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Organizational Learning as a Tool for Adaptation in the Oil and Gas Industry

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Problem Description

The oil and gas industry has faced many challenges, ranging from lower profitability (considering low oil prices) to societal and governmental pressures (driven by climate change initiatives). And with the increase of investment in renewable sources of energy production, the oil and gas industry has found new competitors when it comes to energy generation.

The current business environment is forcing organizations to adapt in order to survive. This work aims to investigate how organizational learning can be used to increase adaptability in the oil and gas industry.

Preface

This master thesis is the final work of the Master of Science in Project Management program, with specialization in Industrial Engineering, at the Norwegian University of Science and Technology. It was carried out during the spring semester of 2016 at the department of Industrial Economics and Technology Management.

This work analyzes how organizational learning can be used to enable the adaptation that oil and gas companies need to make the transition from fossil fuels to renewable energy. The theoretical background builds on some of the topics that are part of the Master's program, more specifically, from the courses Strategic Management (TIØ4265), Project Organizations (TIØ5200) and Program and Portfolio Management (TIØ5210). A theory-based framework is developed and tested using information from Statoil (only publicly available data).

This master thesis was an opportunity to combine the knowledge accumulated from the previous three semesters of the program, and to apply this knowledge to analyze an oil company. It also allowed me to explore other topics of interest, such as climate change. I believe this topic will prove more relevant and important for oil and gas companies in the near future, and more oil companies will follow the steps taken by Statoil (either in wind power or with other sources).

Trondheim, June 10th, 2016.

Karen Kiyomi Shimabukuro

Abstract

This work addresses how organizational learning can serve as a tool for oil and gas companies in the transition process from fossil fuels to renewable energy. Considering that there are external factors (mainly from society, organizations and governments) pressuring oil companies to start combating climate change, there is a need for adaptability in this industry. Companies can address climate change in different ways, but this work analyzes the process of transformation of oil companies into energy companies by adding renewable energy to their business portfolio.

The strategy literature is reviewed in the search for ways of increasing adaptability in the oil and gas industry, and the organizational learning literature is examined to explore how oil companies can develop competences and acquire new knowledge to enter the renewable energy market. Organizational learning, in this work, is seen as a way of facilitating the transition process for oil companies. Some concepts of ways to enter a new market are also indicated, such as acquisitions and projects. A particular focus is given to projects, since this is a path usually taken by oil companies to learn when adapting to new countries and new environmental conditions.

This work is written in the context of the crisis of low oil prices experienced by the oil and gas industry. Since the most affected part of the value chain is the upstream activity, which encompasses the exploration and production of oil and gas, this is the part of the business that the work is referring to.

Finally, a theory-based framework is developed to guide the analysis of the problem and it is tested using a case study on Statoil, a Norwegian oil company, with publicly available information from the company. The conclusion is that the framework fits Statoil's strategy change to develop new opportunities in the renewable energy market. When Statoil started giving more emphasis on renewable energy, there is an increase in investment activity on offshore wind power, which is the type of renewables that is most aligned with Statoil's capabilities (especially considering that most of its upstream activities are offshore). And the company's focus on learning (both in the organizational and individual levels) can be seen as an advantage to expand their position on renewables and become an important international player in this market.

Acknowledgements

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I would also like to thank my husband, Artur Posenato Garcia, for all his support and unconditional love. I would not be able to accomplish this without him.

Thank you also to my father, who was very understanding and supportive of his daughter leaving the country to pursue a better education.

Lastly, this work is dedicated to my mother, who is not here to see my accomplishments but is always in my thoughts and in my heart.

K.K.S.

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List of Abbreviations

CCS Carbon Capture and Storage

CNOOC China National Offshore Oil Corporation

COP21 Conference of Parties 21, also known as 2015 Paris Climate Conference

GE General Electric

GHG Greenhouse Gas

GW Gigawatt

kW Kilowatt

M&A Mergers and Acquisitions

MW Megawatt

NCS Norwegian Continental Shelf

O&G Oil and Gas

OPEC Organization of Petroleum Exporting Countries

PDVSA Petroleos de Venezuela

Sinopec China Petroleum and Chemical Corporation

Chapter 1

Introduction

The Oil and Gas (O&G) industry has experienced rapid changes in the market in the past two years. Most notably, the increase in production coupled with slower growth in demand had a strong impact on oil prices. From January/2014 until January/2016, the oil price has dropped from approximately US$ 105 to US$ 35, as Figure 1.1 shows.

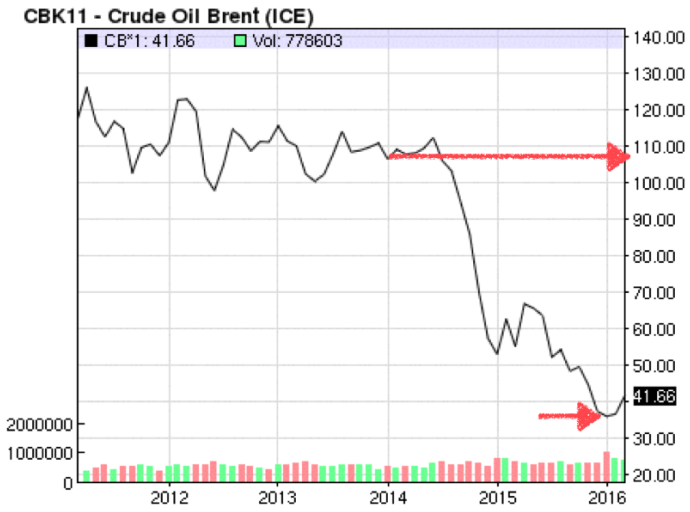

Figure 1.1: Crude oil Brent prices: 5-year frame (Nasdaq, 2016)

Since the sharp drop in oil prices has a direct impact on revenues, oil companies have been struggling to maintain profitability. If the price reduction was a temporary

fluctuation in market prices, these companies would be able to absorb the impact and remain profitable with "business-as-usual" approaches. However, as market analysts continue to forecast a longer period for recovery of oil prices, and possibly the establishment of a "new normal" for oil prices, oil companies have started to implement retrenchment tactics to adjust the companies' expenditures to the new economic conditions. Also, with increasing societal pressure for sustainable sources of energy to substitute fossil fuels, oil companies face the strategic question of how to adapt to this new business environment.

Another change in the past few years related to the business environment is that governments are promoting efforts to reduce dependency on oil and to encourage the development of sustainable renewable sources of energy, such as wind power, solar power and biofuels. Most oil companies have stated their interest in renewable energy, but the number of companies that had relative success in this area is small (Csomós, 2015).

Considering the differences between the resources necessary to be a major player in the oil industry and those necessary to be a player in the renewable industry, it is not a surprise that some oil companies could not sustain their positions in the renewables market. So, in order to adapt to this new business, if they wish to do so, oil companies need to consider radical changes instead of incremental adaptations for short to medium-term transition, or a long-term plan of incremental adaptations.

Organizational learning may provide one of the tools for effective adaptation of oil companies into energy companies, whether by having an auxiliary role in the organizational change process (with the absorption of new knowledge and skills) in the short/medium-term or by enabling organizations to develop new capabilities in a long-term plan. In this context, organizational learning is seen as an integration tool that bridges the capability gap between the current state of the organization and its desired state. And the reason for choosing the organizational learning approach to deal with the problem is that companies will need to acquire and develop new capabilities and new knowledge to transition from fossil fuels to renewable energy.

1.1 Problem Statement

The oil and gas industry has faced many challenges, ranging from profitability (considering low oil prices) to societal and governmental pressures (driven by climate change initiatives). With the increase of investment in renewable sources of energy production, the oil and gas industry has found new competitors when it comes to energy generation. The current business environment is forcing organizations to adapt in order to survive. This work aims to investigate how organizational learning can be used to increase adaptability in the oil and gas industry.

The O&G industry has faced challenges in terms of profitability, environmental responsibility, societal and governmental pressures. The fact that oil is a finite resource plays an important role: oil is being discovered in more adverse environmental conditions and in areas of political instability. Therefore, it does not seem feasible for O&G companies to continue focusing their efforts on oil and gas production alone. Diversification seems like an inevitable growth strategy.

Three basic innovation strategies that can be used to enter new fields of technology or create new markets are (Davies and Hobday, 2005):

- Expand into a new business base by using new technology to meet the requirements of new customers;
- Diversify into a new market by using existing technology;
- Expand into a new technology base by supplying new products to existing customers.

The renewable energy business is significantly different from oil and gas production. Although oil and gas are sources of energy, O&G companies are not necessarily involved in the power generation. They are usually suppliers for power companies, who convert oil and gas in electricity and distribute it to industrial and residential clients. So O&G players may not be totally aware of all the regulations and requirements to operate in the energy production market[1], and that may bring significant risks for a new market

[1] Some regulations and requirements may be used by the O&G companies since platforms and refineries may have their own energy production. They are called energy autoproducers (OECD, 2016).

entry.

Another aspect that must be considered is the availability of technology. Since many sources of renewable energy are still not commercially feasible, the opportunities for acquisition of technology that is readily available becomes restricted. Therefore, the range of possibilities for O&G companies to enter this market depends on their vision and their goals. These companies can enter the market through different routes, such as collaboration projects with technology developers and acquisition of energy companies that already operate in this area. These possibilities vary in time-to-market, cost and market share, but could be appropriate to achieve the companies' goals.

However, an important question arises when these O&G companies try to enter a new market and have to provide a different type of product or service. They cannot simply acquire capabilities and assets to be successful. They must also adapt to integrate new knowledge and resources to the existing organization. The question then is: how can organizations adapt to enter a new market while maintaining competitiveness in their current businesses? Here, organizational learning can provide adequate tools for organizations to transition (or expand their portfolio) from fossil fuels to alternative sources of energy. It enables organizations to integrate new knowledge (either from external or internal sources) into its existing knowledge base, to make knowledge accessible to employees, to facilitate the transfer of tacit knowledge between employees, to improve processes and activities based on lessons from previous mistakes, to identify where expertise is in the organizational structure, and so on.

The alternative for not implementing organizational learning practices in the company would be to have an organizational structure that explicitly identifies the skills or knowledge the organization has, or to have a larger number of specialists because every activity area will need to have all the skills and knowledge necessary to carry out their activities. One of the consequences of not implementing organizational learning is that lessons drawn from past experience will be limited to those who experienced it. And somewhere else in the organization someone will make the same mistake. In other words, the organizational learning approach tries to optimize the use of resources, whether financial, human or physical. The current "low oil prices" situ-

ation challenges organizations because continued low revenues and profits somewhat restrict how much money these companies can invest on organizational change. Also, when resources are constrained, efficient allocation and management of resources becomes important.

In summary, the problem statement analyzed in this work is: how can organizational learning be used as a tool by oil and gas companies in the adaptation process from fossil to renewable energy?

1.2 Objectives

The main objectives of this Master's project are to:

1. Develop a framework of how organizational learning can increase organizational adaptability, considering the context of the Oil and Gas industry;

2. Apply the framework using information from an oil company.

The framework aims at (1) analyzing how the organization's strategy can be implemented in the context of oil companies in the process of transition from fossil to renewable energy; (2) analyzing how organizational learning can be complementary in the strategy implementation. The framework derives from a literature review of relevant theory on strategy, organizational learning, industry context (the Oil and Gas industry and the renewable energy market), and ways of entering new markets. The integration of these topics in the framework provides the boundaries for the analysis, which is then tested using publicly available information from the Norwegian oil company Statoil. The elements of the framework are discussed and some conclusions and limitations of its use are addressed.

In this work, the scope does not comprise strategy formation (how to set vision and goals for the organization), evaluation of technology or selection of technological path for renewable energy, the political and regulatory aspects of both industries, and geographical selection for entering new markets. The ways of entering new markets is limited to the most common ones, which are already used by the oil and gas industry

and that are not used only to enter new markets. Also, this work considers oil companies that want to transition from fossil fuels to renewable energy and not simply to have a symbolic presence in the renewable market for advertising purposes.

1.3 Methodology

The methodology adopted in this work to achieve Objective 1 is a literature review of relevant topics within strategy, organizational learning, new market entry and industry context (the O&G industry and the renewable energy industry), as well as their connections with project management. The literature review is used to gather relevant concepts and theories related to the objectives of this work.

The research was conducted using the University's database Oria, as well as Science Direct and Google Scholar. The method used to narrow down the search was to combine keywords, such as "adaptation", "competitive advantage", "dynamic capabilities", "knowledge management", "new market entry", "oil and gas industry", "oil companies", "organizational change", "organizational learning", and "renewable energy". Material that is specific to aspects outside the scope of this work was eliminated, such as articles about political influence on the O&G industry and advances on tidal energy technology. The follow-up searches, using the references cited in important articles and books, were also used extensively as long as they were relevant to the scope of this work.

Based on the literature review, a theory-based framework is developed to analyze how organizational learning can be used to achieve the organization's objectives regarding adaptation to transition from fossil fuels to renewable energy. The application of the framework is implemented as a Case Study, which is appropriate to answer explanatory research questions that explore the "how" and "why", but with no requirement of control of behavioral events (Yin, 2009). However, the results from a single case study cannot be statistically generalized.

The Case Study is based on the collection of public data from Statoil, mainly consisting of annual reports, sustainability reports, presentations and articles. Usually, strategic analysis involves confidential information as well as organizational resources that are not publicly available. Therefore, the choice of publicly available data was neces-

sary to apply the framework. Other advantages of using public data is accessibility, precision and possibility of review by others (Yin, 2009). The data collected was separated using the elements of the framework as a classification. Then the interactions of these elements were discussed as they are illustrated in the proposed framework.

1.4 Structure of the Report

This work presents a literature review, with theories on organizational learning (Chapter 3) and strategy (Chapter 2) to support the introduction of a framework of how oil companies can use organizational learning as a tool to successfully adapt to make the transition from fossil fuels to the renewable energy market.

The context of the Oil and Gas industry and climate change (Chapter 4) highlight the reasons for some oil companies to start the transition from fossil fuels to renewable energy. The means by which a company can make this transition is explored in Chapter 5. The use of projects as a market entry way is also explored. Then a framework is proposed to integrate important aspects of a strategic analysis for organizational change in Chapter 6.

The case study of Statoil is presented in Chapter 7, with the application and discussion of the framework. Some conclusions are extracted from the discussion and some limitations are addressed.

Chapter 2

Strategy

This chapter presents some concepts on strategy related to vision and goals, and organizational adaptability. The first section addresses corporate vision and goals, and how that affects the strategy implementation in an organization. The main idea is that organizational changes are inspired and driven by intention to achieve a goal. The other sections address concepts related to adaptability (dynamic capabilities and open innovation) and competitiveness (competitive advantage) to illustrate some of the factors that can influence the implementation of a particular strategy.

Since strategic management is a vast field of research, the scope of this work is limited to a few topics due to resource constraints (particularly, in time), and the understanding that these are the main paths where organizational learning can play an important role in the formation of responsive and adaptive organizations.

The topics related to strategy that will be addressed in the following sections are:

- Vision and Goals
- Competitive Advantage
- Dynamic Capabilities
- Open Innovation

In this work, the concepts are explained more broadly, through a corporate-level perspective, before discussing the implications to project management.

2.1 Vision and goals

Corporate vision has an important role in organizations because it provides a concept of a desirable future state, pointing an organization in a particular direction, and motivating employees to work towards a shared end (Wit and Meyer, 2014).

Hodge et al. (1996) identify that the starting point for organizational change is to change the goals and strategy of the organization, although sometimes the change may emerge from lower levels of the organization in response to a changing environment (similarly to what is described by Mintzberg and Waters (1985) as emergent strategy). And the ability to develop a vision is linked to the ability to manage continuity and change (Collins and Porras, 1996).

According to Wit and Meyer (2014), a strategic vision has four main components: envisioned contextual environment, envisioned industry environment, desired future organizational position, and time horizon. The envisioned contextual environment encompasses socio-cultural, economic, political, regulatory, technological factors that affect the organization's business. The envisioned industry environment considers the organization's suppliers, customers, competitors, complementary and substitute businesses, new entrants. The future organizational position will reflect the organization's ambition and long-term objectives, and the time horizon will set a timeframe to achieve the vision. The time horizon varies according to industry characteristics and how challenging it will be to reach the vision. Without these components, there is not enough information to develop goals and a strategy that will enable the organization to reach its vision.

Collins and Porras (1996), on the other hand, state that there are two main components in a well-developed vision: a core ideology and an envisioned future. They defined the core ideology as "...the enduring character of an organization, a consistent identity that transcends product or market life cycles, technological breakthroughs, management fads, and individual leaders." (p.66). Wit and Meyer (2014) call it the cor-

porate mission which, along with strategic vision, provides the organization with direction, legitimization and motivation. The component of envisioned future consists of a 10-to-30-year goal (BHAG - Big, Hairy, Audacious Goal) and a description of what this achievement will be (Collins and Porras, 1996). The idea is to stimulate progress by stating challenging but tangible goals, and making it visible and aspirational.

2.1.1 Vision and Goals in Project Management

Considering that projects exist to support organizational strategies, the project's goals should be aligned with the organization's strategic goals. The importance of this strategic alignment is highlighted by the PMI (2013) through the recommendation of inclusion of the organization's strategic vision, goals and objectives in the project statement of work, which describes the scope, objectives and the need for the project. In the case of internal projects, it relates to the organization's strategy and needs, and for external projects, it relates to the client.

However, it is worth considering that if projects are not aligned with the corporate strategy there may be a problem with the strategy or the project. If the project is cannot be linked directly or indirectly to any goals, corporate mission, or business activities, the existence of the project should be questioned. Or if the project can be linked to the corporate vision, but not to the strategy and goals, perhaps the strategy should be questioned.

The alignment of corporate strategy with the project can be expressed in the project goals. For instance, if the corporate strategy includes adapting the organization to enter another business area, the project goals can be aligned with that strategy by including the development of new capability or acquisition of external knowledge, etc. In this case, learning from the project is necessary to achieve the goals. Schindler and Eppler (2003) state that one of the key success factors for project learning is to institutionalize the lessons learned process. This can be achieved by integrating learning and knowledge goals into the project management process of the organization, which means including the aspects of learning and knowledge into the planning process and into the project goals and metrics.

However, sometimes in the project management literature, project goals are associated to the user (or client) perspective when analyzing the stakeholders' interests in the project (Samset, 2010). So, depending on the type of project, the concept of integrating learning into the project goals may not be appropriate. But perhaps it could integrate the project's purpose, as it encompasses second-order effects of the project and it is more consistent with the interests of the project owner/sponsor (Samset, 2010).

For example, in a project to build a wind farm, the users are the people that are connected to the grid that will receive the electric energy. The project goals can be related to the amount of energy generated, the reliability of the system, etc. But the project's purpose may be more appropriate for including learning, as the project owner or sponsor may be interested in medium to long term benefits of acquiring knowledge about the project, and perhaps exploiting it in subsequent projects. When the project owner and project team have different interests in the project, it is necessary to draw a common understanding of what is important for each stakeholder of the project.

2.2 Competitive Advantage in Strategic Management

While corporate vision and goals determine what the organization wants to be, where it wants to go and what it wants to achieve, the concept of competitive advantage concentrates on what it needs to achieve the organization's vision and goals.

The field of strategic management develops concepts, theories, methods and frameworks to assist practitioners in achieving and sustaining competitive advantage. This broad field has seen different approaches to answer the same question, from Porter's competitive forces to dynamic capabilities. (for a brief overview, see Teece et al., 1997).

The concept of an organization's assets as a competitive advantage was developed by several researchers. They take a resource-based view of the company to assess what are its strengths and weaknesses in terms of competitiveness. Nicholson et al. (1995) defines the resource-based theory as follows:

"Under this theory, resources - tangible and intangible assets - are combined through organizational routines, creating organizational capabilities. If any of these capabilities are valuable to the customer, difficult to acquire, difficult to replicate, difficult to be

appropriated by other parties, and are durable, they provide the basis for sustainable competitive advantage and superior economic performance." (p.113)

This definition considers a broad concept of what resources are, including these types of resources: physical (e.g., land, machines), financial (e.g., money), human (e.g., individual experience, individual training), and organizational (e.g., teamwork among individuals, organizational reputations, organizational culture). (Nicholson et al., 1995, p. 485)

Nicholson et al. (1995) also defines competences in two levels of analysis. On the individual level, competences are described as "... the qualities needed by a job holder."; and on the organizational level, competences are "... relatively stable behaviors which create continuously the processes that enable the organizations to learn, adapt to new environmental demands, and change the environment so that it is better suited to the needs of stakeholders.". (p. 83)

The definitions provided by Nicholson et al. (1995) do not address the fact that to enable the organizations to learn and adapt then the individuals also need to learn and adapt, otherwise the individual competences become obsolete.

Prahalad and Hamel (1990) develop the concept of core competences as the roots of competitive advantage, claiming that core competences are "... the collective learning in the organization, especially how to coordinate diverse production skills and integrate multiple streams of technologies.".

Core competences are defined by Teece et al. (1997) as the competences that define the organization's fundamental business, and their value can by enhanced if combined with the appropriate complementary assets.

When these definitions are combined, the core competences can be interpreted as the combination of competences within an organization that enable it to be competitive in its fundamental business. Within the scope of this work, the core competences of oil companies may need to be changed (or complemented) to successfully enter the renewable energy market, since this is not their fundamental business. However, it can be argued that some oil companies have adaptability in their core competences, due to their constant expansion of operation in new countries and in new environmental

conditions. But the competences they use to make these adaptations may be different from the competences they need to adapt to another type of market.

2.3 Dynamic Capabilities

Teece et al. (1997) considered dynamic capabilities a potentially integrative approach to understanding competitive advantages for organizations that want to compete in a complex environment. The traditional resource-based perspective focuses on exploitation of existing firm-specific assets, since it takes time to build new competences and integrate acquired know-how. The dynamic capabilities approach focuses on difficult to imitate organizational, functional and technological skills, as well as responsiveness and flexibility. In order to develop competences and acquire and assimilate resources and skills that create a sustainable competitive advantage, it is necessary to create paths for skill acquisition, knowledge management and organizational learning.

According to Teece et al. (1997), dynamic capabilities refer to "the capacity to renew competences so as to achieve congruence with the changing business environment ... appropriately adapting, integrating and reconfiguring internal and external organizational skills, resources and functional competences ... ".

The concept of dynamic capabilities is difficult to implement since simply putting together assets and resources to replicate a dynamic capability does not yield the same result. The development of competences takes time and, according to Teece et al. (1997), the competitive advantage of an organization also depends on how competences are integrated and organized within the structure. Ultimately, the unique combination of organizational routines, processes and culture influences how efficiently a company operates and it differentiates its performance from competitors.

Similarly to what was mentioned in the previous section, it could be argued that some oil companies have dynamic capabilities, since they adapt to other countries and environments to explore and produce oil and gas, and they adapt to the changing business environments of the places where they operate (otherwise they would no longer exist). This assessment fits Teece et al. (1997)'s definition of dynamic capabilities. But that does not necessarily mean that they have the dynamic capabilities to enter the re-

newable energy market. And if assuming that capability to adapt is the same no matter the context, the organization will fail to recognize what competences they actually need to be effective in the process of changing to a new market.

2.4 Open Innovation

Innovation can contribute to the organization's competitive advantages by enabling the creation of new value propositions, rationalizing the use of resources, promoting continuous improvement of production processes, and offering novel or unique products (Tidd, 2001).

But it does not refer solely to internal innovation. Teece et al. (1997) consider the importance of integrating external activities and technologies when building the organization's dynamic capabilities. This interorganizational learning can help preventing strategic blindspots and recognizing dysfunctional routines. However, Teece et al. (1997) described difficulties for companies to buy know-how and technological assets. Also, Tidd (2001) argues that in some cases, for example, where there are high transaction costs to acquire technology or uncertainty is high, a network approach may be more advantageous for the organizations involved.

Instead of relying solely on the internal organizational research and development capabilities (closed innovation), companies started to deploy a different strategy to achieve innovation leadership (Chesbrough, 2003). The concept of open innovation adheres to "porous" organizational boundaries, that allows ideas and technologies to flow from outside into the organization and vice-versa, as seen in Figure 2.1.

Some of the options for organizations that apply the open innovation concept are (Chesbrough, 2003):

- Commercialization of internal ideas through channels outside the organization, such as startup companies and licensing agreements;
- Commercialization of external ideas, developed by other organizations, startups, universities, research consortia, etc.

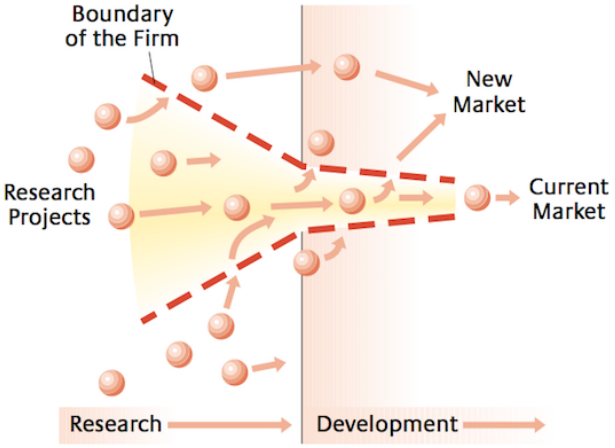

Figure 2.1: The Open Innovation Model (Chesbrough, 2003)

The marketing of internal ideas can operate in different manners, as Chesbrough (2003) points out. The organization may see the potential of the idea but decide to develop it outside the boundaries of the organization. Or the organization may find that it cannot profitably market this idea and decide to sell it to another company. This approach allows companies to recover some of the investment in research and development, even if they decide not to market some inventions. Some organizations hoard inventions that do not pass the corporate filter. In the open innovation model, these "bad" inventions can find their way to market. Also, such filter exists in academia as well and research in universities tends to lack cross-discipline breakthroughs. This should be taken into consideration by organizations that want to explore external ideas.

In terms of the organizations' activities in open innovation, they have focused in three main areas (Chesbrough, 2003): funding (such as venture capital firms, private equity investors, research foundations), generation (like laboratories, research groups and communities) or commercialization of innovation (organizations that profitably bring ideas to market focusing on customer needs, not necessarily creating the ideas). Some companies focus on just one of these activities, while others choose to do all three. Examples of companies that engage in these three activities are GE, DuPont and AT&T (Chesbrough, 2003).

The way organizations manage innovation can vary according to organizational structure and processes, type of innovation and environmental conditions (for a review, see Tidd, 2001). Considering the objective of this work, the scope of the analysis of innovation management is limited to the environmental conditions. Two aspects that have significant influence on management of innovation are uncertainty (as a "function of the rate of change of technologies and product-markets") and complexity (as a "function of the number of technologies and their interactions") (Tidd, 2001). The figure below presents a matrix of uncertainty versus complexity and the quadrants represent the different needs in the management of innovation.

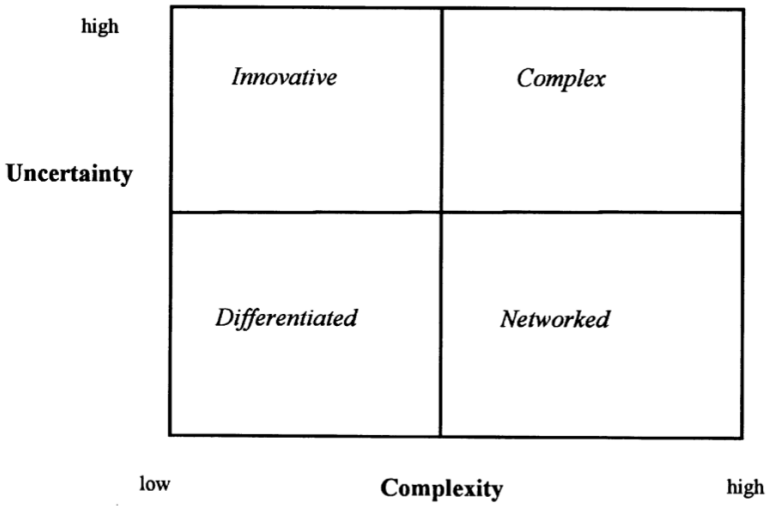

Figure 2.2: Innovation management: uncertainty versus complexity (Tidd, 2001)

Tidd (2001) provides an explanation of the matrix, but here the interest lies in the "Complex" quadrant (high uncertainty and high complexity). Both the oil and gas exploration business and the renewable energy business can be considered as such. They rely on the development of a number of technologies and these technologies have to be compatible with each other, although the rate of change may be faster in renewable energy technologies and it can be considered mainly as incremental in the oil and gas industry (it is considered a mature business in comparison to many of the renewable energy sources) (OECD, 2006). According to Tidd (2001), organizations in the "Complex" quadrant require a range of competencies, including flexibility, adaptation and

learning. This need is reflected in how the organization structures itself internally and how it is linked to external actors.

2.4.1 Open Innovation and Project Management

Innovation projects can be used to implement strategies to access new fields of technology (to enter a new business, for example) and create new markets. Davies and Hobday (2005) mention three basic innovation strategies:

- Expand into a new business base by using new technology to meet the requirements of new customers;
- Diversify into a new market by using existing technology;
- Expand into a new technology base by supplying new products to existing customers.

From the organization's perspective, internal projects can be used to develop new technology and to apply acquired technology, and external projects can be funded to develop new technology and to apply existing technology that the organization does not possess. Even in the case of internal projects, the organization will need to use knowledge or skills from external sources, since it will need to understand what customers need, which complementary technologies from others can be applied, how the acquired technology works, what competitors are developing, etc. The project team needs to manage stakeholders to access these external sources, which may include customers, suppliers, stakeholders, government, competitors, among others.

In the case of external projects, the organization needs to identify what it wants to gain from the project. If the organization is interested in how to develop a technology, then it will need to have more access to how the project is implemented and what knowledge is involved. That is important for organizations that provide funding for external technology development with the objective of developing a new competence. They need to consider how to capture the new knowledge, both explicit and tacit, through project-based learning and that has to be negotiated with the other party

as well. If these issues are not faced by the organization, then there is a risk that the project will not be effectively used to build new competences.

2.5 Capabilities in the Oil and Gas Industry

Donegan (1990) states that the pace of change in the business world points to the need for adaptation in organizations. Similarly, IPIECA (2013) highlights the need for adaptation in the oil and gas industry as a response to climate risk management.

The oil and gas industry has developed several capabilities that allowed companies to perform their activities, even in extreme environments (such as the Arctic, deepwater, hot arid regions, etc.). Oil and gas companies are proficient in project management, risk assessment and risk management, strategic planning, stakeholder management, technology development, and so on. The IPIECA (2013) suggests that these capabilities should be used with a larger scope to include, for example, climate change effects. Then the organizations can prepare to adapt to different conditions.

That stance is also taken by Statoil in their approach to energy alternatives (Rummelhoff, 2016). The organization identified strengths from its oil and gas operations, such as managing complex projects, experience in marine operations, health, safety and environmental processes, knowledge of floating technologies, etc., and it is applying these capabilities in new types of projects and conditions. Their goals are to adapt to develop new businesses opportunities and to build a profitable renewables business, and the challenges are to learn how to deal with other types of uncertainty and to rely on technology and ideas that were not created inside the company.

Another perspective on adaptation is the one practiced by BP in the late-1980s/early1990s. Considering BP's view that people are an essential part of the path for adaptation, it is no surprise that the company adopted a change initiative to transform its organizational culture and management style. As Donegan (1990) describes, this change initiative had a significant impact on BP's human resources management, because most of the challenges involved people. They reassessed the learning and development process, individual development of all employees, management development, the role of training and education, and their appraisal system (how they evaluate individual per-

formance). The purpose was to develop the competencies that the organization needed to achieve its vision.

Oil and Gas companies are currently engaged in open innovation practices, especially due to high level of technology involved in exploration and production. It is expensive to develop all the necessary technology and solutions in-house, so companies had to adapt to use their resources more efficiently.

BP uses its relationships with contractors and suppliers to access resources that it does not possess. For example, BP and Schlumberger collaborated in the development of a logging tool to monitor the production of a horizontal well. BP needed the device, but did not have the necessary knowledge to develop it, so BP asked Schlumberger to do it. BP helped pay for the development and provided access to some wells to test the tool. In turn, Schlumberger gathered researchers and used its laboratory facilities to develop the technology and build the prototype, which was later tested on BP's wells. The successful development of this tool solved a problem for BP and opened a new market for Schlumberger. (Prokesch, 1997)

Chapter 3

Organizational Learning

This chapter presents some concepts on organizational learning and then, it explores the links between the fields of organizational learning and strategy concerning organizational adaptability and changing environments. The content is limited to the concepts that are most relevant considering the scope of this work.

Organizational learning is seen as a tool to achieve the companies' goals, given the case of oil companies that want to be important players in the renewable energy market. This business environment is characterized by competition in the international market and technological advances play an important role in the competitive advantage of companies. (Teece, 2009)

The choice of organizational learning as a tool for adaptation relies on the possibility that it can be effectively used to build dynamic capabilities, to acquire and develop new knowledge, to integrate organizations in the context of mergers and acquisitions, and to promote the efficient use of resources. There may be other ways of achieving these results, but they are outside the scope of this work. It is assumed that individual learning occurs in the organization to enable organizational learning.

Lewin et al. (2004) point out that there is a strong consensus in the literature on the relationship between organizational learning and adaptation, however, it is not unidirectional or even contingently causal. They conclude that the fundamental theme of organizations as entities that learn and its relation to adaptation was still unexplored at

the time.

Organizational learning can take many different forms, but in this work the scope will be limited to some of the most popular ones. The reason is that oil companies most likely already have these tools and concepts implemented in the organization, to a smaller or larger extent, and therefore these would be the easiest choice for them to make. Since implementing new procedures, new systems, and changing organizational culture is resource consuming, it is more efficient for organizations to exploit tools that they already possess. Knowledge transfer mechanisms are frequently employed, both internal to the organization and across organizations, to enable learning through access to knowledge. Communities of practice, which is a form of social learning, is usually cited as a way of sharing tacit knowledge. Learning cultures are also mentioned as a characteristic of organizations that are capable of adapting. These forms of organizational learning will be explained in this chapter.

The means by which companies enter new markets can be through projects, whether internal or external to the company, and therefore this particular type of structure is also considered. Here, the concepts are explained more broadly, through a corporate-level perspective, before discussing the implications to project management.

3.1 Definitions

The field of organizational learning has a wide range of perspectives (for a brief overview, see Wang and Ahmed, 2003) and it has been defined by researchers in many different ways (Argote and Miron-Spektor, 2011; Easterby-Smith and Lyles, 2011; Lewin et al., 2004). Some examples are presented below:

> "Organizational learning is the process by which the organization's knowledge and value base changes, leading to improved problem-solving ability and capacity for action."
>
> Probst and Büchel (1997, p. 15)

> “The embedding of individual- and group-level learning in organizational

> structures and processes achieved through reflecting on and modifying the norms and values embodied in established organizational processes and structures."
>
> Hislop (2013, p. 87)

> "... organizational learning is the process of change in individual and shared thought and action, which is affected by and embedded in the institutions of the organization."
>
> Vera et al. (2011, p. 154)

> "... the ability to learn faster than the competition and reconstruct and adapt the organization's skills, structures, and values ... "
>
> Nicholson et al. (1995, p.221)

But the core of most definitions, as expressed by (Argote and Miron-Spektor, 2011, p. 1124), is that "... organizational learning is a change in the organization that occurs as the organization acquires experience."

This is in line with the view presented by Levitt and March (1988) that see organizational learning as routine-based, history-dependent, and target-oriented. Their perspective clearly emphasizes the importance of experience in the way organizations learn and change, whether it is direct experience, the experience of others or interpretation of experiences.

Argyris and Schön (1996) also consider organizational learning a result of inquiries and responses that lead to a change of behavior that becomes embedded in the organization.

These definitions allow us to make an important distinction between individual learning and organizational learning. The organization cannot learn if individuals that comprise it do not learn. But individuals can learn without resulting in learning for the organization, if the individual learning does not lead to changes in the organization's knowledge base, processes, activities and relationships. For example, employees of an oil company can learn about three-dimensional printing and not apply this knowledge to improve the processes and activities in the organization. In addition, they can keep

this knowledge to themselves and not allow others to learn about it. As a result, they are learning as individuals, but there is no organizational learning as a result of it. In this work, it is assumed that individual learning is possible and occurs in the organization to enable organizational learning to be used as a tool.

3.2 Organizational Learning in Practice

As mentioned in the beginning of this chapter, the research on organizational learning comes from a variety of perspectives. It varies from individual vs. group learning, social structures and interactions, cultures, learning processes, and so on (Clegg et al., 2011; Wang and Ahmed, 2003). These different perspectives provide alternatives to tailor the solution to each organization's problem.

For example, large organizations will probably have more problems to make information (and lessons learned) available to all employees, while small organizations may have expertise in specific technologies or products and lack knowledge on other areas. So, in the first case, a knowledge management system would allow employees to store, share and access knowledge across the organization, and the creation of communities of practice, or social spaces for discussion, would help too. In the second case, it would probably not a matter of accessing the knowledge inside the organization, but most likely accessing knowledge outside the organization. Cooperation and exchange of resources (information, employees, equipment, etc.) with another company could be beneficial in this case, as long as the organization does not neglect the importance of individual learning. Since this is a small organization, it becomes more relevant that individuals are able, willing and encouraged to learn.

If the company needs to adapt to the environment and promote change, there must be mechanisms in place to facilitate acquisition of new skills, development of competences, reconfiguration of resources, etc. In this sense, organizational learning is important to effectively promote sharing and storage of knowledge, encouraging workers to learn and support learning of others, and creating a collaborative environment. Knowledge management tools can provide a structural support for these practices, but a learning culture is necessary for a successful implementation of these tools.

Particularly in the replication of competences, when tacit knowledge is involved, the transfer of know-how and context-dependent information is likely to be difficult (Teece et al., 1997). In this case, social learning approaches may be more effective, like communities of practice.

3.2.1 Knowledge Transfer

Clegg et al. (2011) differentiates organizational learning and knowledge management by pointing out that, while the first focuses on the dynamic development of an organization's resources, the second focuses on the creation, dissemination and transformation of knowledge. Knowledge management focuses on knowledge and not on capabilities, and therefore it is not an adequate tool by itself for the purposes of this work.

If knowledge is a source of competitive advantage for companies, then it becomes logical for organizations to implement knowledge management initiatives in search of competitiveness, as pointed out by Lucier and Torsilieri (2001). They also show that this interest is present in both academic research and high-level members of organizations, but that does not mean that there is a consensus on the effectiveness of knowledge management in delivering results.

The concept of transferring knowledge across organizations is important because external sources, like customers and suppliers, can provide valuable input for learning and improvement. This is mentioned by researchers of business relationships and networks, for example, Håkansson and Snehota (1995) and Knight (2000).

Knowledge is embedded in organizations in different forms. It can be embedded in individuals (in the form of tacit knowledge, transactive memory, etc.), in tools (such as hardware, software, machines and instruments), and in tasks (such as routines, procedures and activities), and in the combination of these elements. These are defined by McGrath and Argote (2001) as knowledge repositories and by Argote and Ingram (2000) as knowledge reservoirs.

Argote and Ingram (2000) argue that knowledge can be transferred within the organization and across organizations by moving knowledge reservoirs from one unit to another or by modifying it at a recipient site. But the knowledge reservoir must be com-

patible with the new context for a successful process of knowledge transfer.

Argote (2013) lists some mechanisms to transfer knowledge across organizations, such as training members of the recipient organization (to observe and acquire know-how), providing opportunities for communication between members of the organizations, providing information (documents, descriptions, technology, routines, etc.), and transferring experienced personnel from one organization to the other (to exchange tacit knowledge).

Argote and Ingram (2000) review some of the factors that influence knowledge transfer, including characteristics of knowledge being transferred, relationship between organizations that exchange knowledge, the transfer process, among others.

3.2.2 Learning Culture

The organizational culture can be described as the values, norms, assumptions and behaviors of the organization's members (Ajmal et al., 2009). It is a shared belief system that can act as a strong integration mechanism, by controlling and coordinating the members' behaviors (Wit and Meyer, 2014). Given the role of culture in establishing accepted behavior, an organization cannot promote learning within a culture that is incompatible with it.

Nicholson et al. (1995) define a learning organization as:
"The concept of organizations as dynamic systems having capacities of self-changing, and the ability to develop and more optimally satisfy the changing desires of stakeholders. Learning organizations embody, probably as a result of deliberate management strategy, a high proportion of the processes of organizational learning." (p. 292)

Similarly in essence, Senge (1990) defines a learning organization as:
"...organizations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning how to learn together." (p. 10)

Kofman and Senge (1993) emphasize the role of organizational culture in building a learning organization and they explain three fundamental areas of cultural dysfunction:

- Fragmentation: refers to separation of production processes into independent functions (such as segregating design, production and sales in the product development), and divisions in the organizational structure that isolate employees, businesses or functions (such as research and development isolated from customer service and therefore not knowing what the customer needs or wants).

- Competition: refers to the need to outperform others at all times. It takes away the potential benefits of making mistakes when trying something new (such as a different approach to problem-solving, another service provider, an alternative product, etc.) because of the fear of failure. It also undermines cooperation and collaboration, since other employees are seen as competition instead of team members.

- Reactiveness: refers to the need for a trigger in order to act, such as not improving systems that work and waiting to change it only when a problem occurs. The reactiveness culture slows development, as it requires a reason for improvements and change, especially regarding incremental improvement. Another problem is the lack of preventive measures, since it favors problem-solving. This problem was also raised by de Geus (1988).

The impact of these dysfunctions on organizational learning vary depending on how much they prevail in the culture and how much they are reinforced by procedures, processes and assessments. Considering that, Kofman and Senge (1993) stated that a learning organization is grounded in the following foundations:

1. "a culture based on transcendent human values of love, wonder, humility, and compassion": openness to see opportunities, understand that improvement is always possible, appreciation for different viewpoints and perspectives;

2. "a set of practices for generative conversation and coordinated action": promotion of dialogue to enable coordination, connections and inventions;

3. "a capacity to see and work with the flow of life as a system": understanding of interdependencies underlying complex issues for long term solutions instead of temporary arrangements.

As a result of these characteristics, Kofman and Senge (1993) argue that learning organizations are more generative (to continuously improve) and more adaptive (to cope with the changes in the environment) than traditional organizations.

3.2.3 Communities of Practice

Communities of practice are social learning systems, that require participation and the production of results (knowledge artifacts, such as concepts, stories, documents, etc.) to be meaningful (Wenger, 2010a). A community of practice is a set of relations among individuals over time and in relation with other overlapping communities of practice (Lave and Wenger, 2009). It allows people from different backgrounds, diverse knowledge and with different perspectives to learn, share knowledge and engage productively with others in the community (Wenger, 2010a).

There are some elements that make a community of practice work properly (Lave and Wenger, 2009; Wenger, 2010b):

- An interest, an activity or a purpose that gives people a reason to interact;
- Openness to engage, considering that differences are as important as having a common ground;
- Ways to communicate so that experience and competence actually interact;
- Access and transparency regarding knowledge artifacts, which can be facilitated by technology.

The differences in a community of practice are important because if all the members have the same knowledge, think the same way and have similar experiences, there will not be significant learning in place (Wenger, 2010b).

Organizations can promote the implementation of structured and supported communities of practice, as described by Saint-Onge and Wallace (2012). The differences between these two types of communities of practice depend on the level of commitment and purpose for the organization. The structured type has more organizational support and can have better infrastructure. In return, the main outcomes expected may

be more focused and tangible. However there are informal communities of practices inside organizations that are set up when employees have a common need to discuss a topic related to their work. In this case, these groups are usually loosely organized and have basic structures.

Saint-Onge and Wallace (2012) provide a Community of Practice Development Process Model (see Figure 3.1), which presents the main steps needed to develop a community of practice. It is not meant to be used strictly as is and it is not a linear process, but it serves as a guideline for organizations to adjust according to their necessity.

The Phase I is basically process-driven and follow a sequence of events. But Phase II is more of a cycle of development, with checkpoints and evaluations that aim to assess development and make corrections. Saint-Onge and Wallace (2012) developed a quick-start toolkit for community development, which is in the Appendix of their book, that presents more details on how to structure and establish a community of practice.

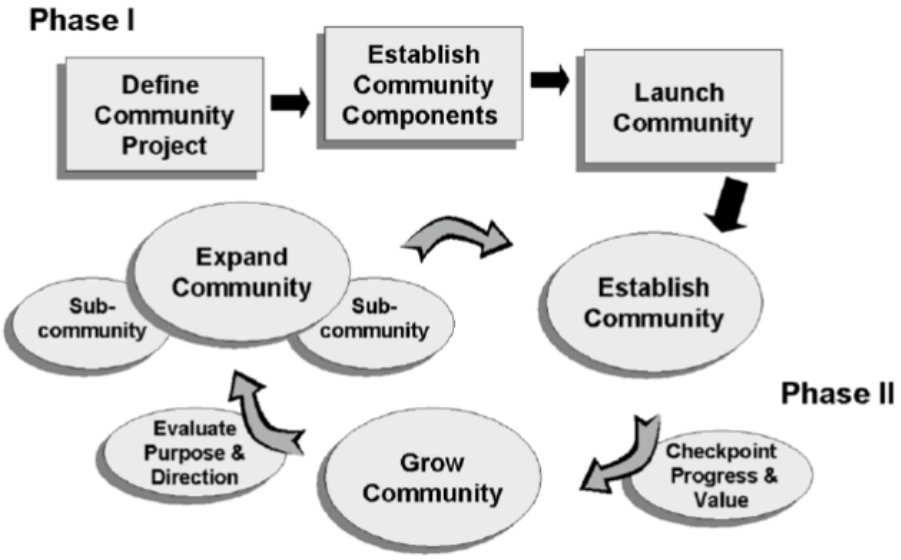

Figure 3.1: Community of Practice Development Process Model (Saint-Onge and Wallace, 2012).

The implementation of communities of practice can have impressive results for companies, such as what the automobile manufacturer Ford achieved in the 1990s, as

part of a knowledge management program (Lucier and Torsilieri, 2001).

However, there are some aspects of communities of practice that can be counter-productive in an organization. Wenger (2010a) argues that in a community of practice, the contribution of individuals is subjected to the acceptance of the group. A cohesive group may have difficulty accepting ideas that are different from what they identify with. So it is important to maintain a balance within the community of practice: have a sense of belonging and trust while still maintaing an identity as an individual, so that different experiences, backgrounds, and knowledge can be expressed to increase the collective knowledge of the group.

Another aspect stated by Wenger (2010a) is that when different perspectives and ideas meet in a community of practice, there is great potential for innovation and conflict. And it is hard to predict which one will come out of it. The result may be a waste of time and resources, a deviation from initial objectives and worse conditions of relationships.

3.3 Organizational Learning in Projects

Brady and Davies (2004) present a model of how project-based learning can be used as a dynamic process of project capability building when an organization diversifies into new technology and market positions. An important remark about this model is that it only applies to projects that can become "major new lines of repeatable business, such as turnkey, outsourcing, design-build-operate, or public-private partnership projects."

The model involves "exploratory learning" and the usual ways of managing projects may need to be revised in order to be successful. In the beginning, efforts are concentrated in capturing the learning and transferring the new knowledge and experience to subsequent projects. As the organizational knowledge increases, the learning becomes more "exploitative" and it becomes a matter of optimizing use of the knowledge. (Brady and Davies, 2004)

The two processes existing in this model are based on organizational learning and the difference between them is the direction and the focus of the learning activity. While project-led learning takes place in individual projects, units or divisions through activ-

ities that are customer-oriented, business-led learning takes place in the organization through corporate-wide strategic choices of which and how to better exploit resources and new project-based capabilities. (Brady and Davies, 2004)

In Figure 3.2, the phases of project-led learning refer to the steps of capability building that start with a novel project (phase 1), then goes to learning between projects (phase 2), and finally the knowledge becomes institutionalized in the parent organization (phase 3) . In phase 1, project team members build on existing knowledge but gain understanding of a new type of project and benefit from the lessons of this experience. There is individual learning involved, but there is also knowledge gain from being part of a group. In phase 2, there is a focus on codification, transfer and sharing of knowledge. So common practices are: reflections (telling stories, team learning, lessons learned exercises), formal mechanisms (post-project reviews, intranets, databases), and transferring project team members to subsequent projects to transfer knowledge. Phase 3 involves a wider reach of the process, as it captures the cumulative learning from projects (the vanguard project and subsequent ones) and institutionalizes it through changes in routines, procedures, organizational processes, information sharing, etc. (Brady and Davies, 2004)

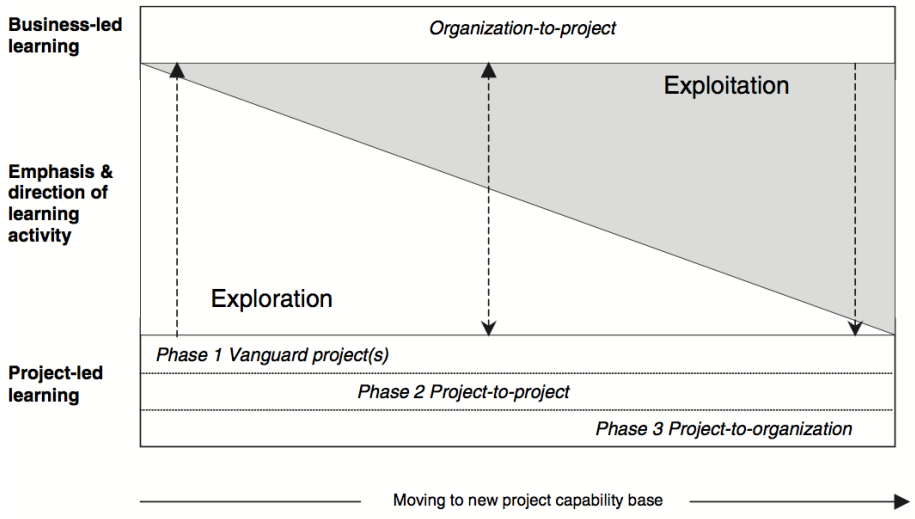

Figure 3.2: Project Capability-Building Model (Brady and Davies, 2004).

3.4 Oil and Gas Companies and Organizational Learning

British Petroleum (BP) is frequently mentioned as a success case by knowledge management and organizational learning researchers (Lucier and Torsilieri, 2001). As BP's former CEO John Browne says, "Learning is at the heart of a company's ability to adapt to a rapidly changing environment. It is the key to being able both to identify opportunities that others might not see and to exploit those opportunities rapidly and fully." (Prokesch, 1997). That statement explicitly shows the intention of promoting change and exploration of opportunities and resources, but BP also focused on incremental change that leads to efficiency.

BP implemented several concepts of organizational learning, including promoting a learning culture (to be a learning organization), learning from their own experience and from contractors, suppliers, partners and customers, collecting and sharing explicit knowledge, fostering personal interaction to facilitate dissemination of tacit knowledge (which Mr. Browne calls implicit knowledge), and keeping track of which employees have which know-how, so that others can access their expertise when in need. (Prokesch, 1997)

For BP, the qualities of a learning organization are (Donegan, 1990):

- Recognizes that organizations must adapt to a future of constant change;
- Accepts that people have a key role in the process of adaptation;
- Facilitates the learning and personal development of everyone in the organization through a truly empowering culture;
- Uses the combined energy, creativity and commitment generated by employees in this developmental climate to fuel an ongoing process of organizational transformation.

BP also has virtual team networks to facilitate cooperation and sharing of knowledge within the organization and across organizational boundaries. Virtual team networks can be comprised of BP employees, contractors and suppliers from several countries. Technology has an important role, as computers are the main equipment used for

interaction. The proper set up of the infrastructure is important so that people can easily use it, both to share and to access information and people. Another important component for the successful implementation of virtual team networks is the behavior and mindset of the users. If they are not open to share information or if they do not see the value of joining the network, it does not bring the expected results. (Prokesch, 1997).

It is worth noting that BP's organizational structure is intrinsically fit for creating a learning organization. With a "flat structure", less hierarchy, less bureaucracy and more horizontal communication, it is easier to promote collaboration between employees that do not necessarily work in the same area of expertise, as points out BP's former CEO John Browne (Prokesch, 1997).

Chapter 4

Industry Context

The Oil and Gas (O&G) industry is large and complex, with many types of activities and products. Here, the scope of analysis is restricted to Upstream activities, which will be defined in the next section. The reason for this choice is that Upstream activities are the beginning of the value chain in the O&G industry and, therefore, without the oil production there is no refining of oil. Another reason is that many of the environmental concerns are focused on this section of the industry. It has more risks involved and it has potential for more environmental impact, as observed in the 2010 BP's deepwater Macondo accident (Hilyard, 2012).

The scope of the study will also be limited to oil, and natural gas will not be addressed. The use of the term "Oil and Gas" is related to the characteristics of the industry. Usually oil producers also produce gas (non-associated gas), or gas is produced as a byproduct in the processing of oil (associated gas). Therefore, oil companies necessarily have to deal with natural gas. (Hilyard, 2012)

Governments have been changing their energy policies to promote sustainable development and combat climate change (OECD, 2016). When considering alternative sources of energy to combat climate change, a lot of the attention is directed to renewables. After the 2011 Fukushima disaster, nuclear energy has been re-evaluated due to safety concerns and environmental liabilities (IMF, 2016). The use of renewables is improving, especially in the electricity production market.

Electricity comes from a variety of sources, including fossil fuels, nuclear, hydro, geothermal, solar, biofuels, etc. (OECD, 2016). In terms of electricity generation, oil is not the dominant source. Coal represented 41% of the fuel share in world electricity in 2013, which is the dirtiest source of energy (IEA, 2015c). Taking this perspective, substituting coal for renewables has a larger impact on greenhouse gas emissions than banning oil as a source for electricity production (IMF, 2016). The scope of this work will be limited to electricity production in the energy market. Transportation fuels and heating will not be addressed.

4.1 The Oil and Gas Industry

The oil and gas industry is large, complex and an important part of the economic landscape worldwide. This industry produces fuels (for transportation, heating and electricity), asphalt, lubricants, petrochemicals, fertilizers, solvents, etc. The exploration of oil began in 1859 in Pennsylvania, United States, but it became more important after its discovery in 1901 in East Texas. Then it started to replace coal as a fuel for ships and trains and later it would be used as a major fuel source for airplanes and automobiles. (Hilyard, 2012; Inkpen and Moffett, 2011)

The figure below is the simplified structure of the Oil and Gas (O&G) industry. The exploration and production (Upstream) refers to the activities of finding reserves, evaluating potential for production, drilling wells for production, bringing oil to surface and preparing it for transportation and processing. The Midstream encompasses a small part of the industry, but important nonetheless. The transportation can be a challenging activity in extreme environments or areas of conflict. The Downstream activities are also important, as they include the processing of oil and transformation into fuels, naphtha, gas, coke, and other products. (Hilyard, 2012)

The O&G industry encompasses all sorts of companies, with different structures, sizes and capabilities. Some companies are called *independent*, because they are not integrated, meaning that they have either on upstream or downstream activities, but not both. *Integrated* oil companies are the opposite. They operate in the whole chain, from exploration and production until refining, and sometimes they extend to petro-

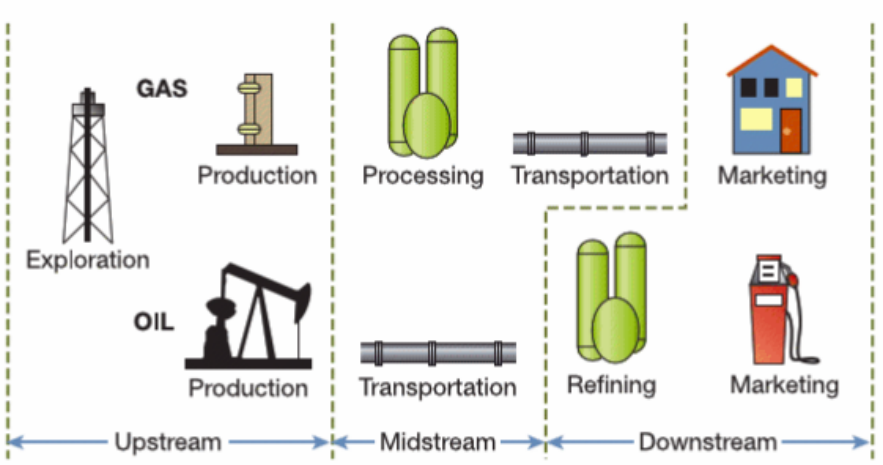

Figure 4.1: The Oil and Gas Industry Structure (Hilyard, 2012).

chemicals as well. Some examples are: BP, Chevron, ConocoPhillips, ExxonMobil, Shell, Total, Eni and Marathon. (Inkpen and Moffett, 2011)

Another category of companies is the *international* oil company. It designates the large O&G companies that compete globally, sometimes in partnership with *national* oil companies. They are usually *integrated* and operate in many industry segments. Some examples are: BP, Chevron, ConocoPhillips, ExxonMobil, Shell and Total. *National* oil companies are those controlled by a national government, that are used to manage the countries' resources. The largest oil and gas reserves are owned by this type of oil company. They may be partially owned by private investors, but the government has a considerable amount of shares. Examples are: Gazprom in Russia, Petrobras in Brazil, Petroleos de Venezuela (PDVSA) in Venezuela, and China Petroleum and Chemical Corporation (Sinopec) and China National Offshore Oil Corporation (CNOOC) in China. Some *national* oil companies operate only in their country, like Pemex, while others compete globally, similarly to *international* oil companies, like Gazprom, Petrobras and Statoil. (Hilyard, 2012; Inkpen and Moffett, 2011)

BP, Chevron, ConocoPhillips, ExxonMobil, Shell and Total are also called *supermajors*, because they are the largest *international* companies (Inkpen and Moffett, 2011).

Another type of company operating in the O&G industry is the *service* providers, like Schlumberger, Halliburton, Weatherford and Baker Hughes. They are suppliers of

products and services for upstream activities of oil companies. Although they are not the main players in the industry, *service* companies have become increasingly important as the need for technology development increased for exploration. (Inkpen and Moffett, 2011)

Oil is mainly used for transportation fuel, but it is also used for electricity generation (IMF, 2016). Oil producers have a dual role when it comes to electricity. Main activity producers are those that generate electricity for sale to third parties and autoproducers are those that generate electricity wholly or partly for their own use to support their primary industrial activity (OECD, 2016). By these definitions, the oil and gas industry provides a source (fossil fuel) of energy to main activity producers and, at the same time, they can be autoproducers and produce electricity to support their operations.

4.1.1 OPEC and The 1980s Oil Price Crisis

The Organization of Petroleum Exporting Countries (OPEC) was created in 1960 by Iran, Iraq, Kuwait, Saudi Arabia and Venezuela to counteract the competitiveness of independent oil companies around the world. The group was created to coordinate oil policies and to stabilize oil prices, which in turn would give a predictability to the income of these oil exporting countries. (Aperjis, 1982)

In the beginning, OPEC was struggling to exercise control over oil prices because non-OPEC suppliers were increasing production and therefore reducing OPEC's bargaining power. The structure of the world oil market started to change, with more commercialization of oil between companies instead of the usual movement through internal channels in vertically integrated companies. That led to the rise in the number of participants in the world oil market, with major and minor oil companies, independent refiners, oil traders and trading houses. But in the late 1960s, Libya successfully used the geopolitical context in the Middle East and North Africa to get a larger barrel share for the government from oil companies. This situation was replicated by the OPEC members. (Aperjis, 1982; Mabro, 1988)

In 1973 the Arab producers decided to decrease oil production and to implement an oil embargo against the United States and the Netherlands, in retaliation to these

two countries' policies regarding the 1973 Arab-Israeli war. Oil prices skyrocketed and OPEC took control of the international oil market. In 1974-1975 an economic recession in the industrial countries led to a decrease in oil demand, but OPEC decided to raise oil prices and decrease production. In 1976 the economies of industrial countries improved and oil demand started to rise again. But OPEC members started to disagree on price policies creating a division in the group, with Saudi Arabia clearly diverging from the other members. (Aperjis, 1982)

In 1978 new non-OPEC production (from Alaska, the North Sea, Mexico, and small-scale producers around the world) created an oversupply that pressured OPEC's oil price control. This new capacity offset the decline in OPEC output from 1979 and 1985. Also, the Iranian Revolution broke out, destabilizing oil production. In 1979, with the chaotic Iranian situation and disagreement among OPEC members, the year ended with Saudi Arabia deciding that each country should do what is best for themselves since they could not reach consensus on how much to increase the oil price. (Aperjis, 1982; Mabro, 1988)

In 1979-1980, oil buyers started building inventory to counteract the supply disruptions. This buildup of inventory had an impact on oil prices in the subsequent years, making it more difficult for OPEC to control prices. Also, this change in the market put more power in the hands of oil traders. From 1981 to 1983, non-OPEC producers took advantage of OPEC's strategy of price control and decided to increase production to maximize volume. Non-OPEC producers started to gain more share of the market. (Ahrari, 1985)

OPEC tried to stabilize prices during the 1970s and 1980s, but after facing many challenges, in 1986 they decided to abandon this practice and a few months later the oil price collapsed from $25-28 per barrel down to $8-12 per barrel. This event is considered a result of structural and economic developments that started in the late 1970s, when the Iranian Revolution destabilized oil supplies and diverted attention from the decline in demand, which continued in a downward trend for the following years. (Mabro, 1988)

But this situation was not new to the O&G industry in 1986, as Mabro (1988) writes:

"The oil industry tends to put on a brave face when the energy world is subjected to shocks. This was noticeable in 1973 and in 1979-80, and the same attitudes, albeit in very different circumstances, emerged again in 1986-7. Companies with large cash balances and favorable gearing ratios believe that their *relative* competitive advantage over others will improve. Cold comfort indeed: these relative gains must be set against an absolute fall in profits and a reduction in the valuation of companies on the asset side of the balance sheet."

The O&G market experienced day-to-day price volatility, as there were no stabilizers for oil price in the short term. In 1987 the oil price went back up, but these cycles continued. Low oil prices drive demand up and, if companies do not invest in future supply capacity, the demand-supply imbalance causes prices to go up again. In the 1990s there was another spike in prices, but in 1997 the Asian financial crisis happened. Then prices went up again, but fell after the September 11, 2001 terrorist attack. Again, prices recovered and collapsed during the financial crisis in 2008. (Inkpen and Moffett, 2011; Mabro, 1988)

The introduction of tariffs or other trade protection measures by some countries segmented the market and contributed to the fluctuations of oil price. Some companies do not have the capacity to adapt to the price cycles and are bought from other companies or go bankrupt. This leads to an industrial concentration, with larger companies becoming dominant. But the market concentration also fuels efficiency, as companies need to outperform a smaller amount of competitors (but bigger competitors nonetheless). (Mabro, 1988)

This brief overview of OPEC's role in the O&G market shows some characteristics of the power dynamics still seen today. The organization is currently comprised of 12 members: Algeria, Angola, Ecuador, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, the United Arab Emirates and Venezuela (OPEC, 2015). Saudi Arabia still plays a dominant role in the group's decisions, sustaining that OPEC should not make cuts in oil production in an attempt to raise prices in the current low oil price environment. However, OPEC's bargaining power decreased considerably, as the United States became the world's leading producer of crude oil in 2014, with approximately 13% of the

market. But OPEC still has a large share of the market (40% in 2014, and Saudi Arabia alone has 12.5% of the world market share). (IEA, 2015b; OECD, 2016)

4.1.2 Low Oil Prices

The end of the latest up-cycle of oil prices ended in 2014, after experiencing a year of Brent prices over $100 per barrel of oil. In the year of 2014 the Brent oil price dropped from $107 to $57 per barrel, equivalent to approximately 47% decrease (Nasdaq, 2016).

According to IMF (2016), the further decrease of oil prices by 32% from August 2015 to February 2016 was a result of strong supply from OPEC and Russia, expectations of higher supply from Iran, concerns about the resilience of global demand and medium-term growth prospects, and risk-off behavior in financial markets. The world oil production grew by 2.4 million barrels per day in 2014, despite output problems in Libya, while oil demand grew only 1.1 million barrels per day (OPEC, 2015).

The OPEC also acknowledges the impact of a more pessimistic economic outlook on oil prices. The low oil prices increased the demand for oil, but this growth was limited by depreciation of currencies agains the United States dollar, removal of subsidies and price controls on petroleum products in some countries and ongoing efficiency improvements. These factors will likely continue to influence the medium-term demand growth. (OPEC, 2015)

One of the effects that low commodity prices have on the industry is the decrease on investment, since energy and mining are very capital-intensive activities. When the commodity prices are high, there is more capital available for investment. Figure 4.2 shows the capital expenditures in the oil and gas sector, quarter-on-quarter, in 2014-2015. From the first quarter (Q1) through the fourth quarter (Q4) in 2014, the total capital expenditure increased, and two quarters after the oil prices started to fall, so did the capital expenditure. (IMF, 2016)

Figure 4.2 shows an accentuated decline in investment in 2015, but the decline in oil price, starting in mid-2014, is even more pronounced. Figure 4.3 shows the oil price (Brent) in the period 2013-2015. The effect of low oil prices is not immediate on investment, since price oscillation varies daily and investment decisions have a mid to

long-term timeframe.

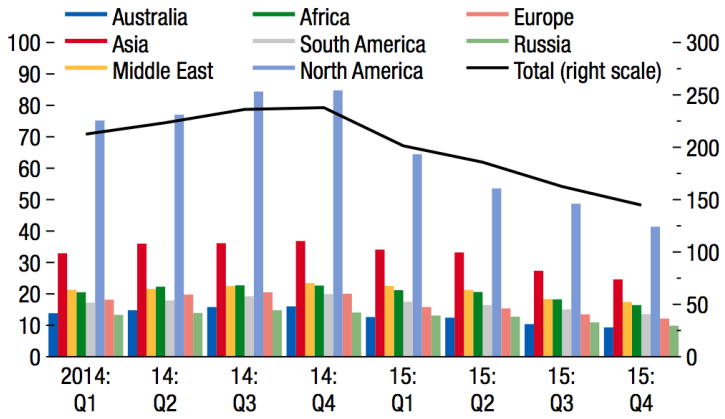

Figure 4.2: Quarterly capital expenditures in the O&G sector in major producers (billions of dollars) (IMF, 2016).

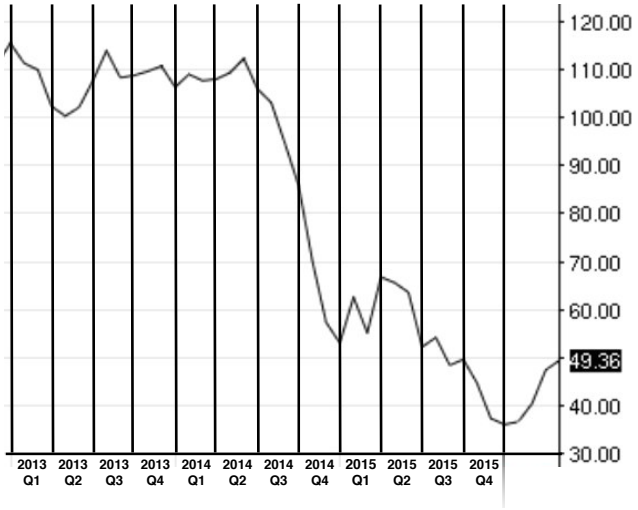

Figure 4.3: Crude oil Brent prices between 2013 and 2015 (Nasdaq, 2016).

The decline in capital expenditure will affect oil supply in the medium to long-term, but the short-term effects can also be measured in job losses. The estimated number of job cuts since mid-2014 in the O&G industry is over 150,000 (OPEC, 2015). These job losses are related to investment cuts and efficiency measures to manage production costs.

With the financial pressure of a prolonged low oil price period, bargain opportunities for mergers and acquisitions start to appear. There are expectations of increase in this type of activity particularly in the upstream and oilfield service sectors, since they are more exposed to lower oil prices. (Deloitte, 2015)

4.2 Climate Change

Climate change exposes people, societies, economic sectors and ecosystems to risks, which arise from the interaction between hazard (severe storms, extended droughts, sea level rise), vulnerability (susceptibility to harm) and exposure. The IPCC (2014) concludes that anthropogenic factors have influence on climate change, especially the increase in greenhouse gas (GHG) emissions (mostly carbon dioxide, methane and nitrous oxide). From the total GHG emissions between 1970 and 2010, about 78% came from fossil fuel combustion and industrial processes. Natural factors, such as change in solar irradiance and volcanic activity, also contribute but to a smaller degree.

The United Nations has been concentrating efforts to deal with climate change. The last Climate Change Conference, COP21, resulted in a commitment from nearly all countries to reduce greenhouse gas emissions. To achieve this goal, the countries need to make an energy transition by moving away from fossil fuels (oil, natural gas and coal) and toward clean and sustainable energies. (IMF, 2016)

The actions to deal with climate change in the oil companies are threefold: transition from fossil to renewables, develop technologies to neutralize carbon emissions, improve operations to continue oil production in an environment-friendly manner.

From the fossil fuels, natural gas is the cleanest source, followed by oil. Coal is the dirtiest, and developed countries and China are reducing its use. However, due to its low prices, developing countries, like India, have increased the share of coal as a source in electricity generation. And higher economic growth resulted in higher demand for energy, therefore increasing the consumption of coal. (IMF, 2016)

If governments agree to a gradual implementation of a global carbon tax, the use of fossil fuels will be less appealing and the revenue from the carbon tax can be used towards mitigation and adaptive measures related to climate change (IMF, 2016). The

implementation of government subsidies to enable the growth of renewable energy markets is one of these adaptive measures (Lund, 2009). The development of O&G resources is also becoming more costly due to environmental regulations. The potential environmental impact of drilling and fracking in the United States has generated a response from most states, which adjusted their own regulations for these operations (OPEC, 2015).

The IMF (2016) warns that if the energy transition from fossil to renewables is successful, assets related to fossil fuels could lose value or become liabilities. It refers to oil reserves that cannot be recovered or fully utilized and equipment and infrastructure that becomes obsolete. This issue is related to technological path dependency, since investments made in the past influence the choices that organizations make. The fact that the oil and gas industry is capital intensive highlights the difficulties of transitioning to a different type of market. It takes time to phase out investments that were approved considering the old strategy and start adjusting to a new strategy.

Part of the efforts to deal with restrictions on GHG emissions are focused on developing the carbon capture and storage (CCS) technology. It can be used to reinject carbon dioxide into maturing oil fields, which need methods to enhance oil production when reservoir pressure decreases. In 2015 there were 14 large-scale CCS units in operation, and another 8 under construction. (OPEC, 2015)

Regarding adaptation in the oil production processes, the IPIECA (2013) considers that it will take place anyway, even if the oil company does not engage in combating climate change. The impacts on environment, like water scarcity, flooding, extreme weather, sea level rise, etc., will likely affect the O&G industry, so oil companies will need to adapt.

The first step in the adaptation process is to identify risks (consequences and probabilities) in order to take the necessary actions. IPIECA (2013) states that there might be some local benefits in certain regions, however the focus is generally on understanding potential hazards to be able to adequately respond to the situation. Figure 4.4 shows some of the potential risks for the O&G industry.

In terms of impact on project management for the O&G industry, some of the pa-

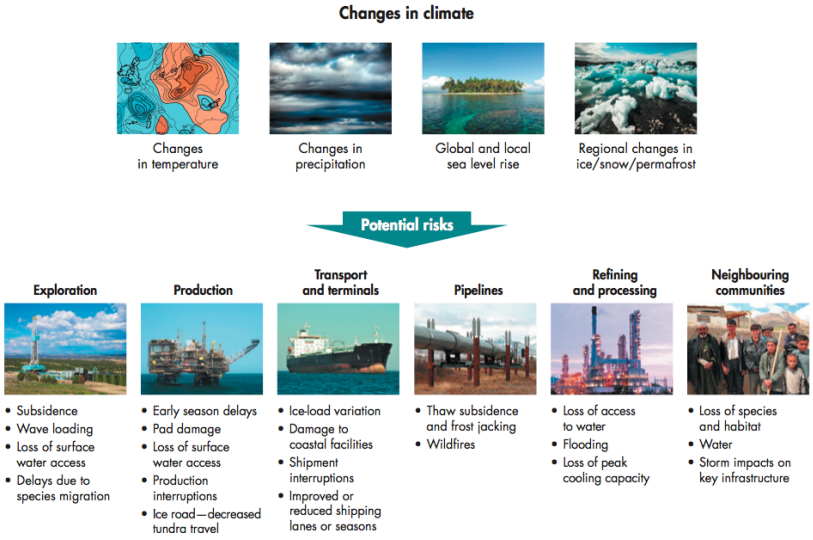

Figure 4.4: Climate change and potential risks (IPIECA, 2013).

rameters identified by IPIECA (2013) that can go into the climate risk assessment include: the location of the operation; the type of facility (depending if it is upstream or downstream); facility design; project lifetime; historical, current and projected environmental conditions (water availability, ecosystem status, climate variability). Given the uncertainty on the early phases of projects, the uncertainty on climate risks can have a significant influence on the feasibility of projects.

4.3 The Renewable Energy Market

Renewables include energy generated from hydro, geothermal, solar, wind, tide and wave, solid biofuels, biogasoline, biodiesels, other liquid biofuels, biogases, and the renewable fraction of municipal waste.(OECD, 2016)

The definitions for these renewable sources are provided by IEA (2015c):

- Hydro: electricity is generated by converting potential and kinetic energy of water in hydroelectric plants.
- Geothermal: electricity from heat emitted from within the earth's crust (available in the form of hot water or steam).

- Solar: there are two types of solar energy generation. Solar photovoltaic generation uses photovoltaic cells to produce electricity from solar radiation, while solar thermal exploits the heating of water through solar radiation.

- Wind: kinetic energy of wind is converted into electricity by wind turbines.

- Tide and wave: the mechanical energy from tidal movement, wave motion or ocean current is converted into electricity.

- Biofuels: fuels derived directly or indirectly from biomass, which is a material obtained from living or recently living organisms. It includes wood, vegetal waste, ethanol, animal materials and waste and sulphite lyes.

- Municipal waste: waste produced by residential, commercial and public service sectors, which are collected for disposal in a central location to produce heat and/or power.

The renewables market has been expanding and becoming more important in the energy market. Figure 4.5 presents the shares for each source of electricity production in the world in 2013. The share of renewables in the generation of electricity grew, on average, 3.5% per year, from 1990 to 2013. That is slightly faster than the total electricity generation growth rate of 3.0%. (IEA, 2015c)

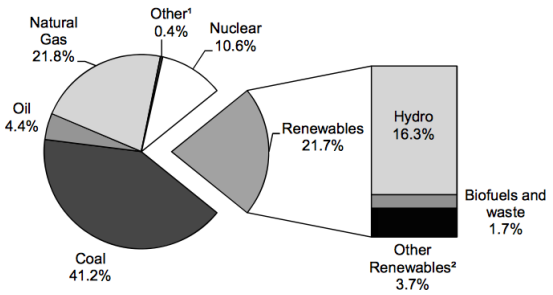

Figure 4.5: Sources of electricity production in the world in 2013 (IEA, 2015c).

However, this relevance of renewables in the electricity production varies significantly across countries, since the availability of resources is not equally distributed around the world. There are differences in natural resources, government policies, investment, etc. which influence how electricity is generated in each country. Each country has a different potential for solar, hydro, geothermal and wind energy, and government policies can provide incentives for energy companies to invest in renewables. The table below shows the representation of renewables in selected countries. (IEA, 2015c)

Table 4.1: Share of electricity production from renewable sources from selected countries (IEA, 2015a,c).

Country	1990 (%)	2013 (%)	Average annual change (%)
Australia	9.7	12.6	1.1
Brazil	94.5	76.8	-0.9
Canada	62.4	62.8	0.0
China	20.4	20.3	-0.0
Denmark	3.2	46.0	12.3
Egypt	23.5	8.6	-4.3
Finland	29.5	35.9	0.9
Germany	3.5	24.3	8.8
Iceland	99.9	100.0	0.0
India	24.5	16.9	-1.6
Iran	10.3	5.7	-2.5
Japan	12.1	13.0	0.3
Nepal	99.9	99.7	-0.0
Norway	99.8	97.8	-0.1
Russia	15.3	17.2	0.5
South Africa	0.6	0.7	0.5
Sweden	51.0	54.0	0.3
United Kingdom	1.8	15.1	9.6
United States	11.5	12.6	0.4
Venezuela	62.3	67.8	0.4

Countries that are large oil exporters have been trying to diversify their economies, such as United Arab Emirates, which has a plan to reach 24% of its primary energy from renewable sources by 2021. On the other hand, Morocco, which is an oil importer, has a project to build the single largest solar power production facility in the world by 2020. (IMF, 2016)

The OPEC (2015) expects that in the coming years, the use of renewable sources will be integrated to the exploration and production of O&G in order to reduce emis-

sions and improve environmental indicators. This could be achieved through energy efficiency improvements, with more control systems and electrification of oil field operations. The increase in electricity demand in the O&G production could be supplied by renewable sources, such as solar and wind.

One of the main challenges in the transition from fossil fuels to renewables is improving the technology to be more efficient, more reliable, more accessible and cheaper. Particularly for developing countries, access to technology can be a barrier in the transition process. The United Nations established a fund, the Green Climate Fund, to help developing countries in the adaptation and mitigation practices. (IMF, 2016)

The OPEC (2015) evaluates the competitiveness of renewables as follows:

- Onshore wind: to become one of the most efficient and cleanest source of electricity at a nearly similar cost to coal and natural gas plants;
- Offshore wind: expected to continue to have high costs due to technology complexity and maintenance problems;
- Hydro: will remain important as it is cost-effective and carbon neutral;
- Solar: still not competitive in terms of cost compared to wind or fossil fuel, but the advances in pace of cost reductions can make it competitive to wind in the long-term.

Considering the reliability problems associated to renewables, OPEC (2015) states that fossil fuels will continue to play a role in electricity generation as a back-up in power supply.

4.4 Uncertainty

Whenever an organization analyzes a business, a market or a possible investment, it has to consider uncertainty. Considering the project setting, the main causes of uncertainty are: economic/financial; environmental; institutional; technological; sociocultural; and political (Samset, 2010).

Samset (2010) makes a distinction between operational (or internal) uncertainty and contextual (or surroundings-based) uncertainty. The first is associated to the implementation of the project and how it is organized. It usually reduces as the project matures and more information is available. Innovative projects are considered high in operational uncertainty, for example. The second is related to aspects that are external to the project implementation, and outside the responsibility and authority of project teams. Projects that are implemented in environments that are unfamiliar and unknown to the project team have high contextual uncertainty.

Therefore, uncertainty is a relevant aspect to be considered when analyzing how oil and gas companies can transition to renewable energy businesses, especially if it is achieved through the implementation of projects. The first project in a new industry context will likely have high operational uncertainty. Subsequent projects will probably have less operational uncertainty if the project team learns from the lessons of the first project. The same applies to contextual uncertainty, as the project teams will be more familiar with the contextual characteristics of the new market.

But some markets and businesses are more prone to uncertainty than others. In the oil and gas market, the main uncertainties identified by OPEC (2015) and Inkpen and Moffett (2011) include economy, policy developments, the pace of technological development, climate change concerns, environmental regulations, speculative activity, fiscal conditions, etc.

In the case of renewable energy, many changes have occurred in the past few years regarding environmental, political and economic factors. One of the difficulties regarding renewables is reliability, since natural resources, such as wind, sun, and rainfall, cannot be controlled (IMF, 2016). Unstable supply patterns can be a problem especially for energy intensive industries, that depend on steady supply to operate safely and efficiently.

Additionally, the decline in commodity prices has affected the economies of countries that either export or import these products. Particularly in the case of oil prices, exporting countries have been strongly impacted (economic growth, strength of currency, inflation, external investment flow, etc.) and that has increased contextual risks

for companies. (IMF, 2016)

Chapter 5

New Market Entry Ways

There are several means by which an organization can enter a new market. Here, the focus is on some of the main options that are currently being used to enter the renewable energy markets, namely projects, joint ventures and mergers and acquisitions. Other opportunities may be available, depending on the location, availability of resources and government policies.

5.1 Projects

Brady and Davies (2004) argues that projects can be used to build new capabilities and enter new markets, increasing the potential for adaptability of organizations. This is supported by Samset (2010) in the discussion of strategic performance of projects and determination of criteria for project success. The role that projects can have as part of the corporate strategy becomes clearer by defining indicators of project success in terms of time, meaning short, medium and long term outcomes (see Figure 5.1).

Projects were used by companies to enter the wind power market in Spain, in partnership with local government (Stenzel and Frenzel, 2008). Iberdrola used a subsidiary to establish a partnership with the regional government of the Navarra province to build wind turbines, to install them and to connect them to the grid. In these projects, Iberdrola acquired the wind turbine capabilities from a Danish company and used its own

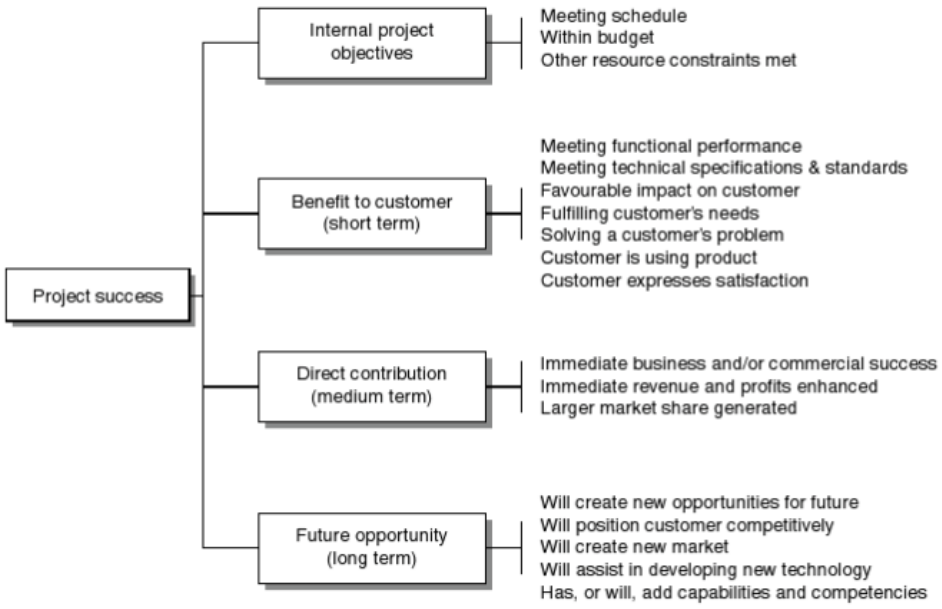

Figure 5.1: Indicators of project success associated with project outcomes over time (Samset, 2010).

capabilities in engineering and services to cover the rest of the value chain.

Projects were also used in the United Kingdom, but in a different context, as Stenzel and Frenzel (2008) explain. The government establish a new policy to support renewables and provided an auction mechanism in which projects could win long-term contracts. However, the scope of the projects (site measurements, technology selection, financial structure) favored larger companies, that could cope with uncertainty and long planning cycles.

Organizations can also provide funding for research projects, as seen in organizations that engage in open innovation (Chesbrough, 2003).

5.2 Joint Ventures

Joint ventures are defined by (Nicholson et al., 1995, p. 275) as: "...a form of cooperation, or a strategic alliance, typically defined as the pooling of separately owned resources by two or more firms to reduce competition, realize economies of scale, pool

complementary resources, ease entry into foreign markets while reducing political risk, and leap over entry barriers to enter new markets (domestic or foreign)."

It can be advantageous for organizations that have different capabilities to establish this type of alliance, since it allows them to access markets that they may not be able to access alone. An example is Proctor & Gamble and Clorox in the bags-and-wraps business. Proctor & Gamble had the technology and Clorox had the manufacturing and commercialization capabilities. (Kline, 2003)

In the tidal energy market, a £400 million joint venture between DP Energy and Bluepower NV plans to start producing 10 MW tidal energy in 2018, and reach the full capacity of 100 MW by 2020. Another joint venture in the tidal energy market is between OpenHydro and Brookfield Renewable Energy Group. They are developing a project for 50 to 100 tidal turbines since 2006, and expect to produce 100 MW by 2020. Other examples of joint ventures in this market are provided by Rajgor (2016).

5.3 Mergers and Acquisitions

Mergers and Acquisitions (M&A) is an expression defined by (Nicholson et al., 1995, p. 324) as: "An acquisition is the legal and accounting act of an investor buying more than 50 percent of a vendor's equity. A merger is a fusing together of two or more organizations. Mergers may occur between any form of organization (business, government, voluntary, religious) whereas acquisitions refer to legal purchases of equity within markets. In practice, the outcome of both a merger and an acquisition is some combination of the human, material, and financial assets of two or more organizations into a new legal and accounting entity."

Mergers and acquisitions have been an important element of the O&G industry history. The industry has seen megamergers, like BP-Amoco, Total-Petrofina, Chevron-Texaco, and ExxonMobil, but a lot of smaller deals also occur (Inkpen and Moffett, 2011). In 2015, Shell acquired BG for approximately $82 billion, making it the largest deal in that year (Deloitte, 2015). Most recently, a $28 billion merger deal between Halliburton and Baker Hughes was stopped by antitrust regulators in the United States, due to concerns over market concentration (Stone, 2016).

The low oil price situation, combined with financial challenges for companies that do not have a balanced cash flow, can bring a period of M&A transactions. That is yet to start, as in 2015 the number of deals in the O&G industry was lower than in 2009, after the financial crisis of 2008 (see in the figure below).

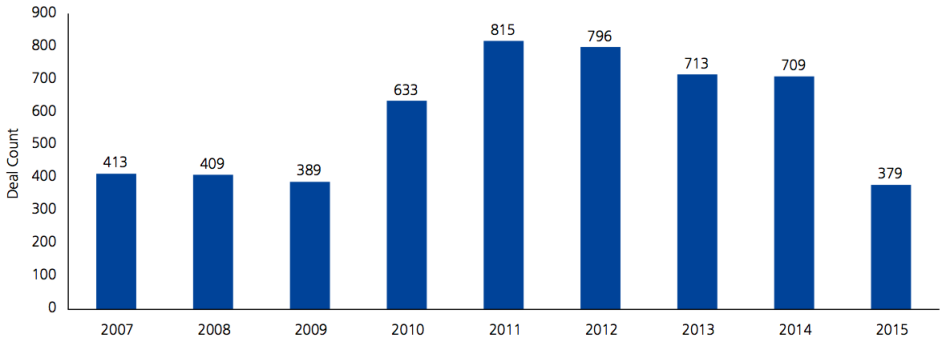

Figure 5.2: Number of mergers and acquisitions per year in the O&G industry (Deloitte, 2015).

The low number of deals may be a result of the measures that many upstream producers implemented in mid-2014 and 2015, such as cost reductions (layoffs, renegotiation or cancellation of service and supply contracts, delay of capital expenditure in projects) and increase in production to generate more revenues. But the effects of these measures were limited and producers started to cut production rates. Upstream and oilfield services are more vulnerable to low oil prices and these sectors represented respectively 67% and 9% of the deals in 2015. (Deloitte, 2015)

Another aspect that might explain the low number of deals is the uncertainty surrounding the oil price. The pessimistic condition of the market can be observed in the risk-averse tendencies of the deals that were executed in 2015. More than half of the deals were acquisitions of producing fields, meaning that there is a lower development risk and immediate cash flows. (Deloitte, 2015)

The combination of low M&A activity with prolonged periods of low oil price, with high uncertainty scenarios, may induce O&G companies to explore options elsewhere.

In Spain, HC Energia entered the wind development market through a series of acquisitions (Stenzel and Frenzel, 2008). These companies were later integrated into a

new group called NEO Energia, which grew to become Spain's second largest utility wind developer. In the United Kingdom, EDF Energy bought the wind power portfolio of a wind developer to enter the renewable energy market. In Germany, RWE acquired wind power capabilities by integrating a small renewable energy developer into its main power division.

5.4 Renewable Energy Market Entry

Renewable energies are considered favorable options to combat climate change, but price remains a problem. As Lund (2009) remarks, in practice, renewable energy prices need some sort of compensation to be competitive. For example: government subsidies to enable market penetration or penalization of traditional energy sources, like fossil fuels, for not fulfilling societal goals.

Some countries are important technology developers in the renewables market, and they are observing economic growth related to these new technologies. Job creation, technology export and industrial production are some of the positive effects seen in these countries. Lund (2009) provides some examples, like Norway, Denmark and Germany. But these countries had government incentives in the form of policy measures, which enabled technology development and commercialization of energy in domestic markets.

Figure 5.3 illustrates the commercialization process of new energy technologies, with the incremental support for existing technologies and policy measures for new technologies. As Lund (2009) explains, there is a learning curve associated with the commercialization process that decreases the unit cost with the increase of volume. The market breakthrough is the point when the new technology becomes competitive against traditional sources of energy in terms of cost.

The policy measures for new technologies can encompass research and development subsidies (grants, loans, guarantees, tax releases, etc.) to foster innovation and market deployment support (quotas for renewables, green certificates, etc.) (Lund, 2009).

One important aspect for new entrants is the strategic positioning. Lund (2009)

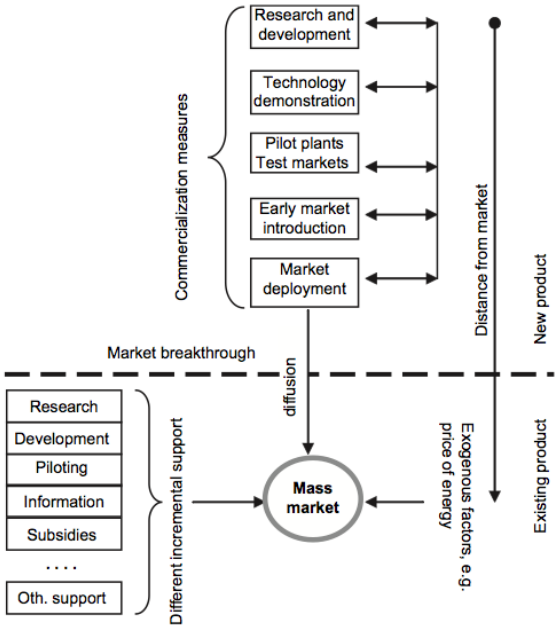

Figure 5.3: Illustration of the commercialization process of new energy technologies (Lund, 2009).

highlights the importance of exploiting the organization's strengths or establishing itself in places where the domestic policies create an advantage. Lund (2009) also observes that vertical integration on a global scale for solar and wind energies is increasing.

Painuly (2001) identifies some criteria for selection of renewable energy technologies considering geographical location, and then some strategies to assess barriers for market penetration. It is relevant for new entrants, since it takes into account several categories of barriers, like market distortions, economic, institutional, technical and cultural, etc. This analysis also include stakeholder management to identify barriers and measures to overcome them.

Stenzel and Frenzel (2008) also address barriers for diffusion of renewable energy technologies, but specifically those created by incumbent utility companies. These utility companies have influence on policy makers, and that can result in policies that prevent the diffusion of renewable energy technologies. Stenzel and Frenzel (2008) develop an analytical framework, based on the dynamic capabilities of the firm and on corporate political activities, to explore firms' technology and political strategies in the wind

power industry in the United Kingdom, Germany and Spain.

Stenzel and Frenzel (2008) review how the development of the wind power market developed in these countries and how companies entered the market. For example, in Spain, two different entry methods were used. Iberdrola used projects in partnership with the local government to enter the market, combining acquired wind turbine technology and its own capabilities in engineering and services. HC Energia used acquisitions to enter the wind development market.

Chapter 6

Theoretical Framework

The theory-based framework is developed using the concepts from Chapters 2, 3 and 5, and in the context described in Chapter 4. In order to integrate these concepts, a model for organizational change process is also used. This model was chosen for its simplicity and fit to the scope of this work.

Hodge et al. (1996) present a Planned Organizational Change Process, which consists of a cycle of twelve steps. In summary, it consists of identifying, monitoring and analyzing opportunities inside and outside the organization, setting a vision and goals, determining a plan to reach the goals and vision, evaluate, adjust and implement plans. The idea is that this is not a linear process, but rather an iterative one that needs to be suited to the organization's situation.

In this process, there is an identification of environmental and internal conditions, assessment and planning to align current conditions with the organization's goals, select change goals, tactics and program, evaluate and implement plans. These main steps could also be used to analyze how oil companies can adapt to a different market, such as renewable energy. Figure 6.1 illustrates the Planned Organizational Change Process.

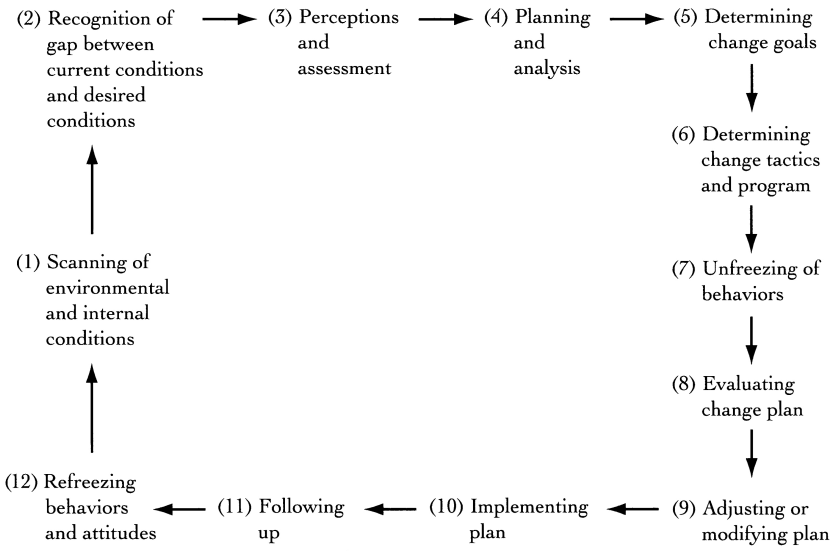

Figure 6.1: Planned Organizational Change Process (Hodge et al., 1996).

Hodge et al. (1996) also proposed an organizational learning perspective to promote organizational change, as an attempt to create an organization that continuously monitors and adapts to the environment. This perspective is based on Senge (1990), but synthesized into five main attributes of a learning organization:

- Develop systematic approaches to problem solving (learning from experience, learning from best practices of others, etc.);
- Develop the ability to "think outside the box" (override past mental models and experiment);
- Develop personal mastery of skills;
- Transfer and disseminate knowledge throughout the organization (knowledge, information and skills should not be hoarded or hidden in the organization);
- Develop and pursue a shared vision of the organization.

It can be concluded that these attributes can help in the absorption of new capabilities and integration of new technologies in the organization. Considering the scope of this work, the development of systematic approaches to problem solving can be done by learning from the experience of other companies that develop renewable energy technology or operate in this business; the development of the ability to override past mental models is necessary to start thinking in how to solve problems in the new environment and not bounded by the frames of the old environment; the development of personal mastery of skills refers to the individual learning, which can be combined with the dissemination and transfer of knowledge, skills and information to contribute to organizational learning; and the pursuit of a shared vision enables the organization to change in a specific direction.

The proposed framework combines the concepts presented before for O&G companies to analyze options when entering new markets in the energy sector and to map adequate actions to achieve strategic goals. The framework assumes that organizational learning has a positive effect on organizational adaptability and that the organization aims to enter a new market.

The framework is based on Hodge et al. (1996)'s organizational change process combined with Teece et al. (1997)'s dynamic capabilities to achieve adaptation. It starts with an identification of the organization's vision and alignment to its strategy and goals, in a top-down approach to the organization. Then, the gaps between desired and current conditions are identified to analyze what type of market opportunities could align these conditions. Next it is necessary to identify actual market opportunities and select the options that could be more advantageous for the organization. The market opportunities selected need to be aligned with the organization's goals in terms of geographical location, market positioning, level of uncertainty and risks, etc.

The same analysis is carried out with the resources of the organization to align the organization's capacity to the resources needed to achieve its goals. The financial resources may determine which market entry options the organization will select. Some opportunities may be too resource-consuming for the organization to pursue. Analogously, the identification of the gaps between desired and current capabilities is nec-

essary to elaborate a plan to align these conditions. If the organization does not have enough capabilities to carry out internal research to develop a technology, it will need to access available technology to enter the market. Next, the most adequate organizational learning tool can be identified and selected to achieve the organization's desired condition through acquisition or development of new capabilities and knowledge.

The figure below shows the framework for adaptation in the energy sector through new market entry. It does not specify other environmental aspects of the analysis, such as policies and government influences, regulations, etc., which can be identified using the risk identification, analysis and management capabilities already possessed by most oil companies. The political and regulatory aspects are usually monitored by oil companies regarding the O&G industry, but that monitoring structure and processes could be adapted to deal with the renewable energy market.

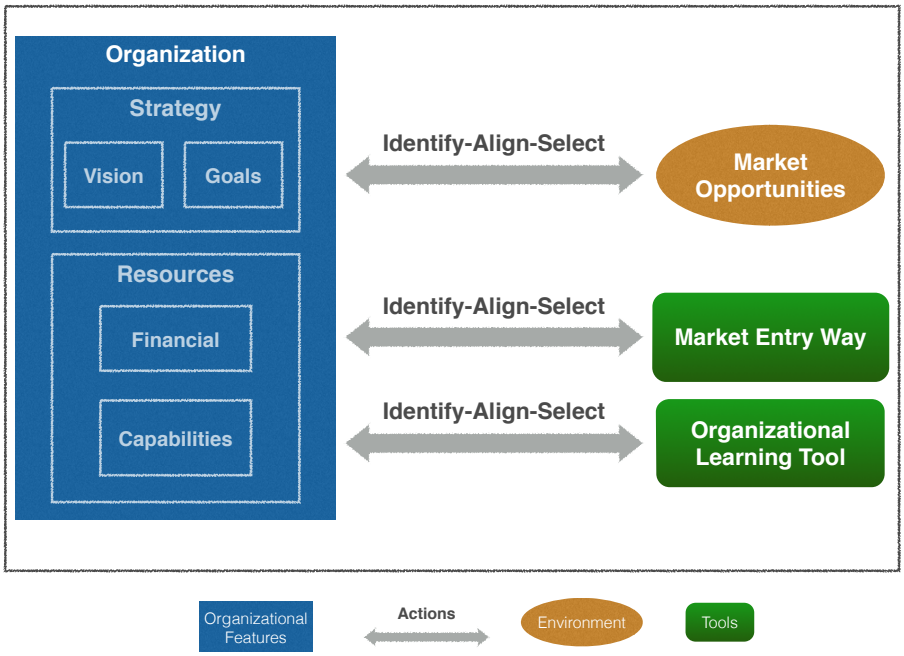

Figure 6.2: Framework for Adaptation in the Energy Sector.

The framework considers that the set of capabilities possessed by the organization can change depending on the goals and strategy. And that organizations already have or

could adopt organizational learning practices so that these capabilities can be exploited to the advantage of the company.

The first step of the framework is important because conflicting vision, strategy and goals can lead to confusion in the organization. The vision should motivate and provide direction to the strategies that the organization implements and to the goals that it aims to achieve. If strategy and goals are not consistent with the vision, either the vision should be revised or the strategy and goals need to be re-evaluated. In some cases, there can be a temporary change in strategy and goals, for example, when environmental conditions change. That is the current situation of the O&G industry. Most oil companies had to adapt and deviate from their strategy in order to deal with the low oil prices. That means cutting costs, postponing investment projects, restructuring the portfolio, and revising their goals. However, it should be acknowledged that it is a temporary deviation and as soon as possible the company will go back to pursuing its vision. Otherwise, a review of the corporate vision should be carried out.

The second step of the framework addresses the identification of market opportunities that are aligned with the company's strategy. This is the initial strategic analysis that scans the environment to figure out what are the options available in the market. Since the number of possibilities may be larger than the organization is capable of assessing, the strategy and goals of the organization can help narrow down the number of options. The strategy can specify what types of markets the company is interested in looking at or what state of development the market should have for investing. For example, the company may be interested in profitable markets, which means that the opportunities that align to the strategy are those that have commercially available technology. The company can narrow the search and look for technologies that have been proven profitable.

The third step of the framework relates to the alignment between the conditions inside and outside the organization. It requires a thorough evaluation of internal resources, that enables a realistic assessment of the gaps that the organization needs to address. The financial resources to complete an acquisition, for example, need to be carefully identified assessed. It involves the estimation of fair value, how much the or-

ganization can spend and how much it will cost to integrate the acquired company to the organization. That also applies to capabilities. The organization needs to identified which capabilities and knowledge it is gaining with the acquisition, and if they can be integrated in the organization. The analysis of cost against benefits should also consider the competitive advantage that the organization can have with the operation, such as entering a market that has a high entry barrier that limits the number of competitors in the business. The resources possessed by the organization may also limit the market entry ways. If the organization already has a large number of financial commitments, it may not have the conditions to make an acquisition, and perhaps the only option is to access technologies through funding of projects.

The fourth step of the framework can be the most difficult to implement. It is the alignment of current and desired capabilities, and it is most likely also the alignment of different cultures, processes and structures. In the case of external projects (with an open innovation strategy), it means acquiring and incorporating the knowledge from an external source to develop new skills or capabilities. There are several challenges in this exchange. The workers from both sides need to be open to learning and sharing knowledge, the conditions for transfer of tacit knowledge should exist, the organization should have systems or processes in place to acquire, store and share the new knowledge in the organization, the employees need to be aware of what they need to accomplish in this process, as well as other challenges. There are also contractual factors that can influence the flow of information, since intellectual property is involved. It is important that the conditions are favorable inside and outside the organization. If this step of the framework is not successfully implemented, the goals may not be achieved, as it will not result in the development of capabilities and knowledge that lead to a sustainable competitive advantage for the organization.

There are some examples from the literature that point to the applicability of this theory-based framework. An example provided by Stenzel and Frenzel (2008) shows the importance of the alignments in the framework. German utility companies did not enter the wind power market because they had a negative experience with research and development, the initial small scale of wind power did not match their strategy and

business model, and the design of the laws were a barrier for use of local knowledge and grid ownership for these developments. So their initial choice for entering the market (through research and development) was not aligned with their resources, the market opportunities were not aligned to their strategies and the market environment did not allow them to exploit their capabilities.

On the other hand, British Gas/Centrica realized that it could leverage its offshore gas capabilities in the offshore wind sector and acquired six offshore wind projects. Their way of entering the market was aligned with their resources and the opportunity was in line with their strategy. Another example of successful adaptation is Gamesa, a subsidiary of Iberdrola (Spain's second largest utility company). Gamesa originally produced aeronautical and automobile components but they secured a licensing agreement with Vestas, a Danish wind turbine manufacturer, to build turbines in Navarra, Spain. They became an important player in the wind power market in Spain. (Stenzel and Frenzel, 2008)

Chapter 7

Case Study - Statoil

Oil companies have different strategies concerning renewable energy. Csomós (2015) argues that Shell and Chevron are in the renewables market mostly for advertising value, and ExxonMobil and BP have not found a profitable and sustainable way of staying in the renewables market. From the oil companies analyzed by Csomós (2015), only Total could be considered a significant player in the global renewable energy market.

Statoil is an international energy company based in Norway, established in 1972, with current operations in 37 countries. Their aim is to meet the demand for energy necessary for economic and social development, while considering the environment and making active efforts to combat climate change. The main shareholder of the company is the Norwegian Government, with 67% of the shares in March 2016.(Statoil, 2016b)

Statoil's operations include upstream, midstream and downstream activities, as seen in the figure below, but in 2012 Statoil divested from the service stations business. Statoil also participates in projects related to offshore wind energy and carbon capture and storage. (Statoil, 2015a)

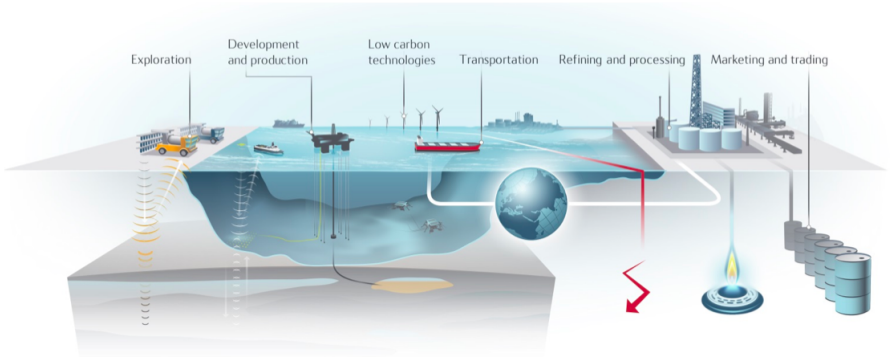

Figure 7.1: Statoil's value chain. (Statoil, 2015b)

Statoil had NOK 966.7 billion in total assets in 2015, with net loss of NOK 37.3 billion due to lower oil prices, and it produced 1,971 million barrels of oil equivalent per day. To adapt to a more challenging environment in the O&G business, Statoil implemented cost reduction and efficiency improvement measures, having saved US$ 1.9 billion so far. (Statoil, 2015a)

The following sections describe Statoil's strategy, resources and actions regarding renewable energy, with publicly available information from the period between 1996 and 2015. The scope is limited to the elements that are part of the framework presented in the previous chapter.

7.1 Strategy

Up until 1999, Statoil's strategy regarding climate change was limited to reduction of greenhouse gas emissions, which limited the company's actions to promote operational efficiency and to develop carbon capture and storage (CCS) technology. In 1999, the scope of Statoil's strategy on sustainability started to change, with the company entering the bio-energy market by acquiring wood pellet manufacturing plants in Norway and Sweden. (Statoil, 1999)

In 2000, the company endorsed the United Nations Global Compact and sustainable development became part of Statoil's internal strategic discussions. Statoil started publishing its Sustainability Reports in 2001, when its share trade began at the Oslo

Stock Exchange and the New York Stock Exchange. At that time, Statoil did not have a clear statement on how the company would operate in alternative energies. (Statoil, 2000, 2001a,b)

Until 2006 the company's position on renewable energies was focused mainly on CCS technology, bio-energy and hydrogen fuel cells. Statoil's strategy changed in 2007, the same year of the completion of the merger with Hydro, to focus on "creating a platform for new energy", which includes wind power and biofuel technologies, to create a profitable business and reduce emissions. The technology strategy continued to be upstream-focused, but integrating technology into value chains, the exploitation of oil sands, carbon management and renewable energy sources also became important. (Statoil, 2007)

In 2007, Statoil's Technology and New Energy strategy was (Statoil, 2007):

- To achieve profitable growth in the sale of wind power and bio fuels. For wind power, there are short-term opportunities in land-based and near-shore developments. In the longer term, the development of technology for offshore wind power may pave the way for the supply of renewable power on a large scale;
- In bio fuels, the main focus is on traditional (first generation) bio diesel and bioethanol, with the emphasis on documented sustainable production. In the longer term, synthetic (second/third generation) products and processes are being investigated;
- To sustain its position as a leading industry player in carbon capture and storage. Building on the Kyoto mechanisms (e.g. the Clean Development Mechanism), Statoil intends to reap the benefits of its carbon dioxide expertise;
- To explore the potential of hydrogen and other renewable energy technologies as additional areas for long-term, profitable growth.

In 2008, the company stated in their annual report their intent to "build a portfolio of near-shore wind parks and develop technology for large scale offshore wind power generation", but Statoil's general strategy has remained the same as of 2007. (Statoil, 2008)

In 2011, Statoil changed its vision to "Crossing Energy Frontiers", and its strategy had the following foci (Statoil, 2011a):

1. Revitalising Statoil's legacy position on the Norwegian Continental Shelf (NCS);
2. Building offshore clusters;
3. Developing into a leading exploration company;
4. Stepping up our activity in unconventional resources;
5. Creating value from a superior gas position;
6. Continuing portfolio management to enhance value creation;
7. Utilising oil and gas expertise and technology to open new renewable energy opportunities.

Currently, Statoil's vision is "to be one of the leaders in our industry that is shaping the future of energy. We will know that we have been successful with our strategy when we are: Staying competitive at all times; Transforming the oil and gas industry; Providing energy for a low carbon future." (Statoil, 2015b)

Statoil's strategy pursues the following goals (Statoil, 2015a):

1. Deepen and prolong its position in the NCS (its main upstream operation for oil and gas);
2. Grow material and profitable international positions (international production currently represents approximately 37% of production);
3. Pursue focused and value-adding midstream and downstream, especially through continuous improvement within health, safety and environment, efficiency and costs;
4. Provide energy for a low carbon future (New Energy Solutions business was created in 2015 to further access, develop, and produce low carbon energy);

5. Research, development and deployment of technology to unlock opportunities and enhance value (aimed at reducing upstream costs and greenhouse gas emissions).

Statoil's response to climate change includes (Statoil, 2015b):

- Climate policy: supporting the development of viable policies and regulatory frameworks to accelerate an orderly transition to a low-carbon economy;
- Climate risk and portfolio resilience: ensuring that Statoil's business model evolves in parallel with the energy transition, allowing the use of low-carbon solutions as an opportunity rather than a threat, while monitoring the regulatory, market, technological and physical impact of climate change;
- Emissions management: prioritising maximum carbon efficiency and energy savings across the entire value chain, linked to executive compensation;
- Low-carbon technologies: harnessing technological capacity to develop and explore a broad array of low-carbon energy solutions.

7.2 Resources

Statoil's resources can be divided into three main categories, for the purpose of this analysis using the proposed framework: relationships, capabilities and infrastructure, and investments. Using Nicholson et al. (1995)'s definitions of types of resources, relationships are an organizational resource, capabilities are a human resource, infrastructure is a physical resource and investments are a financial resource.

7.2.1 Relationships

Statoil's "Powering collaboration" agreement with General Electric (GE) aims to accelerate the development of more sustainable energy solutions by addressing carbon dioxide and methane emissions, water usage and energy optimisation of operations. Leveraging the companies' collective resources and competences, the program focuses on developing new approaches to create efficient, low-cost technologies that can be broadly

implemented. The partnership is using crowdsourcing to reach out to innovators around the world to source ideas, which will result in more relationships developing over time. (Statoil, 2015a)

In 2015, Statoil produced oil and gas in 11 other countries: Algeria, Angola, Azerbaijan, Brazil, Canada, Ireland, Nigeria, Russia, the United Kingdom, the United States, and Venezuela (Statoil, 2015a). The presence in these countries can be used to explore opportunities internationally, especially in countries with high potential for renewable energy and has been under-developed.

Statoil participates in partner-operated fields, which accounts for approximately 11% of Statoil's total oil and gas production on the NCS. These fields are operated by Shell, BP, ConocoPhillips and Lundi. In other countries, Statoil has equity interest in fields operated by Chevron, Anadarko, Suncor, Total, ExxonMobil, BP, Sonangol, etc. (Statoil, 2015a)

The major export markets for gas from the NCS are Germany, France, the United Kingdom, Belgium, the Netherlands, Italy and Spain. Statoil's longer term customers include large national or regional gas companies such as ENGIE, ENI Gas & Power, British Gas Trading (a subsidiary of Centrica), RWE and GasTerra. (Statoil, 2015a)

Statoil's global procurement originates from approximately 12,000 active suppliers. The Procurement and Supplier Relations group encourages and facilitates collaboration with suppliers through communication and supplier relations management. The procurement strategy is to increase diversity, competition and flexibility in the market to better utilize industry capacity and expertise. (Statoil, 2015a)

Cooperation with external environments plays an important role for research and development and Statoil has an Academia program which coordinates cooperation with Norwegian and international universities. (Statoil, 2015a)

7.2.2 Capabilities and Infrastructure

Statoil's technical capabilities are expanding to meet the challenges of the New Energy Solutions business area for renewable and low carbon energy solutions. Technology development is conducted in-house, in collaboration with suppliers and through venture

activities. A key technological focus area is finding more efficient ways of producing clean energy, particularly by reducing costs in the areas of construction and maintenance for both fixed and floating offshore wind applications. (Statoil, 2015a)

Statoil's capability in offshore operations can be used for offshore wind development projects. Statoil's production in the NCS represented about 62.5% of total equity production in 2015, and they have been operating there since the 1970s (Statoil, 2015a). Statoil's knowledge of local conditions and environmental requirements, and existing infrastructure are important resources for development of offshore wind projects.

Statoil has been developing research on CCS technology since 1996. The carbon dioxide and carbon monoxide emissions are reduced by liquefying and transporting these gases for injection into a storage reservoir. The use of CCS technology in Sleipner and Snøhvit allows the continuous improvement of the operations for use in other projects. The accumulated volume of carbon captured and stored from these two assets was some 19.5 million tonnes by the end of 2015. (Statoil, 2015a,b)

In addition to the refinery, the main facilities at Mongstad consist of a crude oil terminal, a natural gas liquids processing unit and terminal, and a combined heat and power plant. The Mongstad Heat and Power Plant has a capacity of approximately 280 MW of electric power and 350 MW of process heat. (Statoil, 2015a)

Statoil's employees are encouraged to take responsibility for their own learning and development, continuously building new skills and sharing knowledge, supported by the Corporate University. Over the past few years, traditional classroom courses were replaced with more flexible forms of training such as e-learning and targeted on-the-job learning. The purpose has been to increase the learning impact and cost efficiency of the training portfolio. (Statoil, 2015b)

7.2.3 Investments

In 2000, Statoil spent NOK 4 million on research and development of renewable products, which is insignificant compared to the company's total investment of NOK 10.7 billion. In 2015, low carbon research and development expenses were NOK 258 million in energy efficiency and methane reductions, and NOK 216 million in CCS and renew-

ables. In relation to total capital expenditures in 2015, the investment in low carbon research, CCS and renewables are equivalent to 3.2%. (Statoil, 2000, 2001b, 2015a,b)

It should be noted that Statoil reported a loss of NOK 37.3 billion in 2015, in contrast to a profit of NOK 22 billion in 2014 and a profit of NOK 39.2 billion in 2013. (Statoil, 2015a)

In the Dudgeon Offshore Wind Farm, Statoil's investment share is NOK 5.5 billion. This project was sanctioned in 2014 and will start operating in 2017. (Statoil, 2014)

In February 2016, Statoil launched a new energy investment fund dedicated to investing in attractive and ambitious growth companies in renewable energy, supporting its strategy of growth in new energy solutions. The new fund, Statoil Energy Ventures, will invest up to USD 200 million over a period of four to seven years. (Statoil, 2015a)

7.3 Market Opportunities and Entry Ways

In 1999, Statoil acquired wood pellet manufacturing plants in Sweden and Norway to move into the bio-energy heating market. They also started cooperating with Northwest Power Systems (United States) and Methanex (Canada) to test methanol-driven fuel cells for power and heat production. In 2001, they had two pilot projects to establish the suitability of fuel-cell solutions for households and industry. At that time, Statoil focused on carbon management, biofuels and hydrogen fuel-cell energy. Statoil joined the HyNor project in 2004, to establish hydrogen filling at service stations and enable the use of hydrogen-fuelled cars. (Statoil, 1999, 2001b, 2004)

In 2006, Statoil joined in a project with Hammerfest Strøm AS, a technology developer for tidal energy. The company developed and installed a 300 kW prototype, which was the world's first tidal turbine to deliver electricity directly to the land grid. Statoil took interest since some of the O&G technologies that the company had could be applied to this type of renewable energy. (Statoil, 2006)

In 2007, Statoil acquired 42.5% of Mestilla, a production facility of 100,000 tones per year of rape seed biodiesel in Lithuania. (Statoil, 2008)

In 2008, Statoil changed their focus away from hydrogen fuel cells and started to invest more in offshore tidal energy, with the early phase of the Sherringham Shoal wind

project and approval for the construction of the Hywind offshore wind turbine demonstration project. In order to access complementary offshore wind technologies, Statoil acquired equity positions in Sway AS and ChapDrive AS. Pelamis, a wave energy device in which Statoil has invested, was the technology chosen for the world's first wave energy park situated off the Portuguese coast. In addition, it has been selected for other new projects in the UK. Hammerfest Strøm AS, a tidal power technology company in which Statoil participated with Iberdrola/Scottish Power, was selected to be used in projects planned by Scottish Power. (Statoil, 2008)

In 2008, Statoil invested in Brightsource Energy, which develops technology for concentrated solar thermal power, and the Iceland Deep Drilling Project, which is a joint-research program within deep geothermal energy in Iceland. (Statoil, 2008)

Also in 2008, Statoil signed an agreement with ONGC, an Indian oil company, to jointly explore the potential of developing CCS and clean development mechanism projects in India. (Statoil, 2008)

Statoil is a non-operating partner in the Scira consortium (40% by Statoil, 40% by Statkraft, and 20% by the United Kingdom Green Investment Bank) which, in 2013, started producing electricity from the Sherringham Shoal offshore wind park in the United Kingdom. The park has an installed capacity of 317 MW from 88 turbines. (Statoil, 2013, 2015a)

In October 2015, Statoil sanctioned Hywind Scotland Offshore Floating Test Park in Scotland; Statoil's ownership share is 100%. The park will have a total installed capacity of 30 MW and planned production start-up is 2017. The Hywind Scotland pilot project was developed after Statoil's 6 years of experience operating Hywind Demo, the world's first full-scale floating offshore wind turbine, with capacity of 2.3MW. The Dudgeon Offshore Wind Park sanctioned in 2014 is expected to be in full operation by 2017; Statoil's ownership share is 35%. The park will have a total installed capacity of 402 MW, with 67 turbines. The Forewind consortium, comprising Statoil, Statkraft, RWE and SSE, all with a 25% owner stake, continues to mature projects and has received consent for four 1.2 GW projects in the Dogger Bank Area off the United Kingdom east coast. (Statoil, 2015a)

Statoil monitors emerging technologies to assess their potential impact on the future energy landscape. This includes onshore wind, solar energy and energy storage technologies, but in a longer time perspective it also includes the development of more immature options such as hydrogen value chains, new carbon dioxide utilization technologies and new marine renewable energy solutions. (Statoil, 2015b)

The Powering Collaboration program with GE has nearly 20 ongoing projects, including new technologies in both offshore and onshore operations. Projects include the development of a lighter, more compact compressor engineered to deliver more power and lower emissions as well as more competitive solutions to capture energy from heat generated in operations. Other projects include piloting a new methane emission monitoring system and testing a new water treatment technology that uses oilfield wastes to treat water, produce electricity and capture carbon dioxide. The partnership is using crowdsourcing to find innovators and the first two open innovation challenges addressed reduced use of sand and water in onshore shale operations. GE Oil & Gas and Statoil will help fund the commercial development of the winning approaches. (Statoil, 2015b)

7.4 Organizational Learning

Statoil has a management system that defines how employees lead and perform their activities. The management system has three main objectives (Statoil, 2016a):

1. Contribute to safety, reliability and efficiency of operations, as well as comply with external and internal requirements;

2. Incorporate organizational values and leadership principles in the company's activities;

3. Support business performance through high-quality decision-making, execution and continuous learning.

One of the recommendations is to propose or suggest improvements on how to perform tasks, based on collective learning and experience in the organization, in order to

promote standardisation. Employees are expected to take responsibility for their own learning and development, to continuously build new skills and to share their knowledge, as can be seen in the figure below. (Statoil, 2016a)

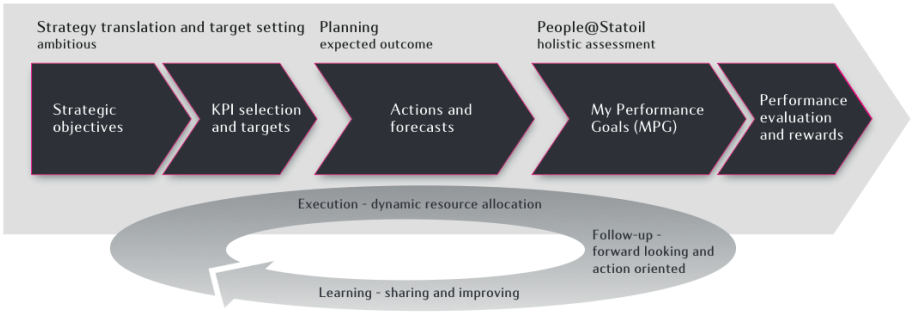

Figure 7.2: Statoil's "Ambition to Action" Performance Process. (Statoil, 2016a)

The performance process emphasizes the role of individuals in the implementation of the organizational strategy. Learning is linked to performance goals so that employees can be held accountable and evaluated, and team members are encouraged to help each since behavioral performance is also part of the program. (Statoil, 2016a)

Other practices described in the management system are (Statoil, 2016a): evaluation of results from activities with the objective of extracting lessons and improving processes; documentation of results, findings, actions and learning to improve systems; implement lessons learned to improve safety measures; share best practices throughout the organization; identify knowledge and experience in the organization that may contribute to the understanding of tasks, risks and execution (identification of expertise); manage risk through in-depth knowledge of suppliers, customers, partners and markets.

Considering how the management system integrates learning in the routines and activities of the organization, Statoil exhibits some attributes of learning organizations, as defined by Senge (1990) and Hodge et al. (1996).

Statoil conducted a research program to analyze the consequences of the merger with Hydro, which was completed in 2007. The objective was to draw lessons from the experience and add these conclusions and recommendations to the knowledge base, so

that they are available if another merger or organizational change is necessary. (Statoil, 2011c)

One of the topics developed in the research is knowledge sharing, since new operational models had to be developed in the integration. The challenge was to create a common understanding on how to work, since employees came from two different organizational cultures. Statoil uses formal professional networks, like communities of practice, where employees can exchange information and share experiences between local units. According to the research group, employees perceived these professional networks as favorable to improve business units and to their own professional development. The use of professional networks was also a challenge in the integration, since Hydro's culture was different and the use of networks was not as structured as in Statoil. After the merger, employees from Hydro expressed similar perceptions regarding favorability of the use of professional networks.(Statoil, 2011c,b)

Chapter 8

Discussion

The application of the framework will be based on the year 2007, since there was a significant change in the organization's strategy. The merger with Hydro and pressure from stakeholders probably had an influence in this decision to focus on the creation of a platform for new energy. Considering how radical the changes were due to the merger, the relevance of Statoil's statements concerning climate change may have been overshadowed.

In terms of strategy, Statoil lacks a clear vision, as defined by Wit and Meyer (2014). But the strategy platforms presented for each business area are clear regarding the type of investments and opportunities the company intends to pursue (Statoil, 2007). In relation to a transition from fossil to renewables, Statoil intends to be somewhere in the middle, with some participation in renewables, but understanding that the business is still not profitable enough and sustainable. The focus remains clearly on upstream activities.

But as long as renewables are concerned, the strategy changed in 2007 to put forward initiatives based on offshore wind power technology (Statoil, 2007). At that time, before the financial crisis of 2008, Statoil had a strong financial position. The price of oil was rising, from approximately US$63 per barrel in 2006 to US$70 per barrel in 2007, and the group's net profit was NOK44.6 billion (Statoil, 2007). Considering Statoil's capabilities, offshore wind power appears to align with the strategy and internal

resources. Knowledge of offshore operating conditions and risks, floating technology, complex projects, electricity generation, and experience with collaborations and partnerships, are advantages when entering the wind power market.

In 2008, Statoil approved the construction of the Hywind offshore wind turbine demonstration project, Statoil acquired equity positions in wind power technology developers, a wave energy device where Statoil invested was chosen as technology provider in Portugal, and Statoil started the early phase of the Sherringham Shoal wind project (Statoil, 2008). In the same year, Statoil chose different ways of entering the market: the Hywind and Sherringham Shoal projects, acquisition of part of technology companies, and one research and development initiative was chosen to be applied in Portugal. From a strategic perspective, Statoil is engaging in open innovation (through funding and commercialization) to develop new capabilities and compete in a new market (Chesbrough, 2003).

Other activities related to Statoil's strategy in renewables include entering in solar and geothermal energy, through investment in a technology developer and a joint-research program, respectively. In terms of alignment to Statoil's capabilities, it can be concluded that Statoil needs to gain more knowledge and experience in these types of technology, as they do not overlap with Statoil's fundamental business. As to the strategy of sustaining its position as leading player in CCS, Statoil signed an agreement with an Indian oil company to explore potential developments there. (Statoil, 2008)

One of the challenges in the activities to enter new markets is how to incorporate the new knowledge to the organization. Given that Statoil already had attribute of learning organizations, it was a matter of integrating the company's practices to the other end of the relationship, whether it is a company recently acquired or a partner in a research group. The use of professional networks (as a community of practice) is particularly advantageous, since it allows for transfer of explicit and tacit knowledge between members of several groups (for example, to allow interaction between Statoil, different technology developers, representatives from universities and research groups). This is important since the technology is still under development and improving fast, with complementary technologies being applied. The figure below shows where costs can

be reduced to make offshore wind projects cheaper.

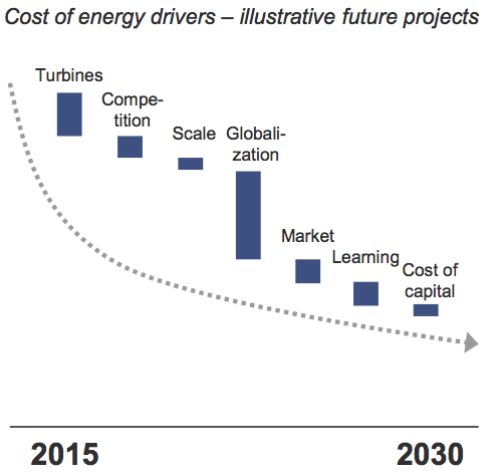

Figure 8.1: Roadmap to reduce costs in future offshore wind projects (Rummelhoff, 2016).

The investment in technology developers and the partnerships to implement projects have the potential to increase the speed of Statoil's development of capabilities, since engaging in the internal development of technology would be time and capital consuming. Also, the diversification in the portfolio of wind power, with projects, operating capacity and research, enables on-the-job learning. Statoil employees can engage in all stages of technology development and identify where their capabilities from upstream activities can be applied. There is valuable interdisciplinary learning in this process for all parties, considering Statoil's experience with complex offshore projects and risk management.

The benefits of learning from projects can be enhanced if the organization institutes learning and knowledge goals in the project planning process (Schindler and Eppler, 2003). Statoil's participation in the early phases of the project can facilitate the acquisition of knowledge and lessons from the project. The model of project-based learning developed by Brady and Davies (2004) is useful if Statoil intends to be a leading player in development, construction and operation of offshore wind power.

The figure below represents the analysis conducted in this section, with the appli-

cation of Statoil's case to the proposed framework.

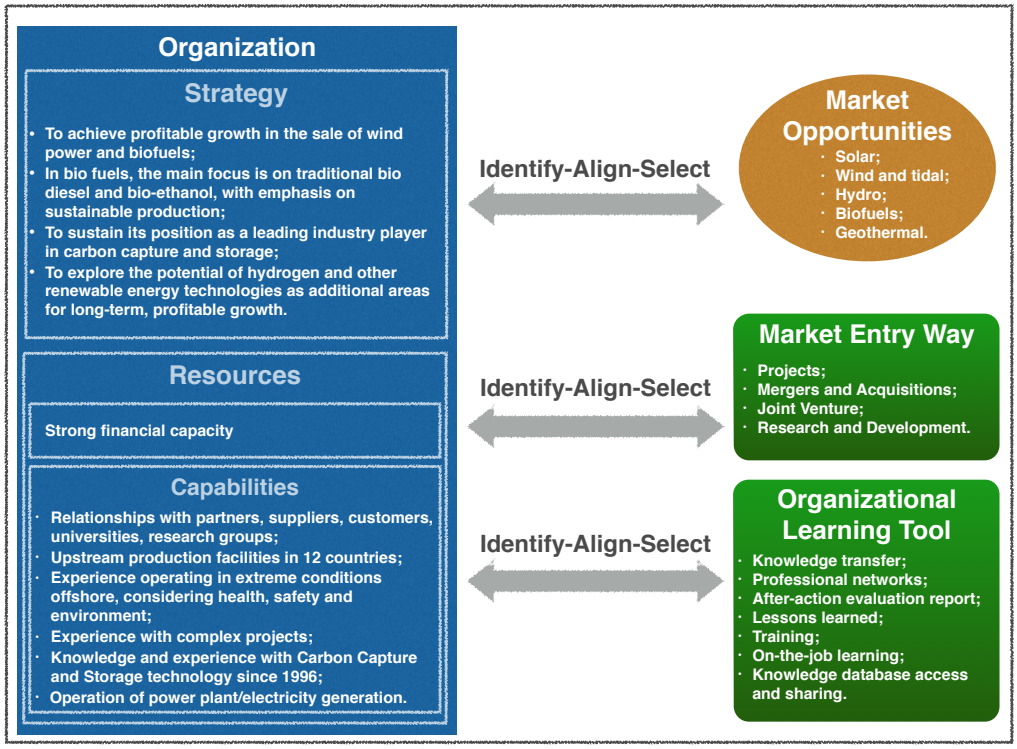

Figure 8.2: Application of the framework - Statoil Case.

It is also important to point out that Statoil is entering the renewable energy markets in different countries, demonstrating how integrated their strategy is to their investment choices. One of Statoil's current goals is to grow its international positions and provide energy for a low carbon future. Considering the portfolio of investments in renewable energy, Statoil may be on its way to achieve the vision of being one of the industry's leaders that shape the future of energy (Statoil, 2015a,b).

Chapter 9

Conclusion and Limitations

The proposed framework presented elements that align with Statoil's case. However, it is a simple framework and provides some topics to be analyzed by O&G companies in the beginning of the organizational change process. It is helpful in the integration of internal features, motivation, and external opportunities. It is simple because a more detailed analysis becomes too specific to each organization, it is not possible to include so many sources of uncertainty, and it is difficult to generalize such diverse market composition.

Regarding the research design, the use of a single-case study as a research method can result in an analytic generalization, but not a statistical generalization (Yin, 2009). Also, there were some difficulties in retrieving information, since the templates of the annual and sustainability reports changed over time. In some years there was more granularity and in others the information was aggregated.

Although this framework appears to be intuitive and obvious, Csomós (2015) presents several examples of oil companies that entered and left the renewables market, and Stenzel and Frenzel (2008) cite some of the difficulties that companies face when entering the renewable energy markets in different countries. It is important to point out that Stenzel and Frenzel (2008) emphasizes the relevance of governmental policies in this market, since regulations and subsidies are still large influences as entry barriers.

One of the crucial points of the framework is the alignment between strategy and

market opportunities. The identification and selection of market opportunities needs to be tactically derived from the strategic goals of the organization, otherwise the activities will not be aligned with the subsequent steps of the framework.

Another crucial point is the development of capabilities through organizational learning. Without this step, the organization does not integrate new knowledge and skills into its resource base. The use of learning tools to increase the knowledge base through project implementation is easier for learning organizations, since learning is integrated in the activities and is spread in the organizational structure. Brady and Davies (2004)'s model for project-learning capability building can be used for more extensive use of projects to transition to renewable energy.

The advantages of building capabilities in the renewable energy sector and applying them in the O&G upstream activities were not addressed in this work, but it would be expected to capture synergies from learning in both directions. The ability to "think outside the box" is, after all, one of the attributes of learning organizations (Hodge et al., 1996).

Since the information used in this work is publicly available, there is a considerable limitation to its use. Most companies avoid publicly acknowledging mistakes, failures, unfavorable facts, especially in areas where there is a strong societal pressure for action. Considering this possibility, Statoil's apparent advantage in entering the wind power market may be fragile and unsustainable. With the currently available information, it does not appear to be so.

However, it is important to consider that the Norwegian Government has 67% of Statoil's shares and therefore has a vested interest in the company's actions. Governmental influence can have positive and negative effects on the organization, but how that influence has changed the outcomes for Statoil was not assessed in this work. The proposed framework does not include political factors, as these actors tend to change frequently and large organizations, including Statoil, constantly monitor political environment to evaluate risks (Statoil, 2016a).

The framework is used in the present work to compare practice and theory from an outsider's perspective. This is relevant for shareholders and investors, for example,

since they do not have access to confidential information. But it can also be relevant for insiders, since it encompasses the strategic and tactical levels of the transition. One of the challenges of promoting organizational change is to communicate to employees where their activities fit in the corporate strategy.

Chapter 10

Further Work

The analysis in this work was done using publicly available information, and the assessment of the framework would benefit from qualitative data from interviews and surveys to understand the process that was used in the beginning of the transition in 2007.

It would be interesting to apply the framework in a multiple-case study with other oil companies that tried to enter the renewables market, such as BP, Shell, Total and ExxonMobil (Csomós, 2015), to analyze where are the divergences and similarities. It would test the boundaries of the framework, as these companies have complex structures and operations. Another analysis would be to use the framework to predict which of the Oil Supermajors would be the most successful in the transition from fossil fuels to renewables, doing the analysis over a period of time.

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