaient pas prêtes à accepter le projet et le début de son exploitation, après la fin des phases d'exploration des innovations technologiques par l'unité d'innovation. Ces tensions et ces conflits d'intérêt sont apparus à plusieurs reprises.

Une autre question critique, identifiée lors de l'étude approfondie des 6 projets innovants a trait au *mélange* des activités et aux différents types d'innovation au sein de l'unité d'innovation. Dans l'entreprise, la mission de l'unité est d'explorer les opportunités nouvelles et de développer des innovations technologiques radicalement nouvelles. Cependant l'analyse au niveau des projets a identifié la présence à la fois d'innovations radicales et incrémentales au sein de cette unité. Ce qui signifie que la structure d'exploration fait passer ses fonctions d'un centrage exclusif sur l'exploration à une combinaison d'activités d'exploration et d'exploitation.

Ce processus de combinaison d'activités exige quelques clarifications. En fait, on a supposé que l'exploration s'arrête à un certain moment dans le temps et qu'ensuite commence l'exploitation, par exemple au cours du processus de développement de l'innovation

technologique. L'analyse au niveau des projets montre qu'il n'y a pas de différenciation pure entre les phases d'exploration et d'exploitation et dans les différents types d'innovation technologique. L'étude de 3 innovations radicales et 3 innovations incrémentales venant de l'unité pour l'innovation montre que tous les projets contiennent de l'exploration. C'est aussi la raison pour laquelle le développement de ces projets, en particulier les projets incrémentaux, a été confié à l'unité pour l'innovation et non aux divisions. Dans les 6 projets innovants, la différence tient au degré d'exploration et à la concentration de nouvelles connaissances, compétences et capacités qu'il faut acquérir. La fonction de la structure d'exploration peut donc évoluer au fil du temps.

CHAPITRE 4. EVOLUTION ET DYNAMIQUE DE L'AMBIDEXTRIE STRUCTURELLE

Ce chapitre décrit les résultats obtenus par l'analyse de l'exploration et de l'exploitation au niveau de l'entreprise, au niveau des projets et au niveau d'exécutif. Il propose la description d'une histoire de création et d'évolution de l'unité spécialisée dans l'innovation au sein de l'entreprise. Cette étude a permis d'identifier les activités à la fois d'exploration et d'exploitation au niveau de l'entreprise et au niveau des projets.

L'entreprise explore et exploite simultanément dans des structures séparées. Au niveau de l'entreprise, l'ambidextrie est organisée dans des entités organisationnelles différentes. L'organisation utilise l'approche structurelle pour parvenir à l'ambidextrie. L'activité d'exploration est dévolue à l'unité pour l'innovation. L'exploitation se passe au sein des divisions commerciales. Ce sont là des structures séparées. Elles sont des types d'activités, des procédés et des projets différents. Elles diffèrent dans leurs objectifs, leur préoccupation centrale, leur culture et leur procédés de R&D.

L'unité pour l'innovation est une structure jeune, entrepreneuriale, orientée vers l'innovation. Le rôle de cette unité est d'acquérir de nouvelles connaissances et de développer des innovations technologiques radicalement nouvelles destinées à de nouveaux marchés. Les divisions présentent des caractéristiques opposées. Il s'agit d'entités de grande taille, bien établies et efficaces. Ces entités sont exécutives par nature et orientées vers le court terme. L'activité des secteurs commerciaux a pour but d'améliorer et d'affiner les technologies existantes. Elle améliore les performances et l'efficacité des produits, services et opérations existantes. L'objectif des divisions est d'améliorer les connaissances existantes et d'apporter des améliorations incrémentales à l'intention des clients et des marchés existants.

L'activité de l'unité pour l'innovation est protégée et soutenue par la direction de la compagnie. Au contraire les divisions disposent d'une liberté opérationnelle et financière. Elles sont autonomes dans leur prise de décision concernant l'organisation, la gestion et l'attribution des ressources pour les activités divisionnelles des R&D.

Au niveau de l'entreprise, l'étude a permis d'identifier *deux mécanismes de coordination* existant entre l'exploration et l'exploitation : l'unité pour l'innovation elle-même et une période au sein du processus de développement de produit. Tout d'abord, l'unité pour l'innovation a aussi un rôle d'intégrateur. Au départ, l'unité avait pour objectif de mettre en liaison et de coordonner l'activité de R&D de multiples divisions. D'un côté l'unité était un endroit pour l'exploration de nouvelles idées proposées par des dirigeants visionnaires et la mise en œuvre d'innovations d'importance stratégique top-down. De l'autre, l'unité était responsable de la sélection d'idées innovantes venant des structures d'exploitation et de proposer à la direction les projets innovants à développer.

Un second mécanisme pour relier exploration et exploitation est apparu pendant le processus de développement de produit. Selon le processus de développement d'une innovation, l'unité était responsable de la sélection et de l'exploration de nouveaux concepts. Suite aux études de faisabilité, le projet était transféré aux divisions commerciales pour être exploité et lancé sur le marché. La période de transition est apparue lors de l'acceptation ou du refus du nouveau projet par les structures divisionnelles.

A ce stade, l'étude a permis d'observer l'apparition de conflits et de tensions entre exploration et exploitation. En réalité, durant le processus de développement "stage-gate", l'unité pour l'innovation a la responsabilité de la recherche et de l'expérimentation. Très souvent, les divisions commerciales rejettent les nouveaux projets qu'ils ne considèrent pas suffisamment aboutis. Pour la R&D au sein des secteurs commerciaux, de tels projets de technologies innovantes ne sont pas vraiment prêts pour les phases de développement et de commercialisation. Le résultat de l'absence de connexion entre exploration et exploitation est le nombre croissant de projets refusés, l'accroissement des coûts de recherche et d'expérimentation et la mauvaise performance de l'activité d'exploration au sein de l'unité pour l'innovation.

Afin de combler l'écart entre les activités et d'éviter une isolation complète de structures d'exploitation ; l'unité pour l'innovation a commencé à développer de nouveaux types de projets collaboratifs. Ces projets visaient un co-développement de l'innovation technologique et le partage des ressources et des responsabilités avec les divisions. Dans certains cas, l'unité pour l'innovation a réussi à impliquer des partenaires extérieurs et à créer des partenariats de co-développement.

L'étude approfondie de 6 projets de l'unité pour l'innovation a révélé un fait nouveau concernant la structure d'exploration. Les projets innovants venant de cette unité visaient non seulement la création de technologies radicalement nouvelles mais également le développement d'améliorations incrémentales des technologies existantes. L'unité pour l'innovation est passée d'une focalisation exclusive sur l'exploration à une combinaison d'activités d'exploration et d'exploitation. Et ainsi, au fil du temps, la structure d'exploration est devenue elle-même ambidextre.

L'évolution de l'unité spécialisée dans l'innovation au sein de la compagnie montre que les fonctions, les rôles et les objectifs exploratoires de l'unité ont tendance à changer au fil du temps. Pour l'unité d'innovation, le rôle critique est de continuer à réaliser des innovations de type radical et de garder la proportion adéquate d'exploration de nouveaux domaines. Si l'unité est amenée à baisser le nombre d'innovations radicales, cela reviendra à un revirement total vers l'exploitation. Ainsi, dans une ambidextrie structurelle, le rôle de la structure d'exploration (jeune unité entrepreneuriale) ne peut exister s'il n'est pas protégé et parrainé par la direction générale de l'entreprise ou du groupe. Sans le soutien des dirigeants, la structure d'exploration va devoir chercher à survivre. Et comme toute organisation elle commencera à explorer et exploiter, ce qui signifie que l'unité pour l'innovation devient elle-même ambidextre.

Les résultats de l'analyse au niveau de l'entreprise et des projets ont démontré que l'ambidextrie est un phénomène complexe, interdépendant et dynamique. Le cas de la séparation structurelle de l'exploration et de l'exploitation de notre étude montre que l'ambidextrie est un phénomène dynamique. Notamment, si l'unité spécialisée dans l'innovation ne maintient pas un niveau approprié d'exploration, toutes les structures de la compagnie de services basée sur la technologie seront "exclusivement" centrés sur l'exploitation. Cela veut dire que le concept d'ambidextrie structurelle n'est pas stable, ce n'est plus une solution organisationnelle soutenable, car elle ne garantit pas sur le long terme la simultanéité de l'exploration et de l'exploitation.

CHAPITRE 5. FRACTALE ET DYNAMIQUE: UNE NOUVELLE DIMENSION A L'AMBIDEXTRIE ORGANISATIONNELLE

Ce chapitre approfondit les résultats issus de la méthodologie multi-niveaux. Notre étude de cas montre que l'ambidextrie organisationnelle est un phénomène dynamique qui peut évoluer et changer avec le temps. La capacité à reproduire l'exploration et l'exploitation

à différents niveaux organisationnels démontre que l'ambidextrie est un processus dynamique et fractale.

Résultats et interprétations

Les résultats de la méthodologie multi-niveaux montrent la reproduction de l'exploration et de l'exploitation à différents niveaux organisationnels. En particulier l'analyse *au niveau de l'entreprise* a montré que la compagnie de services basés sur la technologie est une organisation ambidextre qui utilise la séparation structurelle des activités. L'exploitation est du ressort des divisions commerciales qui sont des entités de grande taille, qui génèrent des bénéfices et ont une orientation à court terme. Dans ces structures la priorité est donnée aux développements incrémentaux et à l'amélioration des solutions technologiques et de software existantes. L'exploration revient à une unité spécialisée pour innover. Cette unité est relativement récente, de petite taille et elle absorbe des fonds proportionnellement importants. Son activité présente un haut degré de risque et nécessite des investissements importants. L'unité a une orientation à long terme et la capacité principale de créer des innovations stratégiquement importantes et radicalement nouvelles. Sa mission est de rechercher de nouvelles idées et d'expérimenter des concepts technologiques complexes. Il s'agit d'une entité indépendante et structurellement séparée. Son activité est protégée, parrainée et soutenue par la direction de la compagnie.

Dans le cas de cette entreprise de services basés sur la technologie, la séparation ne veut pas dire l'isolement de l'unité pour l'innovation. Pour assurer la coordination entre structures de R&D d'exploration et d'exploitation, la compagnie crée des liens entre les processus de R&D. En particulier il existe une division du travail dans la phase de développement de produit : l'unité pour l'innovation sélectionne des idées nouvelles, réalise des études, prouve la faisabilité et ce n'est qu'après que la faisabilité technique et commerciale a été prouvée que l'unité transfère le projet aux divisions commerciales pour la suite du développement. Ensuite les divisions prennent la direction du projet et mettent en œuvre des actions d'affinement, de production et de commercialisation. Ce processus organisationnel a pour objectif de garantir que les nouvelles opportunités, explorées par l'unité pour l'innovation, seront transmises à l'exploitation au sein de secteurs commerciaux. Il a donc pour but d'assurer l'exécution et la livraison de nouveaux produits sur le marché.

Bien qu'au niveau de l'entreprise il existe une séparation claire des structures, des activités et de la division du travail, ces activités sont mixées au niveau du projet. En effet, l'analyse *au niveau du projet* montre qu'à la fois l'exploration et l'exploitation sont présentes

au sein de l'unité pour l'innovation. Par opposition à sa mission première qui est d'explorer – en développant des technologies radicalement nouvelles – l'unité pour l'innovation exploite – en mettant en œuvre des projets complexes qui ont pour but le raffinement de technologies existantes. Cependant un tel déplacement de la pure « exploration » vers une combinaison d'activités résulte i) de l'évolution de l'unité et ii) des turbulences de l'environnement (notamment la crise industrielle et la pression accrue du marché). Pour survivre sans bénéficier d'un soutien marqué de la direction générale, l'unité pour l'innovation devient elle-même ambidextre. En faisant à la fois des projets de R&D innovants du genre exploration (radicaux) et exploitation (incrémentaux), l'unité cherche à prouver sa légitimité, sa crédibilité et son efficacité à la direction générale et aux directeurs des divisions. Ce processus a aussi un impact sur l'entreprise : du fait du changement de l'environnement (pression du marché) l'organisation qui applique une séparation structurelle doit reconsidérer le degré et la localisation de l'exploration et de l'exploitation.

Ces données ont également été confirmées *au niveau exécutif*. Les membres de l'équipe de direction, les directeurs des structures organisationnelles d'exploration et d'exploitation prouvent que les entités sont structurellement séparées, autonomes et indépendants dans leurs prise de décision, l'organisation des procédés et les opérations. Néanmoins, en explorant de façon isolée, l'unité pour l'innovation est devenue une « tour d'ivoire » au sein de la compagnie. Pour les divisions commerciales, elle est devenue une rivale avec laquelle elle entre en concurrence pour les ressources de R&D alloués par la direction générale.

Le concept de l'ambidextrie fractale et dynamique

Jusqu'à présent l'ambidextrie structurelle a été perçue comme un phénomène statique, alors que les solutions organisationnelles suggérées pour l'exploration et l'exploitation bien qu'elles soient réalisables elles ne le sont pas durablement. La raison réside dans les caractéristiques dynamiques et fractales de l'ambidextrie organisationnelle. L'ambidextrie est *dynamique* car l'équilibre dépend de la proportion de l'exploration et de l'exploitation qui repose pour une grande part sur les conditions de l'environnement et de soutien de la part de la direction générale. Comme nous avons pu le montrer dans notre cas, l'ambidextrie devient *fractale* car l'exploration et exploitation finissent par émerger simultanément à différents niveaux organisationnels (l'entreprise, les unités commerciales, les projets, les individus, etc.).

La littérature existante ne fournit qu'une représentation *statique* de l'ambidextrie structurelle et décrit une solution organisationnelle qui permet de réaliser simultanément de l'exploration et de l'exploitation pour une période de temps spécifique. Dans le modèle de séparation structurelle, les activités sont séparées et différenciées dans différentes structures organisationnelles. Chaque structure est spécialisée et met en œuvre une série d'activités et de procédés consacrés soit à la fonction "d'exploration" soit à celle "d'exploitation". Leur intégration peut être réalisée au niveau du management, où les cadres exécutifs supérieurs doivent avoir des engagements communs, protègent et légitiment l'activité d'exploration de la jeune unité entrepreneuriale.

L'étude affirme que la séparation structurelle peut, de fait, aider les compagnies à atteindre l'ambidextrie. Cependant, la séparation et la protection de l'exploration par la direction générale ne sont pas suffisantes. Tout d'abord, sans des canaux appropriés pour intégrer et relier les structures, les deux activités souffrent d'un manque d'intégration. Pour la structure d'exploration, cela peut entraîner des coûts élevés d'expérimentation, une faible rentabilité de la recherche et de l'expérimentation et enfin un isolement complet de l'unité. Pour les structures d'exploitation, cela entraîne une incapacité à utiliser et appliquer les résultats de l'exploration. Deuxièmement, même si un équilibre est trouvé, le modèle d'ambidextrie structurelle ne sera pas effectif sur le long terme. Une organisation sera forcée de réorganiser et de reconfigurer ses activités d'exploration et d'exploitation sous la pression de changements organisationnels internes et externes à l'entreprise.

Le cas de la compagnie de services basés sur la technologie démontre que l'ambidextrie organisationnelle est un phénomène dynamique et fractal qui peut changer et évoluer avec le temps. Pour parvenir à l'ambidextrie, la compagnie doit utiliser une approche structurelle. Elle sépare les activités et confie l'exploration à l'unité spécialisée dans l'innovation et l'exploitation aux divisions commerciales. L'analyse détaillée de la structure d'exploration a montré qu'avec le temps l'unité pour l'innovation se départit de son rôle exclusif d'exploration, de recherche et d'expérimentation. Il est plus probable qu'elle va combiner exploration et exploitation et travailler comme une structure ambidextre. Avec le temps, l'unité passe de la seule recherche et développement d'innovation technologiques radicalement nouvelles et commence à combiner des projets d'innovation de technologies radicalement nouvelles et de technologies améliorées incrémentalement. Pour survivre sans le soutien initial de la part de la direction générale et pour démontrer sa crédibilité et son efficacité dans des périodes de baisses des marchés, l'unité pour l'innovation devient elle-même ambidextre et commence à explorer et exploiter simultanément.

Cette compagnie de services basés sur la technologie montre que la co-organisation d'activités et l'équilibre entre exploration et exploitation offrent plusieurs solutions. La séparation structurelle est une solution temporaire pour parvenir à l'ambidextrie. Elle ne durera pas s'il n'y a pas une coordination entre les structures et si l'intégration des activités est absente. L'absence d'intégration entraînera des faibles rendements de la recherche et de l'expérimentation et une incapacité à exploiter les résultats de l'exploration.

Une solution durable et soutenable pour explorer et exploiter peut être trouvée dans l'ambidextrie dynamique et fractale. Dans l'ambidextrie fractale, l'exploration et l'exploitation émergent simultanément à différents niveaux organisationnels, comme c'est le cas dans notre cas d'entreprise: au niveau de l'entreprise, au niveau des projets et de la gouvernance.

CONCLUSION GENERALE

Le cas de cette entreprise de services basés sur la technologie illustre la dynamique de l'exploration et de l'exploitation. Il démontre aussi que l'ambidextrie et son approche structurelle évoluent au fil du temps et se transforme en ambidextrie fractale. Au niveau de l'entreprise, la compagnie a des activités structurellement séparées, autonomes et homogènes. L'exploitation de capacités existantes revient aux divisions commerciales. L'exploration de nouvelles opportunités est confiée à une unité entrepreneuriale chargée de l'innovation. Ce n'est qu'après un examen approfondi de ces structures au niveau du projet, grâce à la méthodologie multi-niveaux que nous avons pu identifier un mélange d'activités au sein de l'unité d'innovation: l'exploration comme l'exploitation sont présentes dans l'unité pour l'innovation et y co-habitent en parallèle.

Pour la littérature sur l'ambidextrie, cette étude permet de parvenir aux résultats suivants: tout d'abord la séparation structurelle sans aucune intégration conduira à *l'isolement* de l'unité d'exploration et de ses activités et résultera en une insuffisance de résultats probants. Pour éviter cet isolement de la structure d'exploration et le syndrome de la « tour d'ivoire », une organisation doit s'assurer que les structures et les activités sont coordonnées et co-existent de façon intégrée. Deuxièmement, pour les projets complexes de développement d'innovations technologiques, les activités sont *mixtes*. L'exploration et l'exploitation sont présentes dans les projets et dans l'unité elle-même. L'unité pour l'innovation développe des innovations radicales et incrémentales dans le but de survivre et de se maintenir, car le plus grand danger qui la menace est d'être restructurée et liquidée par la direction générale, comme activité trop coûteuse et non rentable. Pour la compagnie dans

son ensemble, cela équivaldrait à un virage total vers l'exploitation. Troisièmement le temps et les *changements de l'environnement* sont des facteurs cruciaux qui ont un impact sur les décisions organisationnelles et le choix entre exploration et exploitation. Par conséquent toute organisation, et même unité, se doit de coordonner l'exploration et l'exploitation et de s'engager dans les deux afin de survivre et de réussir à durer sur le long terme.

Nouvelle perspective sur l'ambidextrie

L'exploration et l'exploitation sont de nature opposée et contradictoire. Elles présentent des caractéristiques, des structures, des processus, des rendements et des cadres temporels différents. Jusqu'à présent elles étaient considérées comme des activités totalement différentes, qui ne pouvaient que difficilement co-exister. Au sein d'une organisation, l'exploration et l'exploitation étaient en concurrence pour les ressources et les dirigeants devaient sélectionner l'une ou l'autre. Avec l'ambidextrie structurelle, une solution a été trouvée pour parvenir à un équilibre entre exploration et exploitation : il s'agit de la capacité organisationnelles à explorer et exploiter simultanément et à produire différents types d'innovations.

Certes la séparation structurelle des activités est une solution organisationnelle pour à la fois explorer et exploiter. Mais ce n'est qu'une approche *temporaire* permettant de s'adresser à ces deux activités en même temps. Elle a ses limites et ne garantit pas le succès organisationnel sur le long terme. En fait même si la compagnie réussit à parvenir à l'ambidextrie au niveau de l'entreprise en faisant de l'exploration et de l'exploitation dans des structures différentes et séparées, le système général d'organisation ne s'avérera pas soutenable. Au niveau de l'unité commerciale, les activités ne seront pas équilibrer. Sous l'influence du temps et des changements dans l'environnement, les unités commerciales rechercheront des performances effectives, efficaces et durables. Dans leur volonté de survie, elles commenceront à chercher un équilibre et à mélanger les activités d'exploration et d'exploitation au sein de leurs structures.

Jusqu'à présent, une question demeurait: comment l'exploration et l'exploitation devaient être organisées dans une organisation. D'un côté, pour arriver à une simultanéité efficace, elles doivent être organisées de manière coordonnée et intégrée. D'un autre côté, pour tenir compte de leur nature opposée, elles devraient être séparées. Le défi était donc de trouver une solution qui permettrait d'organiser l'exploration et l'exploitation en même temps de façon intégrée et séparée.

L'ambidextrie fractale et dynamique apporte une solution : elle se définit comme la capacité organisationnelle à reproduire l'exploration et l'exploitation simultanément à différents niveaux organisationnels. Une organisation peut trouver un équilibre entre ces deux activités, si elle définit une proportion pertinente d'exploration et d'exploitation à chaque niveau. *Fractal* renvoie ici à des modèles de reproduction de l'exploration et de l'exploitation qui émergeraient inévitablement au sein d'une organisation à de multiples niveaux. La *dynamique* représenterait le changement dans les proportions sous l'influence des facteurs temporels et environnementaux. Pour des performances soutenables et de long terme, une organisation prospère doit définir le degré d'exploration et d'exploitation à chaque niveau organisationnel.

Implications théoriques

Cette étude enrichit les connaissances sur l'exploration et l'exploitation et l'ambidextrie organisationnelle. La littérature existante ne fournissait pas une définition et une description claire d'un contexte organisationnel stable pour l'ambidextrie. Notre recherche contribue à la clarification de la nature des activités, définit le périmètre des processus et décrit leurs caractéristiques contrastées. Elle montre que *l'exploration et l'exploitation* diffèrent du point de vue de la rationalité, de l'espace de recherche, des procédés de recherche et de l'environnement. Elles présentent des orientations temporelles différentes et des rendements contrastés. Elle montre également que l'exploration et l'exploitation peuvent prendre différentes formes et formats (tels que des activités, des structures, des procédés, des procédures, des projets, des cultures, de comportements et les prises de décision individuelles).

La clarification de l'approche *structurelle de l'ambidextrie* est une autre contribution théorique importante. L'étude confirme que l'ambidextrie structurelle est une solution temporaire qui permet d'explorer et d'exploiter simultanément. La séparation de l'exploration et de l'exploitation dans des structures différentes peut résoudre la question de la présence réciproque d'activités uniquement au niveau de l'entreprise. Au niveau des divisions commerciales, les conflits et les tensions entre exploration et exploitation ne sont toujours pas résolus, même si l'intégration est faite au niveau du management général de l'entreprise.

Cette recherche montre que la séparation des activités en différentes structures *ne suffit pas* pour permettre la simultanéité durable de l'exploration et de l'exploitation. Sur le long terme, l'exploration séparée de l'exploitation, souffrira de coûts élevés d'expérimentation et de faibles rendements. Dans une organisation une structure orientée

vers l'exploration existera aussi longtemps que la direction générale lui apportera un soutien acceptable. Concentrée uniquement sur l'exploration, l'unité ne sera pas capable de survivre dans des conditions différentes et sans le parrainage du niveau supérieur. L'absence de liens entre les structures d'exploration et d'exploitation entraînera aussi une incapacité à utiliser et à appliquer les résultats fournis par l'unité d'exploration. Avec le temps, et l'exploration et l'exploitation commenceront à faire l'expérience d'un manque d'intégration et souffriront de faibles synergies. Dans de telles conditions, l'unité d'exploration ne peut agir qu'à court terme. Mais à long terme ce sera l'échec. Sans une intégration avec l'exploitation, l'unité d'exploration risque, d'être restructurée ou liquidée, comme structure organisationnelle inefficace.

Notre recherche apporte aussi sa contribution à la signification de *l'ambidextrie*. La littérature existante a suggéré de nombreuses options de cette définition Mais la plupart sont larges, assez générales et ne répondent pas à la question de l'équilibre entre exploration et exploitation. Dans cette étude, l'accent a été mis sur le problème, identifié par March (1991).

En utilisant une méthodologie spécifique multi-niveaux et l'examen approfondi d'une entreprise, la présente étude a pu montrer que l'exploration et l'exploitation apparaissent à différents niveaux et peuvent évoluer sous l'influence du temps et des changements de l'environnement. Ce travail de recherche a analysé une entreprise considérée comme un « système emboîté » qui consiste en de multiples niveaux et où toutes les activités peuvent émerger à tout niveau. Si le terme "*fractal*" indique une solution au problème de l'équilibre, alors le sens et l'essence de l'ambidextrie se trouvent dans l'équilibre à trouver entre les proportions appropriées d'exploration et d'exploitation à chacun des nombreux niveaux d'un système organisationnel.

Implications managériales

Notre recherche a également développé des implications managériales. Les managers, désireux de transformer une organisation en entreprise ambidextre, devraient prendre en compte le fait que la création d'une structure d'exploration et sa séparation du reste de l'organisation *ne sont pas suffisantes* pour en faire une organisation efficiente et performante sur le long terme. Dans une phase initiale de développement, l'unité nouvellement créée accomplira bien ses fonctions exploratoires, surtout du fait du soutien et du parrainage de la direction générale. Mais sur le long terme l'unité séparée risque de devenir une structure non crédible et/ou rejetée ; elle souffrira de coûts élevés et de faibles rendements

(proportionnellement) alors que les managers s'attendent impatiemment à récolter les fruits de l'exploration.

La raison tient au fait que dans les activités structurellement séparées, chaque unité reste centrée sur une seule fonction. La séparation des structures et des activités, sans intégration, conduira à un *isolement* de l'unité d'exploration. Au niveau des procédés, cela veut dire que les rendements de la recherche et de l'expérimentation ne seront pas utilisés par les entités d'exploitation. Alors que les structures d'exploitation vont continuer à être efficaces et rentables, la structure d'exploration deviendra coûteuse et peu rentable.

De plus, un conflit d'intérêt risque d'apparaître entre les deux structures. L'unité d'exploration fera l'expérience des coûts croissants de l'expérimentation tandis que les structures d'exploitation seront incapables d'accepter de nouvelles idées, d'améliorer et de raffiner les produits et les services reçus de l'unité d'exploration par manque de liens avec les affaires en cours et les besoins du marché. En général les structures et les activités d'exploration et d'exploitation souffriront du manque d'intégration, de coordination et de la faiblesse des liens avec les marchés.

Pour la structure orientée vers l'exploration, un autre danger est sa *forte dépendance* du sommet de la hiérarchie. L'activité de l'unité dépendra en large part de la décision de la direction générale et dépendra de la capacité managériale d'allouer des ressources pour la recherche et l'expérimentation. Toute turbulence dans l'environnement, par exemple, la rotation des dirigeants, la pression du marché, les crises industrielle, etc. aura un impact immédiat sur le montant des ressources allouées à l'exploration.

Dans une organisation, l'unité d'exploration exisist aussi longtemps qu'elle a le soutien et la protection de la direction. Sans son intégration dans les structures d'exploitation et sans le soutien des dirigeants, l'unité d'exploration sera très probablement amenée à rechercher d'autres stratégies à mettre en œuvre plutôt que de rester centrée exclusivement sur l'exploration (comme le suggérait le modèle d'ambidextrie structurelle). Dans sa lutte pour sa survie, l'unité commencera à combiner et à mélanger les activités d'exploration et d'exploitation.

Finalement, l'exploration et l'exploitation peuvent être séparées afin de résoudre les conflits et les tensions qui émergent du fait de leurs différences. Cependant sans une intégration et une combinaison de ces activités, une organisation ne pourra pas bénéficier de leur co-existence. Ni l'exploration ni l'exploitation par elles-mêmes ne seront efficaces pour des performances à long terme. La règle est la même pour toute organisation, pour une entreprise, une unité commerciale (business unit) ou un projet. Même un individu devra prendre des décisions sur l'allocation du temps et des ressources entre les deux activités,

indépendamment de la structure à laquelle il ou elle appartient. La différence réside dans la proportion d'exploration et d'exploitation à chaque niveau d'une organisation. La priorité des activités ainsi que leurs proportions à chaque niveau changeront en fonction du facteur temps et des changements dans l'environnement de l'organisation.

Limites et directions futures de la recherche

Cette recherche présente certaines limites. La première est que la dynamique et la reproduction de l'exploration et de l'exploitation n'ont été observées que sur une seule organisation qui pratique la séparation structurelle des activités. Il serait nécessaire de comprendre si un phénomène similaire apparaît lorsque l'entreprise utilise une autre approche pour arriver à une exploration et une exploitation simultanée, comme l'approche séquentielle ou contextuelle.

La deuxième limite porte sur le rôle critique encore non exploré des managers. La présente étude s'est servie du niveau des cadres pour analyser la vision managériale des différentes structures et activités. Des études ultérieures devraient porter une attention plus grande au rôle des managers de haut rang et des cadres, à leur comportement, leurs choix et leurs décisions sur 'allocation des ressources à l'exploration et l'exploitation.

La troisième limite est que l'étude ne porte que sur une étude de cas. Un plus grand nombre d'organisations devraient être analysées pour confirmer les résultats de l'étude sur les caractéristiques de la dynamique et de la reproduction des activités.

Pour développer les connaissances sur l'ambidextrie et les organisations ambidextries, les prochaines recherches devront appliquer une méthode de recherche similaire à la méthodologie multi-niveaux qui recoupe plus d'un niveau d'analyse et prend en compte le facteur temps et les changements de l'environnement. L'ambidextrie organisationnelle est un phénomène complexe et dynamique. Pour continuer à équilibrer l'exploration et l'exploitation au fil du temps, une organisation ambidextre doit l'être à plusieurs niveaux. Il ne suffit pas de séparer les activités dans différentes structures organisationnelles.

Pour parvenir à une ambidextrie soutenable, il est également important de rechercher des synergies entre exploration et exploitation. Celles-ci peuvent apparaître et se mélanger à différents niveaux. Donc l'exploration et l'exploitation sont des activités dépendantes, complémentaires et continues. Une solution organisationnelle durable se définit alors comme une ambidextrie dynamique et fractale cas une solution où une organisation co-organise et gère ses activités d'exploration et d'exploitation à différents niveaux organisationnels et définit la proportion appropriée d'exploration et d'exploitation à chacun de ces niveaux.

Organizational ambidexterity: A fractal and dynamic case

Abstract

The main objective in management of any organization is a successful and sustainable performance. To survive over time, a company should combine two competing activities. On the one hand, it must exploit existing certainties to be effective in the short term, and on the other hand, being capable at the same time to explore new opportunities to be innovative in the future. Ambidextrous organizations have the ability to pursue these activities simultaneously and produce radical and incremental innovation.

In our research, we show that to achieve ambidexterity separation of activities is important, but not sufficient. Without integration between business structures and processes, the exploratory activity of the innovation unit is more likely to shrink and disappear with time as unprofitable function. To survive and sustain in the long term, a company should adapt *fractal and dynamic ambidexterity*. This new concept provides us with a solution to the question of balance and determines the organizational ability to define and set the appropriate proportions of exploration and exploitation simultaneously at multiple organizational levels and re-configure them when it is necessary to meet the change.

Key words: Fractal ambidexterity, structural separation, multiple levels

Résumé

Une performance soutenable et importante est l'objectif principal du management de toute organisation. La viabilité d'une entreprise dépend de sa capacité à trouver un équilibre entre deux activités très différentes. D'une part elle doit exploiter les certitudes existantes pour garantir la réussite des opérations courantes et d'autre part explorer de nouvelles opportunités pour la mise en œuvre rapide des nouvelles idées qui garantissent l'avenir de l'organisation. Les organisations ambidexres ont une aptitude à poursuivre de manière simultanée ces activités et produisent des innovation radicales et incrémentielles.

Notre recherche montre que pour être ambidextre seulement la séparation des activités n'est pas suffisante. Sans une intégration et une combinaison de ces structures et ces processus, l'unité d'exploration sera incapable d'exploiter ses résultats et a plus de chance disparaître avec le temps comme la structure inefficace. Pour survivre sur le long terme, l'entreprise doit intégrer *l'ambidexterité* de manière *fractale et dynamique*. Ce nouveau concept propose une solution à la question de l'équilibre entre les activités et elle se définit comme la capacité organisationnelle à reproduire l'exploration et l'exploitation simultanément à différents niveaux organisationnels et être capable de changer leurs proportions quand cela est nécessaire.

Mot clés: Ambidextrie fractale, séparation structurelle, multi-niveaux