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The role of the Digital Strategic Orientation: a quantitative analysis about its antecedents and relationships with the Absorptive Capacity in the Italian energy sector

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Abstract

Nowadays, with the advent of Big Data and other complex technologies, new potentially disruptive innovations are knocking at the door of the energy sector, pushing firms to face the so called Digital Transformation. This sector is characterized by history: the monopolistic nature and the high barriers to enter the market have led firms within the industry to be not enough flexible to catch up with the new opportunities offered by digital technologies. From the literature is known that the company's ability to innovate is strictly linked to the ACAP construct. Studying its antecedents, the research focuses on the Strategic Orientation which has been declined into the new construct of Digital Strategic Orientation (DSO): it represents the Strategic Orientation of the firm regarding the new emerging technological opportunities and their potential positive effects on the organization's performances and results. It contributes to generate Prior Related Knowledge which in turn fuels the ACAP components. The study analyses the antecedents of DSO by firstly selecting seven major components previously mentioned in the scientific literature and then investigating through a regression analysis their relative effect on the dependent variable. Subsequently, a theoretical framework has been developed by testing seven hypotheses through a survey administered to a sample of 83 Italian companies belonging to the energy sector. Econometric analyses show the different contribution that the seven dependent variables have on the DSO, serving as guidelines for understanding the managerial implication led by the digital transformation. The overall result of the research highlights correlations among respectively the senior management support, acquisition methodologies, existence of a dedicated BU and knowledge sharing practices and the DSO of the firm, supporting in this way the importance to further investigate this construct with future researches.

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1 INTRODUCTION

Digital transformation is a continuous and complex process with the aim of shaping the companies' operations. It impacts on the business model of firms, forcing them to rapidly adapt to new environments and challenges (Matt, Hess, & Benlian, 2015). Definition and implementation of a digital transformation strategy result therefore a critical aspect. Our research aims at investigating the internal strategies of firms to manage the digital

transformation in the energy sector. This sector is strongly characterized by history: it is subjected to high barriers and a sophisticated supply chain due to the monopolistic nature of some segments and a previous domination of big companies protected by ancient legislations (Gitelman, Kozhevnikov, Starikov, & Rada, 2019). With the liberalization of these markets, also the static energy sector started to be affected by many innovations, but the poor flexibility from an operative and strategic point of view creates huge difficulties to face the technological transformation for companies. Nowadays, with the advent of Big Data and other complex technologies, new potentially disruptive innovations are knocking at the door of the energy sector, pushing firms to face the so called Digital Transformation. Virtual and decentralized marketplaces for energy are emerging. The need of digitalization enables new business model and new competitors to enter in the market. So, the incumbents are challenged by newcomers from other sectors such as IT or Telecommunication, but also by innovative and disruptive business models in niches at the grid's edge that might steal conspicuous market share (Löbbe & Hackbarth, 2017).

Thus, the focus of this work will be on the understanding of how companies need to behave to respond to threats and opportunities coming from the environment and how firms in the energy sector are strategically acting in order to catch up with the digital transformation. From literature emerges that the construct of absorptive capacity (ACAP) (Cohen & Levinthal, 1990) linked with the concept of Digital Skills, represents the main mean for incumbents to unlock the potential of emerging technologies (Tu *et al.* 2006). More in details, the research will be focused on four main areas: *ACAP, Strategic Orientation, Digital Skills and new trends of the energy sector*. The first one will be investigated by analyzing the meaning of the construct, concentrating also over the antecedents that influence the development of ACAP and the potential outcomes for firms. With this first part, we can understand how companies can react, from a strategic point of view, to a changing environment.

The second topic refers to one of the direct antecedent of ACAP: Strategic Orientation (SO). This construct symbolizes the strategic direction of the company as a set of values, attitudes and objectives that allows to gather relevant prior knowledge from a technological and market point of view (Zhou, Gao, Yang, research, & 2005). Thus, SO initializes the ACAP processes through which companies can achieve higher performances. In this research, performances of companies and the ability to manage and exploit new digital trends and technologies are directly linked. So, the third topic refers to the construct of Digital Capabilities (Junior, Maçada, Brinkhues, & Montesdioca, 2016), which represent a set of digital skills that unlock new potentialities for companies. The aim of this third focus is to enter the digital environment, understanding the key elements that characterize it. The fourth and last investigation area is the energy sector: here, we will firstly analyze the technologies that are coming closer to this market and how companies are behaving.

Literature presents lots of developments regarding the concept of ACAP but some researchers have understood that more has to be discovered between the innovation process and related performances (Johnson, Martin, & Saini, 2011; K. Z. Zhou & Li, 2010). ACAP represents just a part of the overall picture: it constitutes actually the bridge between Strategic Orientation and Innovation Performances. However, unpacking the SO, it emerges that there are few quantitative researches that address the topic of the Digital Transformation together with a deep analysis of the factors that characterize it. Furthermore, focalizing the attention on the energy sector, one question came out from the analysis: have companies in this sector developed the right SO towards new digital trends? Since the large width of the gap, we decided to focus specifically on those factors that, we think, can potentially affect the strategic direction of a firm. The SO will be declined as *Digital Strategic Orientation* since the Digital Transformation

is significantly relevant for mostly every type of organization, and few are the researches on the required Digital Skills for this technological transition. Digital Strategic Orientation represents the Strategic Orientation of the firm regarding the new emerging technological opportunities and their potential positive effects on the organization's performances and results. It contributes to generate Prior Related Knowledge which in turn fuels the ACAP components.

The study uses the dependent variable "*Digital Strategic Orientation*" (DSO) to evaluate the SO of Italian energy companies towards new digital technologies. The research studies the antecedents of DSO, in particular the impacts of Senior Management Support, Acquisition Methodologies for digital skills, Knowledge Sharing mechanisms and the presence of a Dedicated Business Unit for innovation. The empirical analysis is performed using a sample of 83 Italian energy companies. From a linear regression model the Senior Management Support towards technological scanning activities and investments seems to be the most relevant aspect to foster the digital culture within the energy company. Moreover, the existence of knowledge sharing processes in parallel with dedicated business units is fundamental to address the focus towards new tech trends and generate prior related knowledge. However, from a statistical point of view, not all the Acquisition Methodologies seem to play a crucial role in the development of DSO. Among them, the most impactful results to be Project Outsourcing. Afterwards, those components flow into the ACAP processes which are known to improve firms' innovation performances.

2 LITERATURE REVIEW

By analyzing the papers with a holistic view on the three macro-areas of research, it is possible to identify gaps in the literature. A systematic search procedure (Torres-Carrion, Gonzalez-Gonzalez, Aciar, & Rodriguez-Morales, 2018) to classify and compare the different papers is therefore implemented, starting from the broad topics of ACAP, SO, Digital Transformation and Characteristic of the energy sector. The objective is to find linkages between those categories and, if not present, possible gaps of research. The aim of this section is to investigate the construct and the antecedents of ACAP, the business models that companies should put in place to face the digital trend and the main aspects related to the energy field.

2.1 Paper classification

The first phase of the scientific literature review is characterized by keyword research. These keywords are inserted in search engines such as Google Scholar and Scopus. The main research topics are "Absorptive Capacity", "Strategic Orientation", "Digital Transformation", "Digitalization in the energy sector". The purpose of this first phase is to identify as many papers as possible concerning the thesis research field.

Then a second wave of research is performed, focused on deepening macro areas in more detail. The sub-categories of research are therefore identified: "Performance Analysis", "Coordination Mechanisms", "ACAP antecedents", "Exploration/Exploitation", "Knowledge Management"; "Organizational Capabilities", "Inter/intra Organizational Learning", "Microfoundations of Absorptive Capacity", "Entrepreneurial Orientation", "Market orientation", "Innovation orientation", " Radical Innovation", "Corporate Entrepreneurship", "Technological innovation", "Dynamic capabilities" , "Digital skills", "Digital Technologies ", "E-Business", "Electricity sector".

The process of research, selection, analysis, classification and structuring is shown in *Figure (2).*

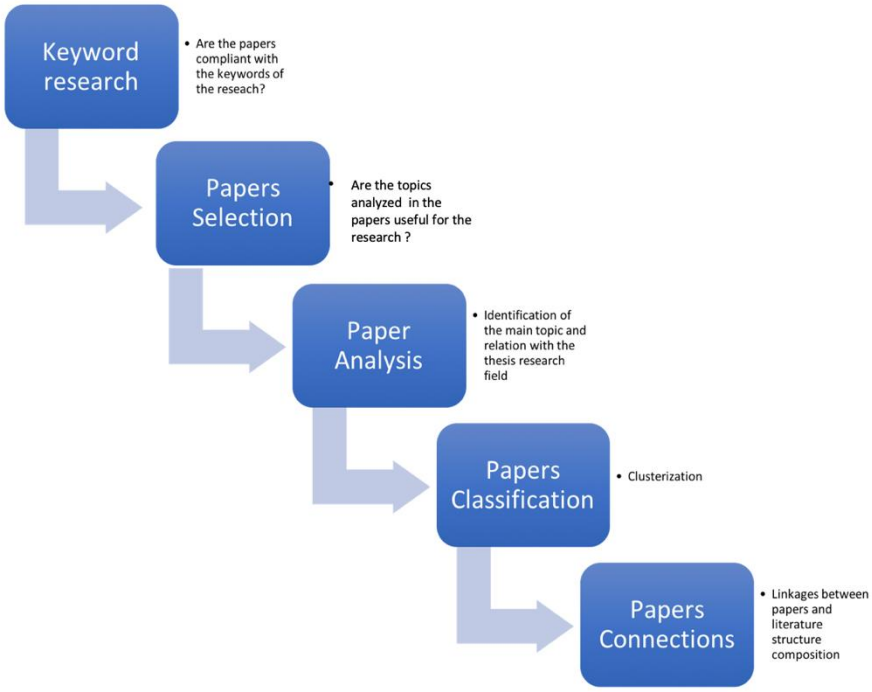

Figure 1 - Systematic search procedure

Each selected article is inserted into a database with the aim of implementing, once the paper is unpacked in sub-categories, a clustering analysis necessary to structure the scientific literature. The paper is broken down into the keywords that characterize it, research question, theory addressed in the article, variables under examination, methodologies, hypotheses and results.

2.2 Literature Analysis: the structure

The structure has been developed using the papers resulting from the first skimming phase:

- SO: Market Orientation, Technology Orientation;
- SO: Antecedents;
- ACAP: construct and general aspects;
- ACAP: processes and conditions necessary for implementation;
- ACAP: multilevel antecedents starting from the bibliometric analysis;
- ANTECEDENTS: introducing factors which influence ACAP;
- ANTECEDENTS: Organizational, Managerial, Inter-organizational, Environmental, Micro;
- ANTECEDENTS: Strategic Orientation;
- OUTCOMES: explicit effects that ACAP has on performances and results of the firm;
- DIGITAL TRANSFORMATION: Digital trends overviews, the role of dynamic capabilities;
- DIGITAL SKILLS: The connection between ACAP and Digital Transformation
- INFORMATION TECHNOLOGY CAPABILITIES (ITC): The mediating effect of the ACAP in the relationship between ITC and E-Business Capabilities;
- MANAGERIAL IMPLICATION: Qualitative and Quantitative approaches;
- THE ENERGY SECTOR: Overview about the digital transformation of the sector;
- THE ENERGY SECTOR: Barriers;
- TECHNOLOGY ENTREPRENEURSHIP: Overview and new possible direction for the energy sector;

- TECHNOLOGY ENTREPRENEURSHIP: Strategies to pursuit innovation;

The papers are classified through a rigorous framework composed by four main areas which are later subdivided in different categories as shown in *Figure (3).*

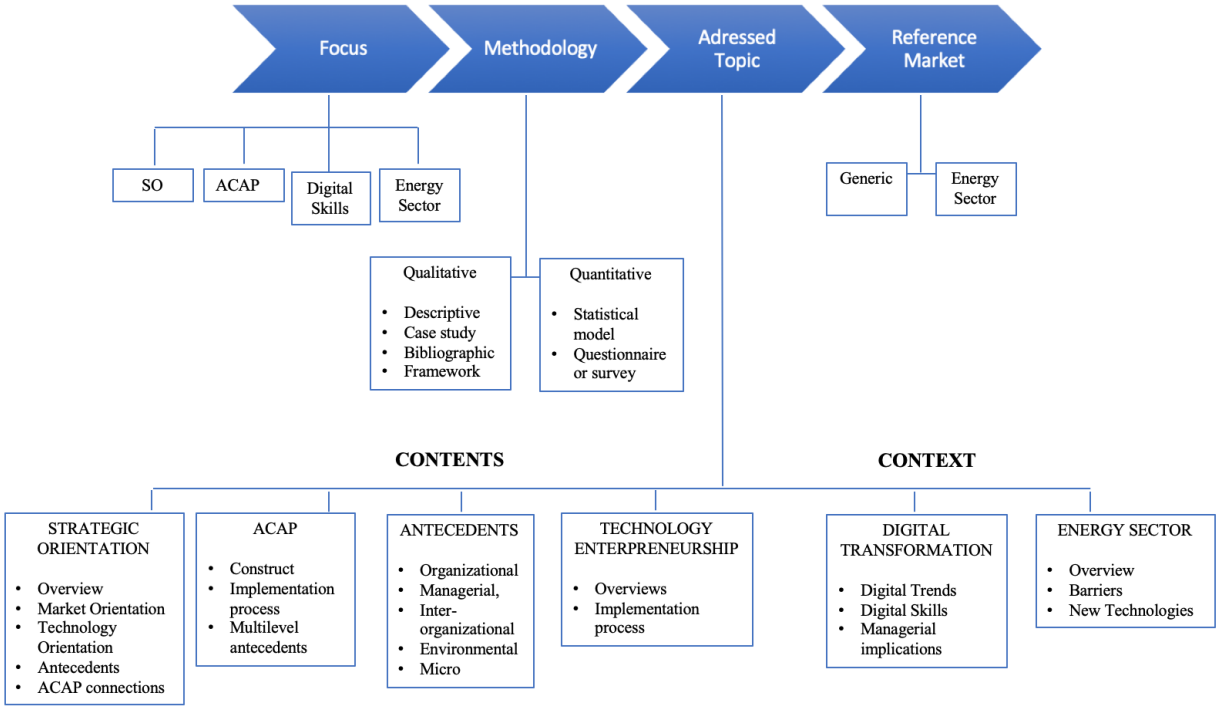

Figure 2 - Structure of the literature analysis

3 LITERATURE ANALYSIS

In this chapter, we provide an overview of the key factors that global scientific researchers are investigating, which characterize the innovation processes and outcomes of competitive firms.

3.1 The concept of ACAP

The actual literature formalizes the importance of developing capabilities to gather specific knowledge from different sources. From this perspective, it's crucial to introduce the concept of Absorptive Capacity (ACAP) (Cohen & Levinthal, 1990) the firm's ability to recognize the value of new knowledge, assimilate it and exploit it for commercial purposes. As stated in the paper, it can provide a competitive advantage for companies by increasing the ability to understand knowledge spillovers and catch innovative trends coming from competitive, adjacent and distant markets of the company itself.

Building around this concept**,** Zahra & George (2002) specified the nature of this construct, recognizing ACAP as a set of organizational routines and processes through which firms are able to process knowledge and develop dynamic capabilities. In particular, they subdivided the main aspects of ACAP, classifying them in two main dimensions: Potential and Realized ACAP. The former represents the receptiveness of the firm in front of new knowledge

opportunities whilst the second one refers to the ability to transform knowledge in real products and services.

Dimension /Capabilities	Components	Role and Importance	Citation
Acquisition	• Prior Investments • Prior knowledge • Intensity • Speed • Direction	• Scope of search • Perpetual schema • New connections • Speed of learning • Quality of learning	Boynton, Zmud, & Jacobs (1994); Cohen & Levinthal (1990); Keller (1996); Kim (1998); Lyles & Schwenk (1992); Mowery, Oxley, & Silverman (1996); Van Wijk, Van den Bosch, & Volberda (2001); Veugelers (1997)
Assimilation	• Understanding	• Interpretation • Comprehension • Learning	Dodgson (1993); Fichman & Kemerer (1999); Kim (1998); Lane & Lubatkin (1998); Szulanski (1996)
Transformation	• Internalization • Conversion	• Synergy • Recodification • Bisociation	Fichman & Kemerer (1999); Koestler (1966); Kim(1997b,1998);Smith &DeGregorio (in press)
Exploitation	• Use • Implementation	• Core competences • Harvesting resources	Cohen & Levinthal (1990);Dodgson (1993); Kim(1998);Lane &Lubatkin(1998); Szulanski (1996);Van den Bosch, Volberda, & de Boer (1999);Van Wijk, Van den Bosch, &Volberda (2001)

Table 1 - ACAP components, Zahra and Gerard George (2002)

Deep diving into the construct, Lewin & Massini (2011) formalized the concept of meta-routines: they represent the expression of ACAP in a practical way, how actually the construct works inside the organizations. Indeed, there are two kinds of meta-routines: the internal ones, which are focused on the management of processes regarding internal variation, selection and replication (practices like knowledge sharing, selection regimes, etc.), whilst the external ones cover the management of processes that aim to look at the environment and assimilate from it (management of external stakeholders, learning practices, etc.).

By looking at general implications of ACAP and its deployment, Vasudeva & Anand (2011) analyzed three concepts: portfolio alliances, technological diversity (Latitudinal ACAP) and

technological distance (Longitudinal ACAP). By processing the interactions between them, it comes out that there is an inverted-U relationship between the technological diversity inside the alliance portfolio and its knowledge utilization outcome. Moreover, from the study emerges that there is a negative interaction between the company's latitudinal and longitudinal absorptive capacities. Indeed, when the technological diversity in the firm's alliance portfolio is high, knowledge utilization reaches its highest levels at a lower technological distance between the firm and its alliance portfolio, and vice versa. Thus, basically companies have to reflect over the so called 'cognitive distance' when they choose partners and, in general, stakeholders, balancing them in order to create a structured portfolio that enables firms to absorb the right knowledge.

A holistic overview of the concept has been developed during the years, with studies that span across the diverse internal boundaries of ACAP, converging to the importance of Dynamic Capabilities to face the changing conditions of environments. In particular, authors highlighted the value of learning processes under the development of ACAP, discerning different categories: the Exploratory Learning, which encompasses activities such as Recognize (scan and monitoring) and Assimilate (absorption of knowledge); the Transformative Learning, which refers to activities like Maintain (retaining, store, share and communicate knowledge) and Reactivate (catch up opportunities relying on the existing knowledge); lastly the Exploitative Learning, which comprises activities such as Transmute (combine new and existing knowledge) and Apply (implementation of knowledge or technologies in new products or services).

Defined those different aspects of learning, the environment can have a strong influence over them. Specifically, Technological and Market Turbulence of the environment positively affect

all the learning constructs and the complementarity of them improves ACAP for innovation and performances. In contrast with Cohen & Levinthal (2002), ACAP does not depend only on R&D intensity, but actually it is built upon technological and market knowledge. The latter is internally produced through specific learning processes and activities.

To wrap up, nowadays, ACAP seems to be not important for companies, but crucial. It represents the fundamental mean to build an internal environment which is aligned with opportunities and threats coming from the external ecosystem.

3.2 The antecedents of ACAP

To better understand and assimilate the concept, it's important to highlight which are the elements and factors that characterize and influence the structure, the parameters and the growth of ACAP (Volberda, Foss, & Lyles, 2010).

Widely investigated in literature, antecedents represent essential elements to be considered by firms in order to adapt their continuous growing ACAP in function of the changing behavior of the environment and their objectives. In the following section of the analysis we will disclose the different typologies of antecedents, describing the diverse effects that they can have on ACAP.

A quick overview of the Antecedents:

- *Organizational*: form, structure, mechanisms and rules of the firm that provide the right direction for the ACAP's development
- *Managerial*: decision making process, control management, performance feedbacks and goal orientation. They have different impacts on both realized and potential ACAP
- *Interorganizational*: alliances and knowledge sharing strategies to reduce costs of knowledge management and increase its effectiveness

- *Environmental*: dynamism, turbulence of the environment together with market's characteristics like competitiveness and appropriability moderate and influence firms' ACAP
- *Micro*: individual attributes, skills and behaviors together with sharing processes have multiple granular effects that, at the end of the day, strongly characterize the ACAP's construction
- *Strategic Orientation*: Technology and Market strategic orientation for the development of a structured ACAP, particularly important for the exploration and assimilation of external knowledge

3.2.1 Organizational Antecedents

The study of Van Den Bosch, Volberda, & De Boer (1999) offers a first general overview of the types of antecedents that influence the effective absorption of knowledge. Indeed, they subdivided antecedents in two main clusters: the organizational form and the so called 'combinative capabilities'. The former represents the formal structure that a firm adopts to manage the activities and it can be further divided in functional, divisional and matrix form, whilst the combinative capabilities represent the ability to integrate the individuals' specialized knowledge inside the firm. In particular, the authors distinguished across three types of this construct: system, coordination and socialization capabilities. These two macro-factors, the organization form and the combinative capabilities, interact over time and have a combined effect on absorptive capacity.

Keep elaborating on this theme, Jansen, Van Den Bosch, & Volberda (2005) proposed that there are other organizational antecedents that influence both potential and realized ACAP.

Specifically, they stated that there are Organizational Mechanisms that, associated with the combinative capabilities, can play a significant role in improving the two sides of ACAP. Those mechanisms can be described through activities like cross-functional interfaces, job rotation, participation, formalization, routinization, connectedness, socialization tactics and many others. The combination between them and the combinative capabilities creates positive synergies for ACAP.

3.2.2 Managerial Antecedents

A second layer of antecedents is represented by the managerial ones. They symbolize a worthy topic of literature since they directly impact on the dynamic managerial capabilities (Adner & Helfat, 2003): the capacity of managers to create, extend or modify the knowledge base of a firm. Jansen, Van Den Bosch, & Volberda (2006) have carried a study which regards the effect of managerial mechanisms that affect the level of the exploratory and exploitative innovation. The study highlights how a centralized decision-making process generally does not fit with innovative firms (exploratory purposes), whereas a formalized process, with clear rules, can increase the unit's exploitative innovation. It is noteworthy to outline that Combinative capabilities (before mentioned in the organizational antecedents) belong to the managerial antecedents (Jansen et al., 2005). However, as stated previously, they have to be analyzed together with organizational mechanisms in order to proper understand their impacts.

Another layer of antecedents within the Managerial ones is represented by the Controls. As reported by Turner & Makhija (2006), Controls play a considerable role in managing the organizational knowledge: each control, from the outcome to the process, fits only for the administration of specific traits of knowledge. Thus, the control system of an organization can

strongly influence the ability to leverage on the firm's knowledge and managers have to pay attention on the control's mode for developing or exploiting specific type of knowledge. Keeping this direction, Ben-Oz & Greve (2015) demonstrated that also feedbacks, connected with control, have differential impacts on both potential and realized ACAP. More precisely, the nature of the objectives and, in turn, of performance feedbacks have to be defined in order to better plan the management. Indeed, from the study emerges that long-term goals positively affect potential ACAP, whilst short-term goals are important for the improvement of the realized one.

However, the focus of our study is more oriented to two faces of the same coin: the Senior Management Sensibility and Senior Management Risk Appetite. The underlying reason of this choice is that both the constructs strongly influence the 'Attention Structure' of the firm (March & Olsen, 1976) which consists in the directions that the organization wants to pursue, the settlement of time, resources and efforts towards specific goals. Thus, the attention of the organization depends on decision-makers' attitudes and the so-called Rules of the Game (Shepherd, Mcmullen, & Ocasio, 2017): the first factor refers to the power embedded in the role of the decision maker (typically CEO or Senior Management (Hambrick & Mason, 1984)) and the values that he follows in the decision-making process, whilst the second one symbolize the social, economic, cultural and competitive trends that shape the behavior of firms in specific sectors. Hence, the attention of the firm resides in the sensibility of the top management to perceive upcoming trends that are running over the market, but still it is crucial also to add in this theoretical formula the Risk Appetite. Indeed, besides something can be perceived as important, if no risks related to investments are undertaken the exploratory innovation performances are significantly lower (Tuncdogan, Boon, Mom, Van Den Bosch, & Volberda, 2017). In this study, the authors focalize the attention over the importance of psychological and

cognitive behavior within top managers, concluding that the higher is the propensity to take risks (Promotion Focus), the greater will be the sensibility of managers towards new external knowledge which in turn, ultimately, impact in a positive way on the exploratory innovation performances of the firm.

3.2.3 Interorganizational Antecedents

Acquiring knowledge and learning from sources that are outside the firm represent the main focus of interorganizational antecedents. Vanneste & Puranam (2010) highlights the inverted U-shaped relationship between knowledge overlapping across two firms and the effectiveness of the alliance. Indeed, some 'shared' knowledge can make easier the transfer and assimilation of it. Thus, in the literature, multiple antecedents have been investigated since they may lead to significant reductions of costs connected to knowledge management (assimilation and exploitation). Examples of those kind of antecedents are research ventures, joint ventures, strategic alliances, industry clusters and networks, which of course have different applications and advantages in function of the context (Benson & Ziedonis, 2009).

According to Bianchi, Croce, Dell'Era, Di Benedetto, & Frattini (2016), what plays a fundamental role in acquiring innovation coming from outside, is the presence of a dedicated R&D units. To manage an extensive flow of external technological knowledge, firms need to establish a dedicated R&D unit with formalized procedures. Moreover, the involvement of external consultants in R&D activities positively moderates the relation between external technological knowledge acquired through R&D outsourcing and product innovation performance. The development of future capabilities will be influenced by firm's exposure to

knowledge within its environment (McGrath, Macmillan, & Venkataraman, 1995). The sources of external knowledge comprehend licensing and contractual agreements (Grandstrand and Sjolander, 1990), acquisition (Chaudhuri & Tabrizi, 1999) and inter-organizational relationship such as R&D consortia, alliances and joint ventures (Vermeulen & Barkema, 2001). However, Weeks & Thomason (2011) diverge to the traditional belief that hiring externally spurs greater creativity and innovation. They support the internal hiring process considering it as a "high performance work system" when integrated with training and compensation policies (Becker & Gerhart, 1996). As Bernardin (2010) argues, there is no evidence in literature which confirms the belief that hiring from within neutralize creativity and innovation.

By integrating the focus on technological development with the continuous exploration of the market in search of innovative solutions, the creation of a business unit dedicated to digital innovation plays a fundamental role in increasing a company's Strategic Orientation (SO). This construct aims at linking the conceptual definition of strategy with empirical indicators. SO will be deeper analyzed in the following paragraphs.

A dedicated Business Units may have a positive impact on both the components of SO: Market Orientation and Technology Orientation. As previously reported, market and technological knowledge strongly impact on the exploration, assimilation and exploitation of new skills linking SO, ACAP and firms' performances. Fostering knowledge acquisition methodologies which integrate external sources with an internal development of competences could generate the best fit to increase PACAP on the firm. Consultancy can support this integration. According to (Gans, policy, & 2003, n.d.) Gans & Stern (2003), consultants through their network and the possibility to look out on more markets and sectors are able to reach a wider and more sophisticated knowledge on the continuous trend affecting the market. However, increasing

firms' exposure to external different sources of knowledge should be supported by knowledge complementarity (Bunderson, Lofstrom, & Van De Ven, 2000). This knowledge complementarity or "prior related knowledge" allows successful innovation transfers of technical and knowledge capabilities within an outsourcing relationship. Reliance on external consultants, Staff Leasing contracts and project outsourcing practices would create a customer-supplier relationship which is analyzed under the ACAP perspective by Weeks & Thomason (2011). They study the absorptive capacity of the firms through the retained IT function of the client and account management structures of the supplier.

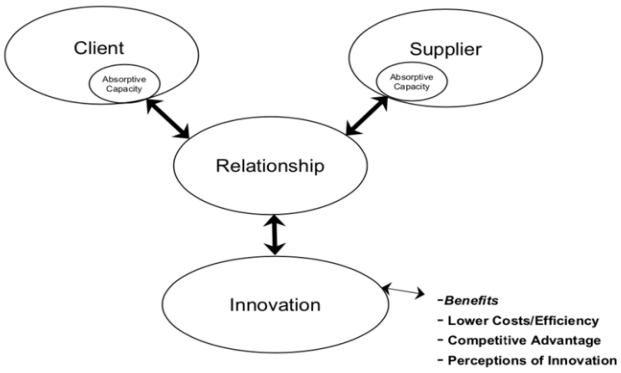

Figure 3 - Client and supplier relationship framework, Weeks & Thomason (2011)

The framework illustrates the idea that innovation is generated by the outsourcing relationship between client and supplier. The bidirectional arrows in the diagram illustrate the interdependencies between the elements of the model: innovation in turn will impact the relationship between customer and supplier, contributing to the benefits of the individual actors taken separately. ACAP resides inside both client and supplier filtering knowledge flows into and out of the organization. Furthermore, Dyer & Hatch (2006) have shown that the development of network relations across firms provides competitive advantages for organizations as it allows to interorganizational knowledge sharing. Kern & Willcocks (2000)

states that the relationship dimension in IT outsourcing is key to outsourcing success, but often neglected in outsourcing research.

The study of inter organizational antecedents is directly linked with the Strategic Orientation (SO) construct. From studies emerge that companies require both market and technological knowledge to properly feed their ACAP (Narasimhan, Rajiv, & Dutta, 2006). Indeed, companies should explore the market to gain external knowledge while continuously integrating it with internal development of technology and competencies.

3.2.4 From Macro to Micro Antecedents

Many studies in the literature show the multidimensional nature of ACAP, describing it as a phenomenon that manifests itself at the organizational level. However, the scientific knowledge reveals that the recognition and assimilation of knowledge strongly depend on individuals (Nemanich, Keller, Vera, & Chin, 2010). On top of that, Ojo, Raman, Chong, & Chong (2014) built a conceptual model that clarifies which are the micro (individual) antecedents that impact on the different dimensions of ACAP. The first one is Prior Experience, which the more is heterogeneous the better it is. Still, as stated by Amabile, Conti, Coon, Lazenby, & Herron (1996), it is not sufficient to build a balanced ACAP, thus, the second element is Need for Cognition. Indeed, cognitive processes can combine different individual traits and paradigms, leading them to better performances. The last two elements are learning and performance goal orientation: the former refers to objectives that some individuals pursue with the aim to acquire skills from the external environment, whilst the second one concerns individuals which are guided by their own personality and oriented to prove and show their

competencies. The effects of the latest antecedent can have a negative effect on the ability to recognize and assimilate value from external knowledge.

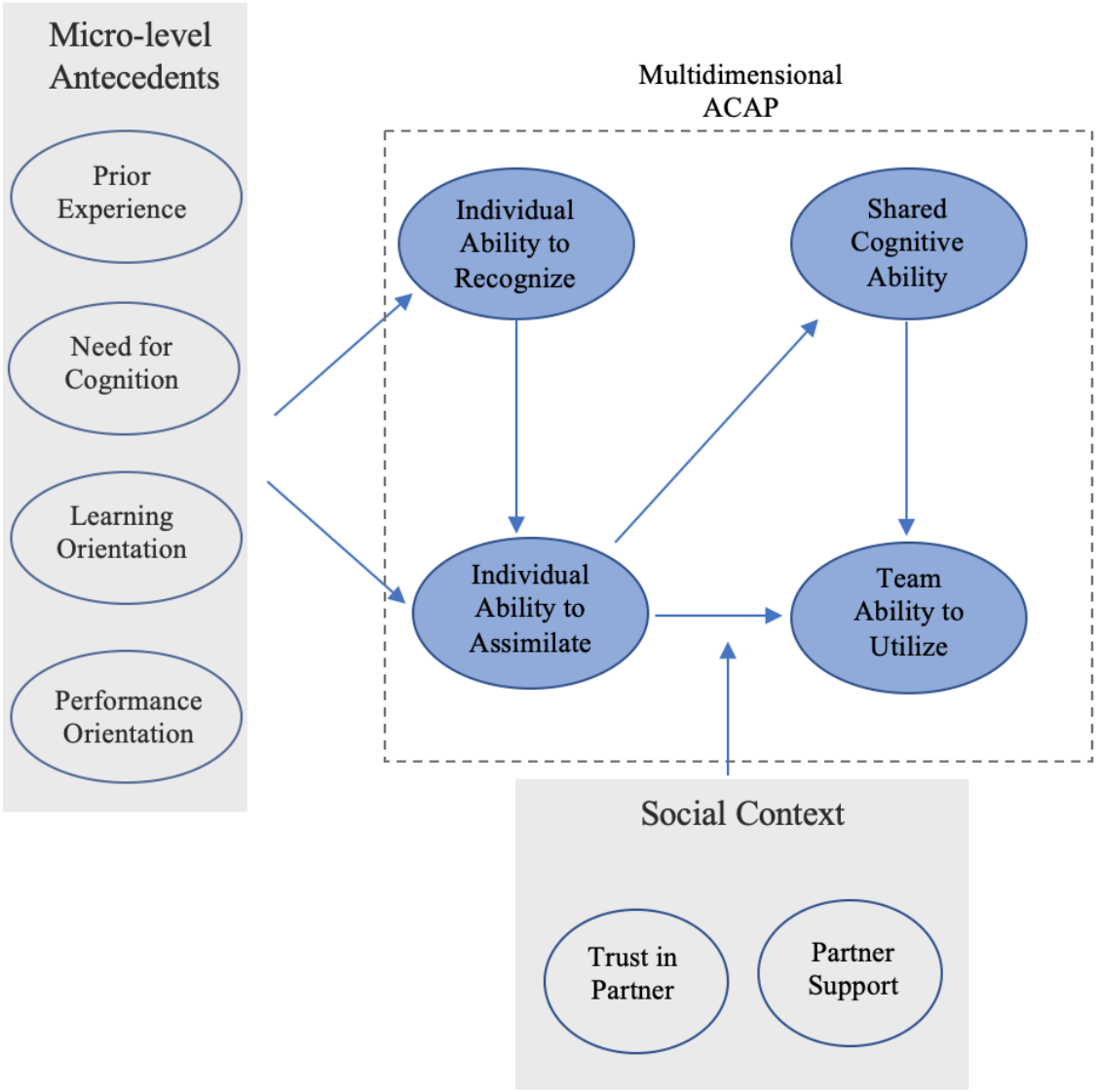

Figure 4 - Micro-level antecedents, Ojo et al. (2014)

N. Foss, K. Husted and S. Michailova (2010) contributed to fill the gap regarding micro antecedents of ACAP in the literature, pointing out the importance of knowledge sharing that, in turn, is influenced by individual knowledge sharing behaviors. Those attitudes are stimulated by multiple micro organizational factors such as rewarding systems, mobility, job rotation and

leadership. Understood the key role of individuals for the development and exploitation of ACAP, Tortoriello (2015) poses the attention to the importance of the social network: the network of connections that each individual is able to make. Aligned with the Cohen & Levinthal (1990) assertion/paradigm, he states that a firm's ACAP is not present in any single individual but it revolves around the connections between individuals' capabilities. Therefore, the individual ability to transform knowledge into innovations depends on the role that the individual resides/has in the internal knowledge sharing network. Thus, the group organization and the social mechanisms across the firm represent a crucial antecedent for the development of a company's ACAP. Organizations need a wide use of coordination mechanism to disseminate information and to respond to market changes(Kohli & Jaworski, 1990; Narver & Slater, 1990). This has a positive impact on Strategic Orientation (K. Zhou et al., 2005), considering it as antecedents of market orientation and innovation culture within the firm. Since employees are encouraged to work together and participate in the firm's decision-making process, innovation is facilitated by the dispersion of ideas within an organization, which in turn generate new ideas (Damanpour, 1991). Connecting functional units through information sharing and interaction methodologies, individuals are more willing to accept new ideas and engage in innovative activities (Han *et al.*, 1998).

3.2.5 Environmental Antecedents

Despite we have already cited environmental factors as key elements for ACAP, we need to deep investigate this field since it does not just influence the costs and speed of knowledge absorption, but actually it changes the nature and characteristics of the ACAP itself (Van Den Bosch et al., 1999). In fact, the higher is the turbulence of the environment, the higher the firm will tend to focus over exploration, whilst if the environment is stable, the firm will probably

develop an ACAP oriented to exploitation. Moreover, there are many moderating contextual factors that affect the connections between antecedents, ACAP and performances such as competitiveness, appropriability regime and dynamism (Zahra & George, 2002). Hence, to conclude, firms have to continuously adapt their ACAP and SO in order to face the challenges, threats and opportunities coming from the external environment.

3.2.6 A new antecedent: Digital Strategic Orientation

Only through a strong Strategic Orientation firms are able to reach the right conditions for acquiring new external knowledge and pursuing innovation. The Strategic Orientation (SO) represents the ability of a firm in addressing the focus on the right issues, whilst providing a common ground of reference for debating and processing strategies (Moon, 2013). SO is composed by two main dimensions: the Technological and the Market one. The first one represents the attention that the company puts on changing technological trends that are pervading markets (K. Zhou et al., 2005), while the second one implies the orientation towards the changing needs of customers and the mutations happening at a competitive level (Morgan, Slotegraaf, & Vorhies, 2009). The main outcome of the construct is represented by improved innovation performances. Indeed, according to Rakthin, Calantone, & Wang (2016), innovative firms consistently search for and examine innovation opportunities within or outside the firm or industry. Changes in the market, perception of customers or the advent of new technologies can all present opportunities for a firm (Drucker, 1998). In this perspective firm innovativeness can be seen in two ways: the rate of adoption or generation of new, timely, and creative products and/or services by the firms, while the second way refers to the firms' openness to new ideas, products, and processes, including their willingness to change and adapt

to emerging technologies and market trends (Acur, Kandemir, & Boer, 2012; Calantone, Cavusgil, & Zhao, 2002; Hurley & Hult, 1998).

The construct of SO has been investigated in the scientific literature mainly for marketing and new product development purposes. However, with K. Zhou et al. (2005) the concept was extended in the innovation field, embracing companies' psychological, structural and organizational characteristics that influence their strategic directions. Indeed, from previous papers like the one of (Montoya-Weiss & Calantone (1994), SO was recognized as a critical factor for the effective management of new product development. But to properly understand the context for launching a new product is important to have knowledge about the market, the technology and the customer (Cohen & Levinthal, 1990; Zahra & George, 2002). For this reason, many were the researchers that started enlarging the scope of the construct, looking at the connections between SO and antecedents, and between SO and performances.

K. Zhou et al. (2005) proposed a first conceptual model:

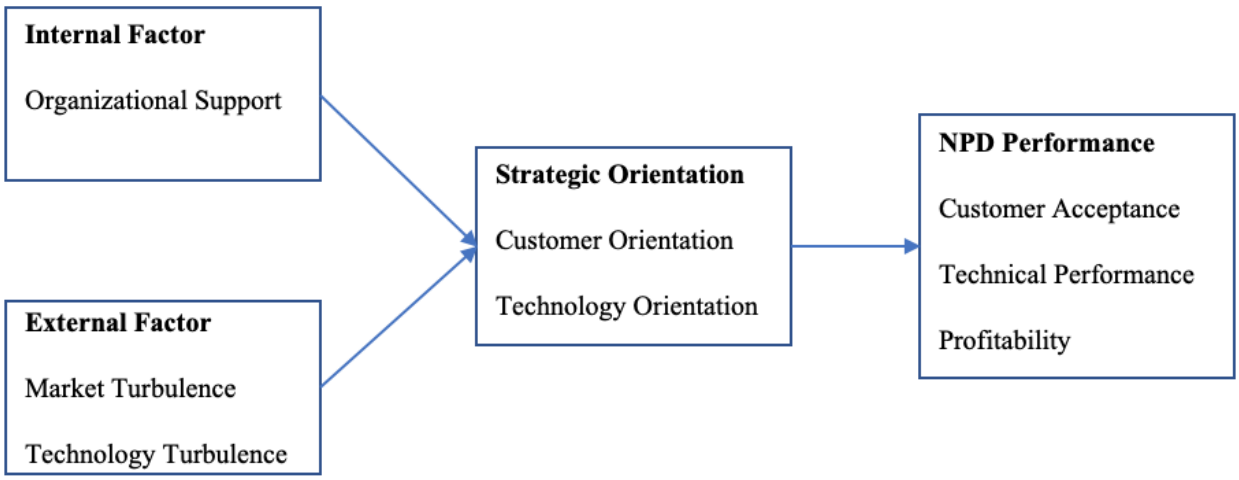

Figure 5 - Strategic Orientation, Zhou et al. (2005)

From the research emerged that there are two natures of antecedents under SO: Internal factors, which consist in the support of the organization, that manifests itself with the culture, the

structure and the internal mechanisms of the firm, and then External factors, which comprehend the Market and the Technology Turbulence. Basically, the model supports that the higher is the market turbulence, the greater would be the customer orientation, whilst the higher is the technology one, the greater would be the attention of the firm towards technological directions for strategies of NPD.

In turn, the study proved also that the greater is the SO, declined in its two fundamental components, the higher would be the positive effects on launch performances. In fact, the needs of customers are likely to be more aligned with the company's offers from a technological and marketing perspective, and also the profitability benefits from proper SOs.

Going deeper with the components that have an impact on SO, Reid, Szatny, Johnson, & Lochmann (2012) added to the set of antecedents also psychographic elements like risk proclivity, aggressiveness and future orientation of the management.

However, through the years there was an evolution also in the scope of the construct. Indeed, Dahan & Shoham (2014) proposed that the effects of SO do not just address NPD but, more

generally, they affect the overall innovativeness of the company. The authors also built a more comprehensive framework in which more factors are embraced:

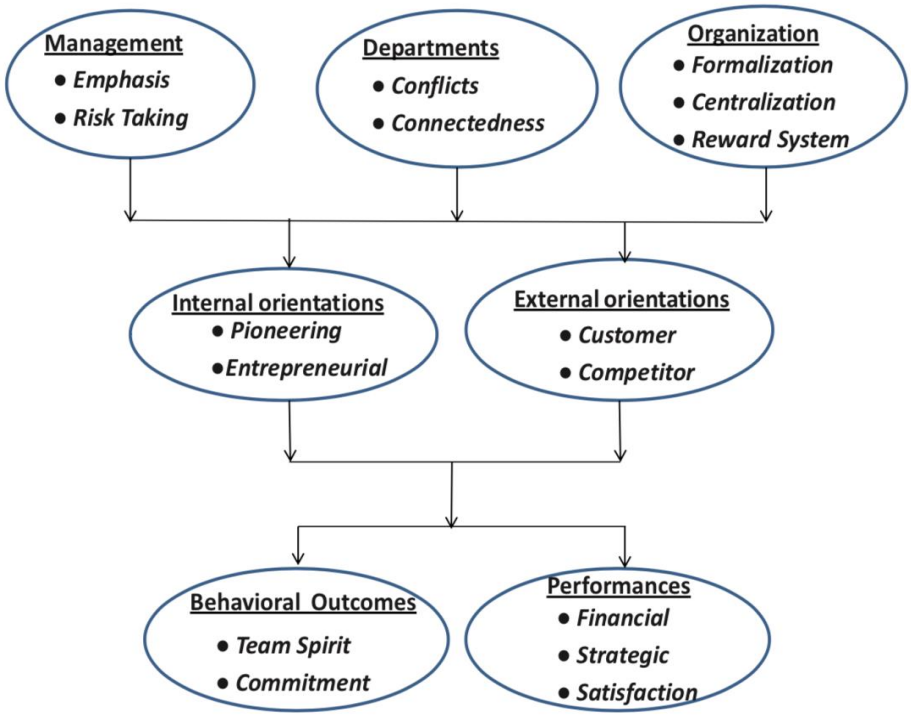

Figure 6 - Strategic Orientation antecedents, Dahan & Shoham (2014)

They envisioned three main types of antecedents, the Managerial ones, where particularly the Senior Management attitude and risk aversion strongly influence the orientation of the firm; then Departmental ones, in which are highlighted cultural and intraorganizational mechanisms for sharing knowledge and overcome potential obstacles during the innovation process; finally, the Organizational antecedents, that comprehend routines, practices and roles within the organization. The cocktail of these factors has positive and some negative effects on the two types of orientations: the internal one, which addresses to pioneering and entrepreneurial innovations, and the external one, which focus more on the competitive framework of the company itself.

A similar study that presents similar outputs is the one of Moon (2013), where he found resembling antecedents but he pushed the attention particularly on the sharing processes for improving interdepartmental teams' performances.

So far, we have discussed about SO and its importance relatively to innovation performances and antecedents. However, it is missing a fundamental brick that connects SO with performances: the ACAP.

Extending the work of K. Zhou et al. (2005), it is possible to describe the ACAP as a bridge that transform the strategic direction into a real innovation.

The concept of ACAP funds its bases on Prior Related Knowledge (Cohen & Levinthal, 1990), which have actually two natures: one in terms of Technology and one of Market. The two sides of SO (Zhou et al., 2005), the technological and the market orientations represent the real antecedent of the prior related knowledge from which the ACAP of a firm is built on. In fact, to get the proper knowledge it is crucial to see externally both at the market and potential emerging technologies.

From the literature, some authors proposed a conceptual model in which the three layers of SO: technology orientation, responsive market orientation and proactive market orientation have positive impacts on the three layers of ACAP: exploratory, retention and exploitative learning (Lane, Koka, & Pathak, 2006).

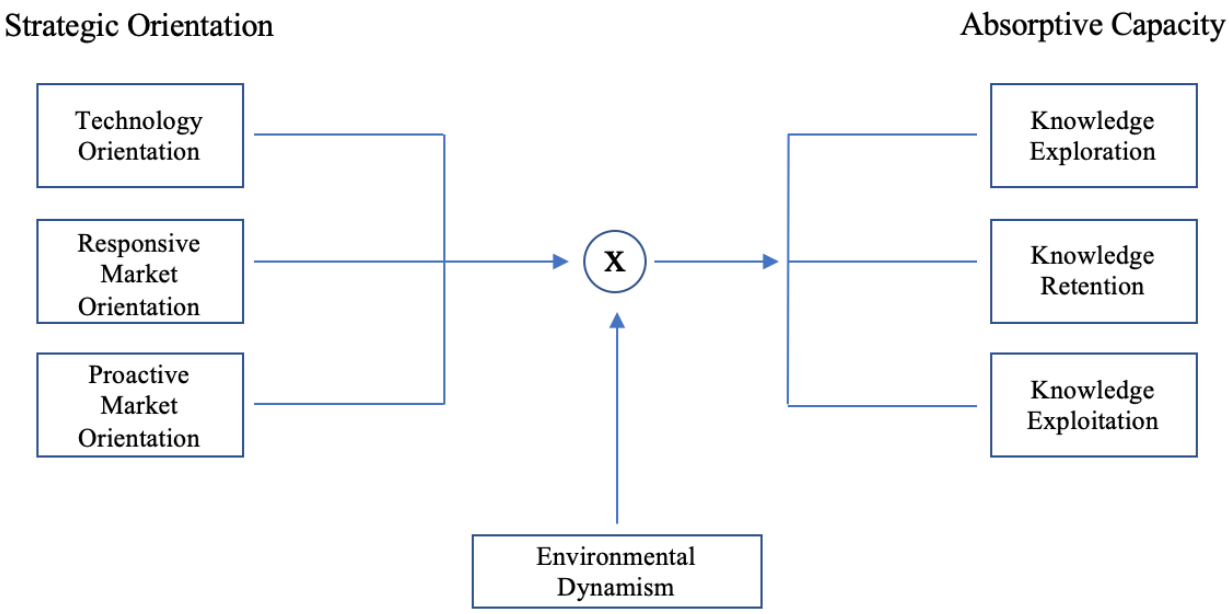

Figure 7 - Strategic Orientation, Lane et al. (2006)

Of course, they have different effects on every single layer of ACAP, but a proactive attitude towards external knowledge positively impacts firstly on the information acquisition process, and then on the overall innovation performances.

More recently, the study Molina-Morales, Martínez-Cháfer, & Valiente-Bordanova (2019) adopted the technological and organizational orientation of the firm as control variable for a research that investigates the development of ACAP. Of course, the control can be even more important for the analysis at the Potential level of ACAP, on the Exploratory part of it.

That's the reason why our study will focalize on this final concept, which of course has to be declined with the energy sector's paradigms, looking at the challenges that the digital transformation is bringing. In details, we will go through the study of some new antecedents that we think are worthy to be analyzed according to the lines of thought of previous authors.

Being Digital Transformation the lens through which we analyze energy companies, we decided to refer to SO with the term Digital Strategic Orientation (DSO).

3.3 The outcomes of ACAP

After the analysis of the construct and subsequently of the antecedents of ACAP, we need to clarify the implicit and explicit effects that ACAP has on performances and results of the firm. As we already anticipated, Cohen & Levinthal (1990) and Zahra & Gerard George (2002) showed that an increase of firms' ACAP leads to higher possibility to introduce emerging technologies and opportunities coming from external stimuli.

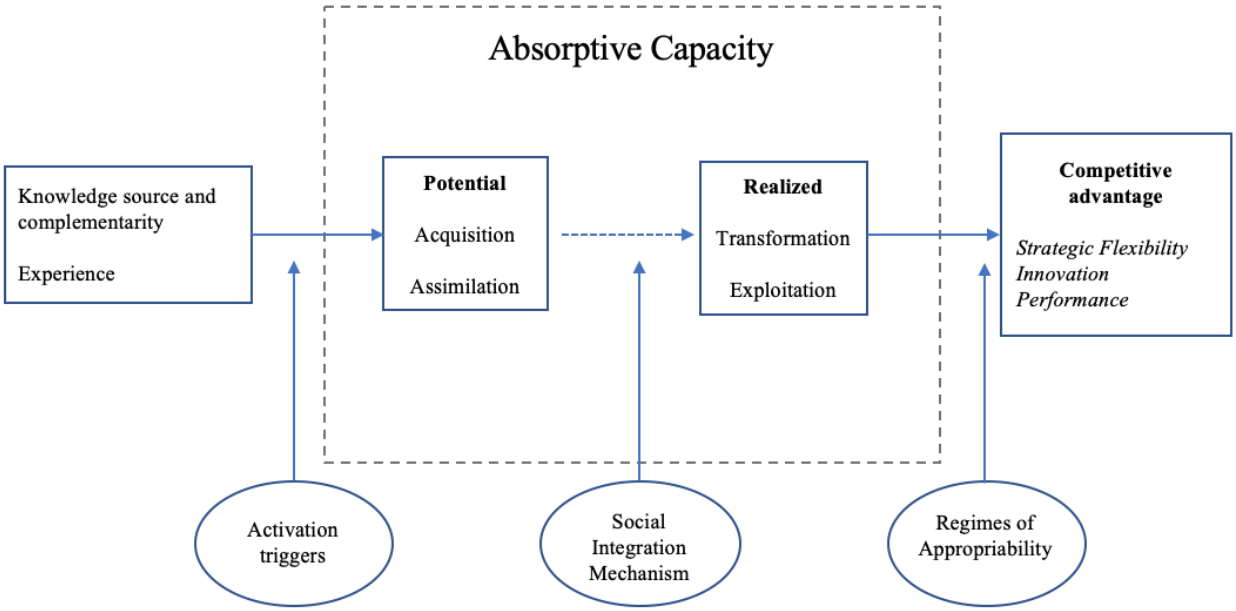

Figure 8 - ACAP components, Zahra & George (2002)

Thus, notwithstanding the undeniable importance of ACAP, Ahuja & Morris Lampert (2001) showed the real impact that ACAP can have in innovation. They state that from investigation of Novel and Emerging technologies, ACAP presents a curvilinear inverted-U-shaped relationship with the possibility to reach a breakthrough invention. Moreover, the study reveals

that for Pioneering technologies, ACAP presents only a positive slope in the relation to radical innovation since exploration enlarges the knowledge base of the firm, increasing in turn the creativity.

Shifting the focus on financial performances, Wales, Parida, & Patel (2013) paper sheds the light on the real impact that ACAP might have on firms' economy. Literature generally refers to a positive linear relationship between ACAP and firms' performances (Cohen & Levinthal, 1990; Leonard-Barton, 1995; Tsai, 2001; Zahra & George, 2002), ignoring the costs associated with this firm-level capability. They show that ACAP is not directly proportional respect to financial results, and it can diminish them. However, despite an increase of ACAP raises costs for firms, if it is cultivated in parallel with Entrepreneurial Orientation (EO), the synergy between them can lead to high financial returns, justifying the related costs. EO represents strategy-making practices, management methods and firm's behavior traits, such as innovativeness, risk taking and proactiveness. Hence, ACAP has a cost and, if it is built alone, can be risky, but at the same time it can open the doors to possible disruptive inventions if firms approach innovation strategies with the right paradigms and practices.

The paper changes the role of EO from a simply enabling factor to a critical condition in order to increase the financial benefits related to ACAP. Kohtamäki, Heimonen, & Parida (2019) analyse the join effect of ACAP and Entrepreneurial Orientation (EO) on firms' sales growth. What they find out analyzing a mature industry context is that, in companies with high levels of slack resources, an increase in EO from low to moderate levels accelerates sales growth; however, potential sales growth generated by high level of EO need a high absorptive capacity level to be capitalized.

Thus, the authors evidence the nonlinear effect of EO on sales growth if we consider a medium or high level of EO and the positive moderating effects of ACAP and slack resources.

Entering in the world of high technological markets, Narasimhan, Rajiv, & Dutta (2006) find that ACAP has a significant impact on profitability and that the effect is moderated by the pace of technological change: the greater the pace of change, the greater the impact. The know-how absorbed is function of R&D, marketing expenditure and innovation stocks (quantity and the quality of one's prior technological experience). However, ACAP is nothing but a combination of resources-capabilities, so it is not obvious that the more resources you have the more knowledge you get. Stiglitz (1987) suggest that past technological project can generate positive spillovers to be absorbed and exploited into new areas. Alternatively, a larger innovation stock may actually hamper the firm from actively pursuing technological know-how from outside.

Before veering to the next topic, we want to provide a clear picture of the ACAP construct, underlining all the most important factors that characterize it. To do that, we will rely on the framework created by Volberda et al. (2010).

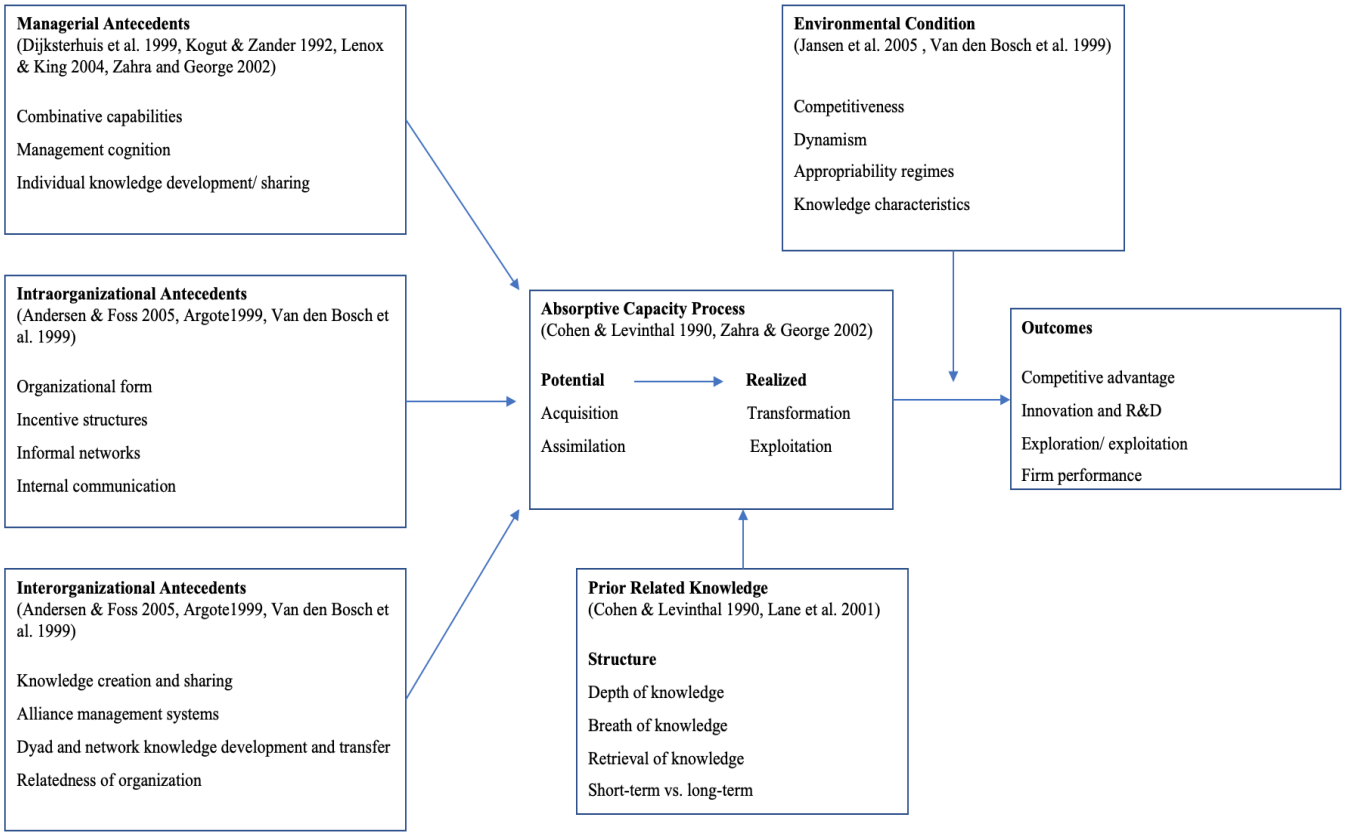

Figure 9 - Integrative framework of ACAP, Volberda et al. (2010)

3.4 The connection between ACAP and Digital Transformation: Digital Skills

The nature of the ACAP construct has been developed hand in hand with the changes introduced by the market during the decades. The antecedents necessary for the development of the construct in question have been adapted and updated according to the constantly evolving economic and environmental context. The trend that today's markets are facing is the one of

the digital transformation. Digital technologies are reshaping the traditional business strategy also transforming the structure of social relationships for both the consumer and the enterprise. However, we do not have a deep knowledge of the digital skills needed to face the new challenges brought by the digital economy.

Analyzing the literature, Fernandes et al. (2017) provide an overview regarding the elements needed by companies due to the digital change. This broad analysis carries out a bibliometric study on dynamic capabilities with a slightly different focus in respect to precedent articles. They disclose that dynamic capabilities are concentrated on five approaches: Digital Capabilities, Knowledge Capabilities, Absorptive Capabilities, Strategic Capabilities and Resource. All these capabilities are necessary for companies to face the digital and technological changes of the current market and to build a flexible but at the same time solid business base for the future.

Having already analyzed some of those factors, we want to shift the focus of the research over the Digital Capabilities. Freitas Junior, Maçada, Brinkhues, & Montesdioca (2016)

conceptualized digital capabilities based on the digital literature.

Journal	Definitions for Digital Capabilities (Concepts)	Authors
MIS Quarterly	Can be conceptualized as services that one system provides to another through value-creating provider-user interactions; can also be conceptualized as a digital outcome or service.	Srivastava and Shainesh (2015)
JAIS	The internal ability of providing information to the customers in the instant required.	Kohli and Grover (2008)
Information Systems Journal	The capacity of a self-contained (digital) system to generate new outputs, structures, or behaviors endogenously through the participation of uncoordinated third-party actors without deliberate planning from the originator of the system.	Lyytinen, Yoo, and Boland Jr. (2016)
MIT SLOAN Management Review	The skills needed go beyond pure IT to include specific technologies, such as social media or mobile, as well as the analytic skills to drive value from big data.	Westerman, Bonnet, and McAfee (2012)
Organization Science	The skill to design and control multiple products or subsystems using the same digital tools that in the past would have required different tools.	Yoo et al. (2012)

Table 2 - Digital Capabilities, Freitas Junior, Maçada, Brinkhues, & Montesdioca (2016))

The paper notes that digital capabilities drive forward digital business. Skills and resources required by digital capabilities are categorized into five variables: Agility, Responsiveness, Multi-channel Ecosystem Connectivity, Visualization (capability of displaying business information) and Governance Modelling of data. These variables positively influence E-Business performances and thus, information technologies represent a key factor to leverage on in order to catch up with the new challenges brought by digital trends.

In line with this topic, it's important to highlight the importance of ACAP. The mediating effect of the ACAP in the relationship between Information Technology Capabilities (ITC) and Electronic Business or E-Business Capabilities (EBC) is analyzed by García, Díaz, & Perez (2017). Results show a partial mediation with an incidence of ITCs on the EBC depending partially on the development of soft organizational skills aimed at creating value from the acquisition and assimilation of external knowledge. It is concluded that technology resources are necessary but not sufficient to guarantee the success of the digital operation.

This concept is taken up again by Setia & Patel (2013). ITC systems are a necessary but not sufficient condition. Integration through digital, technological, managerial skills is needed in order to increase ACAP. A capabilities perspective of absorptive capacity is used to examine potential absorptive capacity (POAC) and realized absorptive capacity (ROAC) capabilities. It is underscored the importance of integrating information system (IS) and operational management efforts, considering IS design as an antecedent to POAC and ROAC capabilities.

3.4.1 The Role of Big Data

However, to leverage on and exploit information and communication technologies, companies are called to manage Big Data (BD). Indeed, an effective use of Big Data, in terms of volume, velocity, and variety, has the potential to improve service quality and reduce service costs. However, potentialities of BD go far beyond the improvement of traditional performances, opening to different business opportunities for companies.

The new kind of data and technologies such as data analytics generate, however, both opportunity and risk for companies. Lam, Sleep, Hennig-Thurau, Sridhar, & Saboo (2017) define ‘‘big data absorptive capacity’’ (BDACAP) as routines by which a firm acquires, assimilates, transforms, and applies big data knowledge to create a dynamic marketing capability. This absorptive capacity is driven by the capability of combining and integrating big data and small data knowledge at both the firm and Front-Line Employees levels (FLE). ‘‘Small data’’ refers to FLEs’ data collected through their interactions and relationships with customers. They underline a widely-neglected fact that BD has both benefits and costs. On one hand, BD availability raises BD completeness, on the other hand, it also enhances BD veracity, or inconsistency, which can be a deterrent for firm to use them. The framework reveals the role

of the firm's big data absorptive capacity in altering the balance between the positive and the negative impact of big data availability on frontline outcomes. FLEs' role is therefore fundamental in building BDACAP.

The risks and opportunities in the use of big data are part of a broader discussion that goes to consider the digital transformation of businesses. Opportunities are linked to the creation of new business models, while risks for example can be associated with the need to improve processes or the evolution of organizational structures. As already mentioned by Setia & Patel (2013) IS has a predominant role. Kutzner, Schoormann, & Knackstedt (2018) consider IS as a tool which supports transformation but also digitalization. The paper aims at consolidating the rising amount of digital transformation-literature considering IS. Four clusters can be identified about this theme: business strategies/models, working culture, technology, and skills/knowledge. An example of the impact that digitalization has brought is the opportunity for companies to lower the level of business and market barriers. Huber, Wainwright, & Rentocchini (2018) stated that, to improve firm's ACAP, Small and Medium Enterprise (SME) can focus on Open Innovation (OI). External assets can help SMEs overcome resource and capability constraints (Eftekhari & Bogers, 2015) manage the liability of smallness (Colombo *et al.*, 2012) and increase revenue growth (Henry Chesbrough & Crowther, 2006).

3.4.2 ACAP and managerial implications for Digital Transformation

Tronina, Tatenko, & Bakhtina (2019) agree on the previously cited principle: digital transformation does not end with the introduction of new software purchased from an IT company. It needs a change in the corporate culture through new organizational mechanism.

Flexibility to face changing environmental conditions and a strong management system are the characteristics compliant with the requirements of digital economy.

Figure (11) provides a descriptive model that a modern enterprise should follow to embrace a digital transformation under a managerial perspective.

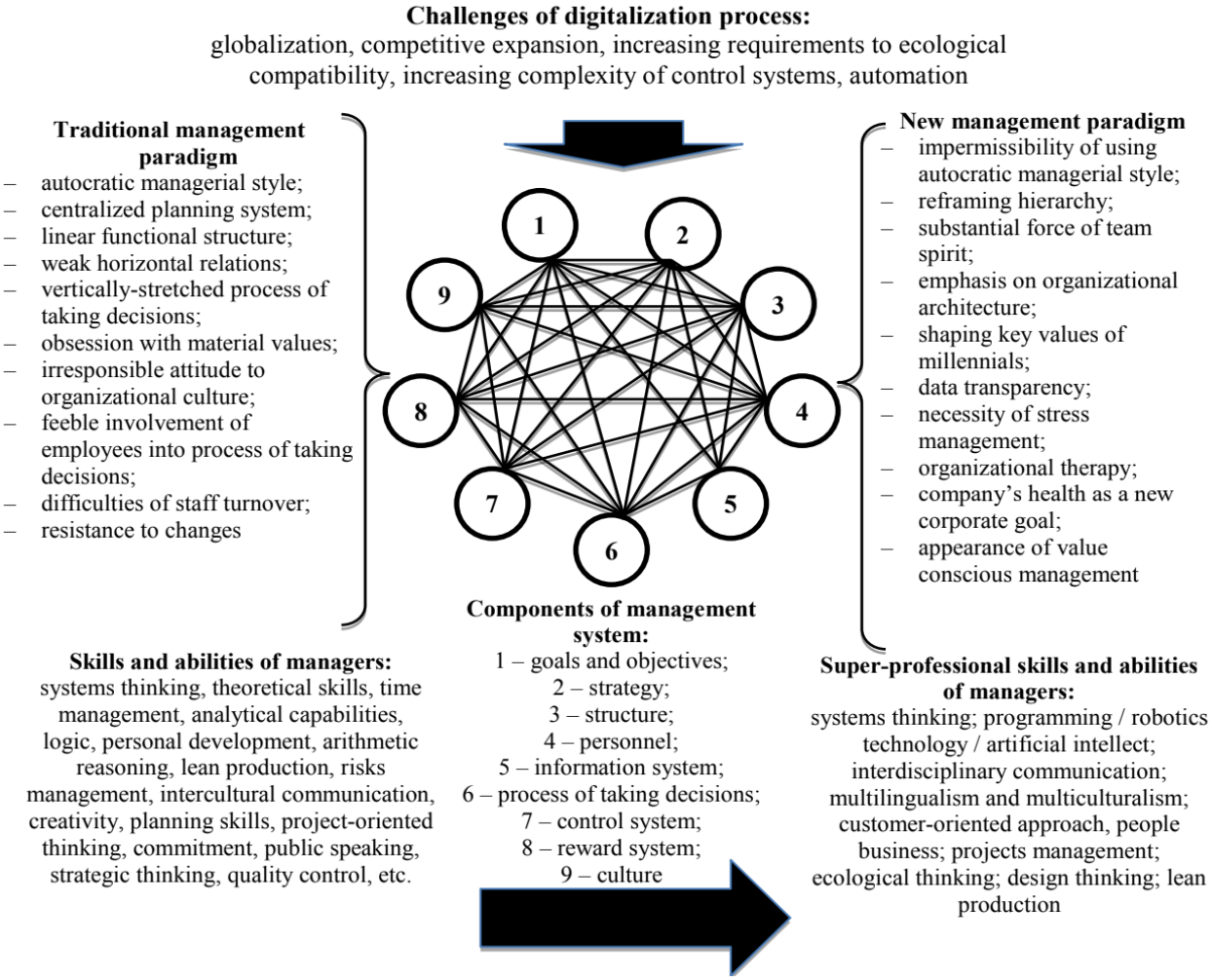

Figure 10 - Model of transformation of industrial enterprise management system under conditions of digitalization, Tronina, Tatenko, & Bakhtina (2019)

If we consider the capability of top managers to absorb digital competences, however, there are few studies investigating those factors that drive top management's' ability to absorb IT governance knowledge within organizations.

Ali, Green, & Robb (2013), from a research on Australian empirical data, show that top managers, in order to have a good level of ACAP of IT governance knowledge, must own four factors:

- prior relevant knowledge,
- communication network,
- communication climate,
- knowledge scanning

This study proposes a construct called 'absorptive capacity in IT governance knowledge (ACAP-ITG)'. It refers to "the ability of top management in an organization to recognize the value of IT governance information and knowledge, assimilate it, and apply it for competitive advantage".

The four factors are a combination made by Tu *et al.* (2006) of Brown (1996) studies on ACAP's operationalization and Cohen & Levinthal (1990). ACAP is therefore defined: the organizational mechanisms that enable identification, communication, and assimilation of relevant internal and external knowledge. This concept is then applied to IT governance within organization. Starting from the four constructs, they develop 11-item schema for facilitating top management's absorption of IT governance knowledge. In this way, the study gives an empirically reliable and valid measure of ACAP through which organizations that want top management to be positively involved in IT governance can rely on.

These researches allow us to connect digital with the concept of Strategic Orientation since the construct aims at setting the 4 factors (prior related knowledge, communication network, communication climate and knowledge scanning) by undertaking proper strategic directions within the organization focalized on digital opportunities.

3.5 Focus on The Energy Sector

A literature overview about the digital transformation of the energy sector is needed, considering the field of study of the thesis. Digitization is changing society's habits, economy, enterprises way of doing business generating an increasingly interconnected world. Digital technologies have proven to be the basis of countless impressive innovations. These innovations are often accompanied by the term ‘disruptive’: they have the ability to destroy companies already on the market, eroding their market shares. Therefore, the laws and models of business change, also impacting stable and hypothetically unassailable sectors such as energy. The ongoing energy transition leads to falling barriers, changing roles and markets, and the appearance of new players (e.g. think of Google’s investments in renewable energies and home automation, or numerous start-ups in the energy sector). Existing energy companies are moving slowly, potentially losing their future market share. Moreover, the application of new digital technology to improve products and services could not be enough. In order to adapt to the continuous change, avoiding external actors to destroy the market, companies should elaborate a new organizational culture, focusing on exploring new way of doing business to offer additional value-added services. Although changes and digital challenges can be perceived as a risk, they can generate important opportunities. Indeed, incumbents can build upon not only their specific knowledge advantage, but also on their existing large customer base and strong relationships.

However, the potential inability for companies in the energy sector to capture the innovation changes is shown in the article of Guedes, Ziviani, De Paiva, & Herzog (2017), which study innovation related to the Brazilian electricity market. What they find out is that Brazilian manufacturers of solar panels do not yet have a balanced ACAP for developing an innovative

product. Indeed, their behavior exposes a higher tendency for the potential dimension of ACAP when compared to the realized one. Generally speaking, companies of the energy sector lack the competences in absorbing knowledge and external experience, focusing too much on routine activities, neglecting innovative products and processes.

Barriers and new business models will be therefore analyzed starting from an excursus on the German market. Löbbe & Hackbarth (2017), examine the transformation of the German Electricity Sector and the emergence of new business models in distributed energy systems. The need of digitalization enables new business model and new competitors to enter in the market. The incumbents are challenged by newcomers from other sectors such as IT or Telecommunication but also by innovative and disruptive business models in niches at the grid's edge that might steal conspicuous market share. Virtual and decentralized marketplaces for energy are emerging, basing on Blockchain Technology, but it still lacks a regulatory environment adjusted accordingly to conquer the energy market.

In a decentralized energy market, the customer becomes the wheel of this mechanism considering that value generation partially migrates from central production to the customer's building. German politics is trying to support this direction across the last two decades. Furthermore, customers are getting more acknowledged and emotionally involved, seeking for participation, codetermination, and self-sufficiency. As previously mentioned, actors involved in the competition in the energy sectors are increasing: incumbents, start-ups, large and small utilities, energy service companies, storage provides, e-commerce, IT companies. Success will be achieved thanks to the ability to understand the environment and trends to follow, in order to develop and realize a clear strategy in turbulent times regarding technological development. The whole context has to be seen from a customer centric perspective with a continuous propensity to effectiveness and efficiency.

The ongoing energy transition is driven, as said, by digital technologies but also renewable energies. Considering the German Market, the share of electricity produced from renewable resources increased to 31.6% in 2015 (UBA, 2016) with a targeted share of renewable resources in the electricity mix of 55%–60% in 2035 (RAP, 2015), opening perspectives for new products and services.

3.5.1 Barriers to overcome from Theoretical Researches

Despite the current inevitable digital transformation, what emerges from the energy sector is a lack of entrepreneurship both in terms of number of business innovations and independent startups (Gitelman et al., 2019). The authors identify typical barriers to technology entrepreneurship development, trying to understand the overall scenario and developing an interaction processes between energy companies, consumers of new products and service, universities, developers, and investors to support innovation projects.

The main barriers that limit technological entrepreneurship in the energy sector are therefore identified:

- *A rigid legal framework:* often companies have to coordinate their investment policy with the authorities, which minimizes their ability to react promptly to market changes and for developing new technologies. Moreover, the paper suggests that developing countries have more flexibility due to the still undeveloped and institutionalized industrial structure. This generates a key determinant that shapes a comfortable environment for innovation.

- *Market inertia and weak competition*: the energy market is an artificial fusion of

monopolistic companies (electric power transmission, operations control) and competitive ones (generation, retail markets for electric power, sales, maintenance, engineering, non-core activities). The problem relies in the position along the value chain of those actors who directly interact with consumers (for example, power supply companies). Being located at the end of the supply chain, those companies de facto have no freedom of strategic maneuver.

- *Closing the gap* between the current expectations of consumers and what energy companies should offer. This would be made possible only thanks to a de-structuration of the vertical hierarchy of the sector by introducing new layers in the centralized generation and distribution process, up to the sales sector. This would increase competition boosting innovation.

- *Conservatism of market participants*. Fast changes are not well accepted by the corporate culture of many energy companies. As a result, Managers tend to postpone strategic decisions to face changes in the external environment. Reactivity of decision making is quite absent and the new technologies leading the digital transformation are passively and slowly integrated inside the companies. Sporadic are the innovation teams inside the companies leading to a non-systemic search for innovation.

3.5.2 Technology Entrepreneurship

The innovation process needs to be analyzed specifically for each case. However, technology entrepreneurship is an essential variable for innovation that should be the base of each business model.

Technology entrepreneurship was defined by Shane & Venkataraman (2000) as an activity aimed at "assembling organizational resources and technical systems, and the strategies used by entrepreneurial firms to pursue opportunities". Subsequently, literature on this field was summarized by Bailetti (2012). He stressed the importance of assembling specialized individuals and heterogeneous assets advancing scientific and technological knowledge to create and capture value for the firm. So, different business models mean also different way of pursuing technology entrepreneurship.

Through a survey of over 100 respondents in 28 countries, Gabriel & Kirkwood (2016) cluster four business models in technology entrepreneurship specific for the energy sector. The models are:

- Consultants
- Distributors
- Integrators
- Technology-Owners

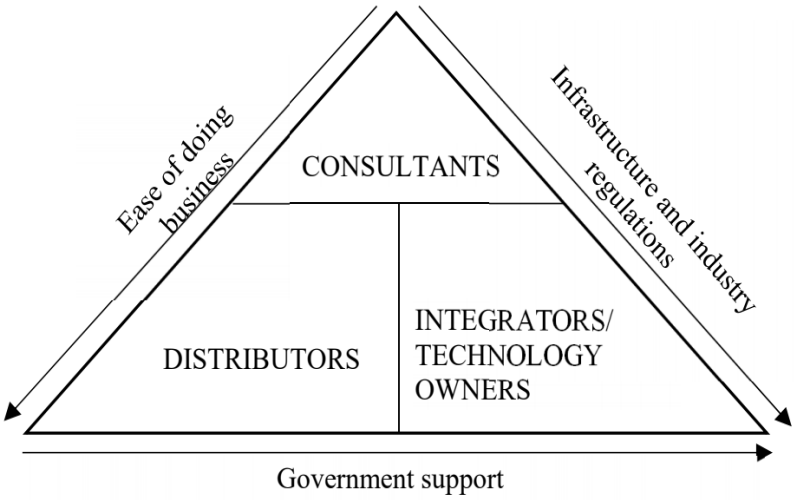

Figure 11 – Triangular matrix of business models for technology entrepreneurship, Gabriel & Kirkwood (2016),

Comprehensiveness of the product offering and lifecycle stage of the innovative process are the variables differentiating the various business model. “Consultants” focus mainly on auxiliary services (market analysis and forecasting, product and systems design) rather than the tangible aspects of product. “Distributors” act as technology intermediaries between the developers and buyers of new systems assembling ready-to-use components to meet customer’s needs. “Integrators” design, built and fabricate complex systems while providing ancillary logistics, information and technical services. “Technology owners” create fundamentally new technological solutions and principles that constitute the creation of the innovation.

Generally speaking, the development of technology entrepreneurship in the energy sector has been mostly driven in two directions while it could find a broader application. The two strategic paths concern the adaptation of renewable energy sources to meet the requirements of mass consumption (e.g. enabling services to integrate consumers into the energy market) and creation of energy efficient and environmentally friendly technological solutions.

Here a list of possible new entrepreneurship directions:

Name of energy company/ organization/project	Technology being introduced	Stakeholders
Hangzhou Zhongheng Electric (China)	Sensors concealed within workers' uniforms can analyze their emotions and help increase their productivity through timely job rotations	Energy company
Smart Grid Project in Belgorod (Russia)	"Smart" energy consumption measurement based on automated system of commercial electricity measurement using Neuron smart meters	Energy company and state
Machine learning for business process management at General Electric (USA)	Corporate university that specializes in training the company staff in machine learning technology and building learning digital twins that help predict equipment failures	Energy company and university
Carnegie Mellon University (USA)	Energy consumption management system for companies that incorporates a smart control board for monitoring energy costs and reducing them at peak loads	University
Aquion Energy (USA)	Aqueous Hybrid Ion Battery that uses a water-based sodium sulfate electrolyte for energy storage	University and startup
Shell (USA)	The oil company has invested in a startup that sells solar energy for a flat monthly rate	Energy company and startup
Moya Power (UK)	Big plastic sheets are installed along railways and in tunnels. The sheets generate electricity by capturing air streams.	Startup
Construction of smart grids in Australia	A project to build distributed energy generation installations that are connected to a smart grid for energy redistribution. Solar panels and batteries rolled out to 50,000 homes will be pulled together into a single virtual power plant. Project jointly implemented by an investment fund, the government and Tesla.	Energy company (Tesla) and investment fund and government

Table 3 - New energy entrepreneurship direction, Gabriel & Kirkwood (2016)

Römer, Gemsjäger, Di Lembo, & Fröhner (2017) developed a novel approach to manage digital challenge in five phases: understand the environment, ideate new value propositions, cluster and select promising value proposition bundles, design business models around them, and evaluate their viability. This approach guides companies from endless alternatives to concrete options that can be chosen or rejected based on quantitative assessment eliminating inertia and enabling action. This method was successfully applied to utilities in Germany, India and Italy.

In addition, ten key points the innovation team has to follow are established:

- Bring substantial energy domain knowledge
- Look out for diversity
- Create the right atmosphere
- Create the ‘right box’ (think outside the box fitting the level of abstraction)
- Provide strong guidance and moderation
- Provide tasty food for thought
- Fuel the imagination
- Rely on self-selection
- Tell the story before thoroughly calculating the potential

Moreover, antecedents to develop technology entrepreneurship can be associated to R&D investments and to a close cooperation with those actors better informed to markets trend and technology evolution. Universities and energy companies should establish joint structures for knowledge transfer that are designed to monitor the latest achievements in science and technology and exchange best practices. In addition, technology entrepreneurship cannot be done without building teams that with a systemic approach search for new ideas, methods of their implementation. The explorative role is fundamental to create an innovation flow which aims to change the organizational culture in a stagnant sector.

Inside technology entrepreneurship, we can find strategies of Digital Energy (DE) which consist in projects intended to drive performance improvements. Reid, Szatny, Johnson, & Lochmann (2012), suggest that through an effective use of DE technologies, transformations and breakthrough gains for companies in the sector are possible. In order to achieve digital

transformation goals companies should pursue a clear strategy: value creation and innovation must go hand in hand. As a matter of fact, be focused only on traditional sources of value creation tends to draw the attention on value chain cost increments, which, by themselves, are not sufficient to differentiate against competitors. Innovation without value tends to be technology driven and often it is perceived as not being directly associated with value creation and, thus, it is not accepted/adopted. Value Innovation simultaneously try to lower costs or increase margins while developing value through innovation. So, a benchmark process is needed to gradually change the way of working and optimizing operations. It should be composed by both measured and subjective components which provide feedbacks. Subjective and objective data support or complement each other. Taken together, they give to firms' management a more complete understanding of where a company stands in relation to its goals and objectives.

Benefits associated to DE strategy can be:

- Increased recoverable reserves
- Improved recovery
- Increased production
- Increased asset use
- Increased organizational efficiency
- Reduced operating costs
- Improved safety performance
- Reduced environmental impact

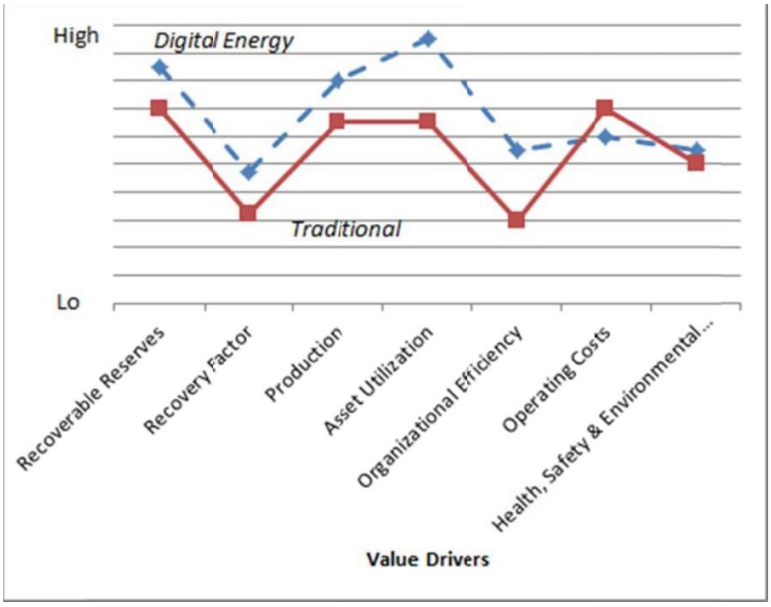

Figure 12 – Value Innovation for DE and Traditional Assets, Reid et al. (2012)

To conclude, we have seen that a strategic approach for facing the Digital Threats and opportunities is needed. In fact, from the theoretical to the field-focused literature there is a clear convergence on the importance of the underlying values of SO. For this reason, our theoretical framework that will be exposed in section 7, will investigate this area, contributing at the definition of the Digital Strategic Orientation and looking at the antecedents that influence DSOs.

4 LITERATURE REVIEW OF PRACTITIONERS

In this chapter, we will go through non-scientific reports, documents and publications to picture the scenario in which companies of the energy sector compete. In this way, the Oil & Gas and Electric sectors are described, including statistics, barriers, challenges and benefits that the digital transformation is bringing.

4.1 Electric Sector

In recent decades, there has been an evolution in the structure of the electrical system in many countries of the world. We moved from a monopolistic and vertically integrated system to a competitive and liberalized one. The electric and gas system is an organized network system which activities are conducted by different actors. These activities regard the production, the transmission, the distribution and the trade of energy. For simplicity, to explain how the system is structured we will focus on the electric sector.

The production is a liberalized activity which consists in the transformation of fossils or renewable sources to electricity inside the power plants. The latter represent the primary sources from which the energy is transmitted to consumption areas through a network system composed by electric lines, stations and transformation stations. The transmission enables the safe transportation of energy from disseminated power plants or abroad sources through a high voltage line system. The next block of the supply chain is the distribution. It is a regulated activity that consists in the delivery of electricity in medium/low voltage to end users. The actors that perform the transmission and distribution are both regulated but present a different structure: for technical reasons the transmission has to be managed by a single company, a Natural Monopoly, that in Italy is carried by Terna, whilst the distribution is run by diverse companies which have the governmental concession for operating in specific geographical areas. To conclude the excursus regarding the electric supply chain, we need to introduce the traders/suppliers of electricity: their role is to sign contracts with end users such as Domestic users and Firms, offering different prices and services. Suppliers can buy electricity from big retailers, producers, or from the National Electric Market.

The electricity market is a telematics marketplace for the negotiation of retailed electric energy. The price corresponds to the equilibrium price coming from the intersection between the demanded electric quantity and the offers of operators that participate in. It is actually a real market where insertion and withdrawal programs of electric energy are defined but, however, it is possible for operators to buy it even outside the marketplace, for example with the so called bilateral contracts.

4.1.1 Statistics

By looking at the latest statistics provided by Terna (2017), the monopolistic company that manages the entire transmission activity in Italy, it is possible to see how the demand is changing and how the Italian system manages the consumptions with different types of sources.

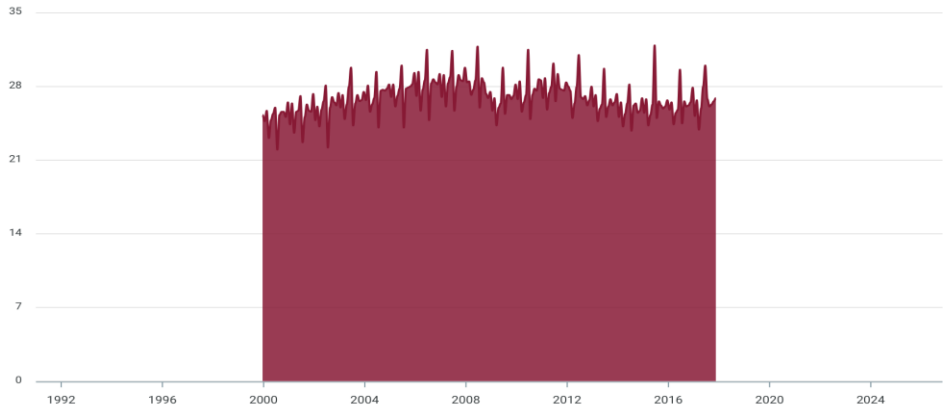

Figure 13 – Italian demand, Terna (2017)

This first picture represents the Italian demand of electricity from 2000 until 2017, expressed in TWh. It is possible to notice a first contraction in 2008 due to the financial crisis, but after a

second contraction in the 2013, the demand is steadily increasing with yearly peaks that happen during the summer.

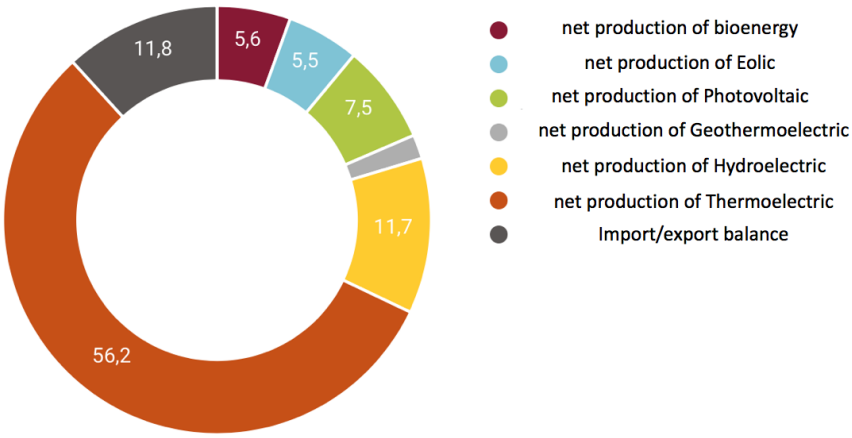

Figure 14 – Electricity sources, Terna (2017)

The second picture shows the production portion of each different typology of electricity source in 2017. More than a half of the entire demand is met through the exploitation of the traditional Thermoelectric system whilst the two main secondary resources come from hydroelectric systems and from abroad transportation.

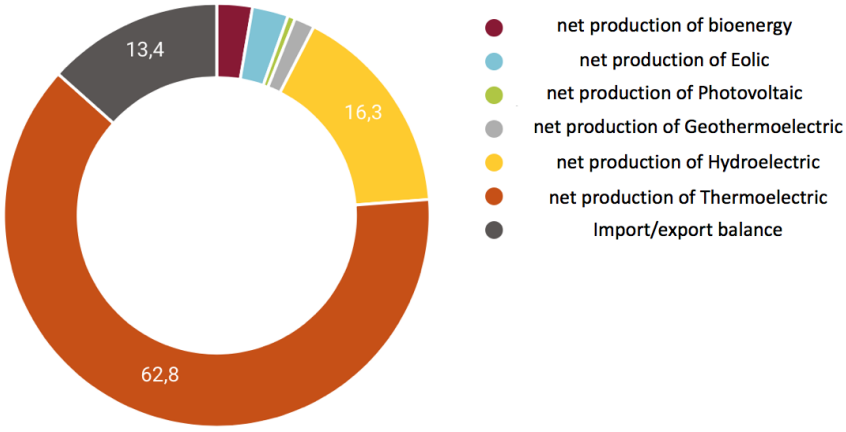

Figure 15 – Electricity sources, Terna (2010)

However, it is interesting to notice the significant improvement of Eolic, geotherm electric, bioenergy and, in particular, of the photovoltaic system from 2010. It has led to a consistent reduction of thermoelectric production and a decrease of energy coming from adjacent countries (France).

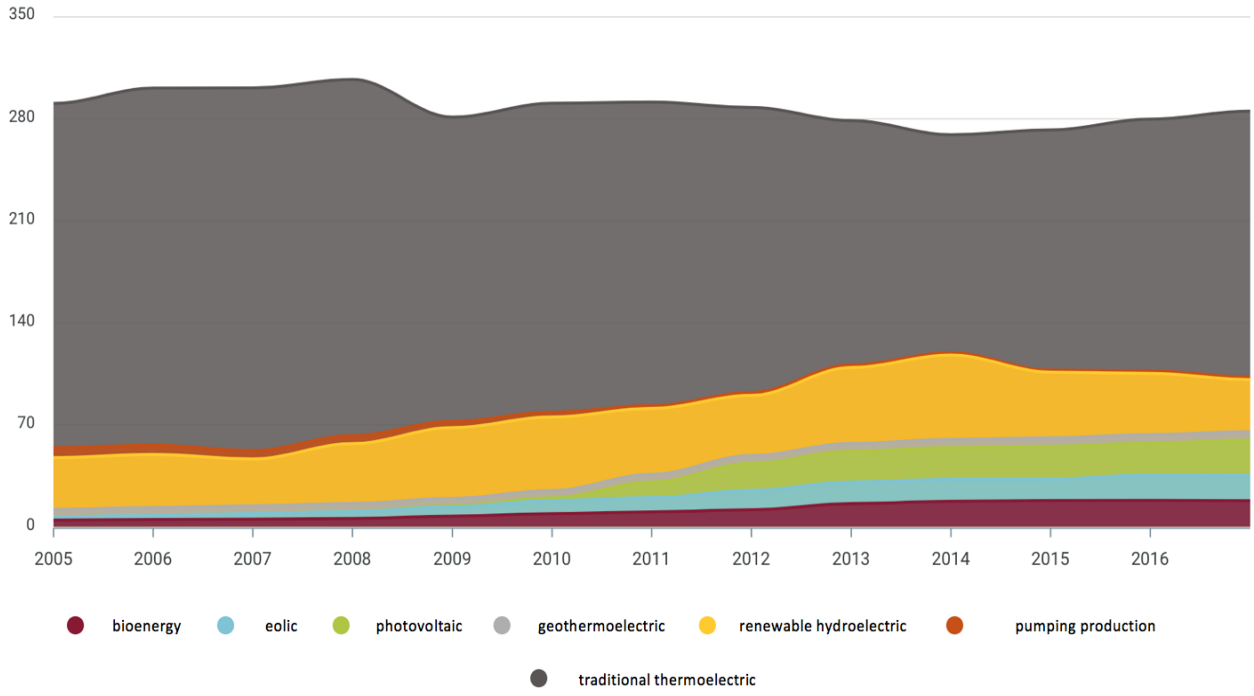

Figure 16 – Energy sources, Terna (2017)

In this picture, it is possible to understand the clear path for each type of energy across the last decade (the measure is still MWh). It is undeniable that Italy will still rely for many years on traditional systems, but the growth of renewable energies can be exponential with the adoption of digital solutions. These technologies, together with the new energy storage systems, could change the current energy scenario, abating huge amount of costs and Co2 emissions.

4.1.2 Barriers

From industry publications to venture capital discussions it is possible to identify five barriers guarding the energy sector from change:

- A highly stable and mature industry
- A conservative risk-averse corporate culture
- Very high switching costs (loss aversion)
- Significant technology development costs
- Extremely long technology development and adoption rates

Difficulties in implementing Innovation strategies and project can be grouped into three main pillars:

Lack of a true innovation culture: this sector has never been interested in it, the focus has not been "out-of-the-box" solutions. Innovation culture, indeed, is difficult to pursuit if the aim is the one of solving problems rather than anticipating them. Moreover, utilities companies usually rely on external contractors to develop solutions for problems.

Focus on Technology Development not Innovation: The technologies developed have historically been evolutionary technologies, not revolutionary technologies.

Too much money: According to some VC opinions, too much money managed by this sector desensitizing the industry to the need for innovation. Financial constraints foster innovation since constraints breed creativity.

4.1.3 Benefits of digitalization [1]

Benefits related to the digitalization of the sector can be clustered into energy efficiency, economic and environmental. According to the World Economic Forum, the value generated by service platforms, smart devices, and advanced analytics in the energy sector is US$1.3 trillion. Adopting the rights asset management solutions, is possible to unlock a huge value by lowering operations costs and eliminating unplanned downtime. Through the introduction of digital solution companies in this sector can reduce greenhouse gases emissions, while generating new job and value for consumers. IoT solutions enable the creation of a cleaner, smarter, and more prosperous world.

The global e-Sustainability Initiative estimates that ICT could bring about a 20 percent reduction in global carbon dioxide emissions by 2030 through the application of Internet-enabled solutions. This has an impact on cost that would be reduced by US$4.9 trillion by 2030. Estimated savings of US$1.2 trillion will come from electricity expenditures, and US$1.1 trillion from fuel expenses. GE developed a Digital Power Plant (DPP) which integrates application that improve the performance of power plants and reduce asset downtime using cloud-based analytics. The spread of this Digital Platform solutions across the global fleet of

[1] Source GE report

coal and gas-fired power plants is supposed to reduce carbon dioxide emissions, generated by plants, by 10 percent. Moreover, an important topic refers to the deployment of digital grid technologies. GE discussed that a global and full adoption could reduce electricity consumption by 12 percent and carbon dioxide emissions could be reduced by 2 billion metric tons by 2030. Furthermore, what comes up from this research are the significant environmental benefits beyond carbon emission reductions generated by the digitalization of the energy sector. Concerning the global water consumption, if current trends persist by 2030 industrial water use is expected to rise to an estimated 764 cubic kilometers (km3), up from just 200 km3 in 2000. GESI and Accenture study this trend and link it to the development of ICT solution. ICT could save over 300 trillion liters of water by 2030, across eight sectors including energy, buildings, manufacturing, healthcare, education, and agriculture. Digitalization shows the potentialities of energy sector to provide significant economic and environmental benefits. Companies should ride this wave in order to exploit potentialities, seeing them as an opportunity rather than a risk.

4.2 Oil & Gas sector

Now, we want to shift the focus over the oil & gas sector, which of course is strongly influenced by the digital transformation. Indeed, the adoption of digital solutions in areas concerning the management of resources' life cycles, collaboration and involvement of the client enables the sector's firms to transform their operative and business models.

4.2.1 Structure

The oil & gas sector is structured in three key areas:

- the *Upstream*: exploration and production. The first one represents the research for underwater and underground natural gas spots or crude oil fields whilst the second refers to the drilling activities to recover oil and gas

- the *Midstream*: in this macro area we find transportation, storage and processing of recovered oil and gas. Typically sources and refineries are geographically distant, so there are different means such as ships, pipelines and trunks

- the *Downstream*: the first activity in the downstream set is the refinery of crude oil and natural gas, then we find the distribution and commercialization of the transformed product to customers and end users in different forms: natural gas, petrol, diesel, kerosene, gasoline and many others.

Italian Landscape

In this section, the focus is oriented to the Italian market and its structure. As previously anticipated, the first layer of the supply chain is the extraction, but in Italy this activity covers just the 10% of consumptions. The remaining 90% is imported from other countries, in particular from Algeria, Libya and Russia. It is transported in two main forms, the first as natural gas and the second in a liquid form. The second layer of the chain is the transportation and storage, where the firm Snam works as monopolist due to the massive investment needed to build methane channels, even though it is actually a free market. The storage permits to face peaks of demand generally related to the coolest weeks of winter. The third layer is represented by the distribution, where the pressure of channels is lower and ramifications of conducts are

higher. Here there is a large number of companies that, through a government concession, distribute gas reaching end users. The last ring of the chain is retailing. In this area, we can find large retailers, which supply both big companies and smaller retailers. The latter instead provide gas to families and smaller commercial activities with a fair that changes according to the geographic position, the distributors tariffs and the price of the international gas market.

4.2.2 Statistics

To provide an overview picture of the oil & gas sector we will rely, for oil, on the Eni World report 2019, whilst for gas the ARERA (Autorità di Regolazione per Energia Reti e Ambiente) database.

Oil Sector

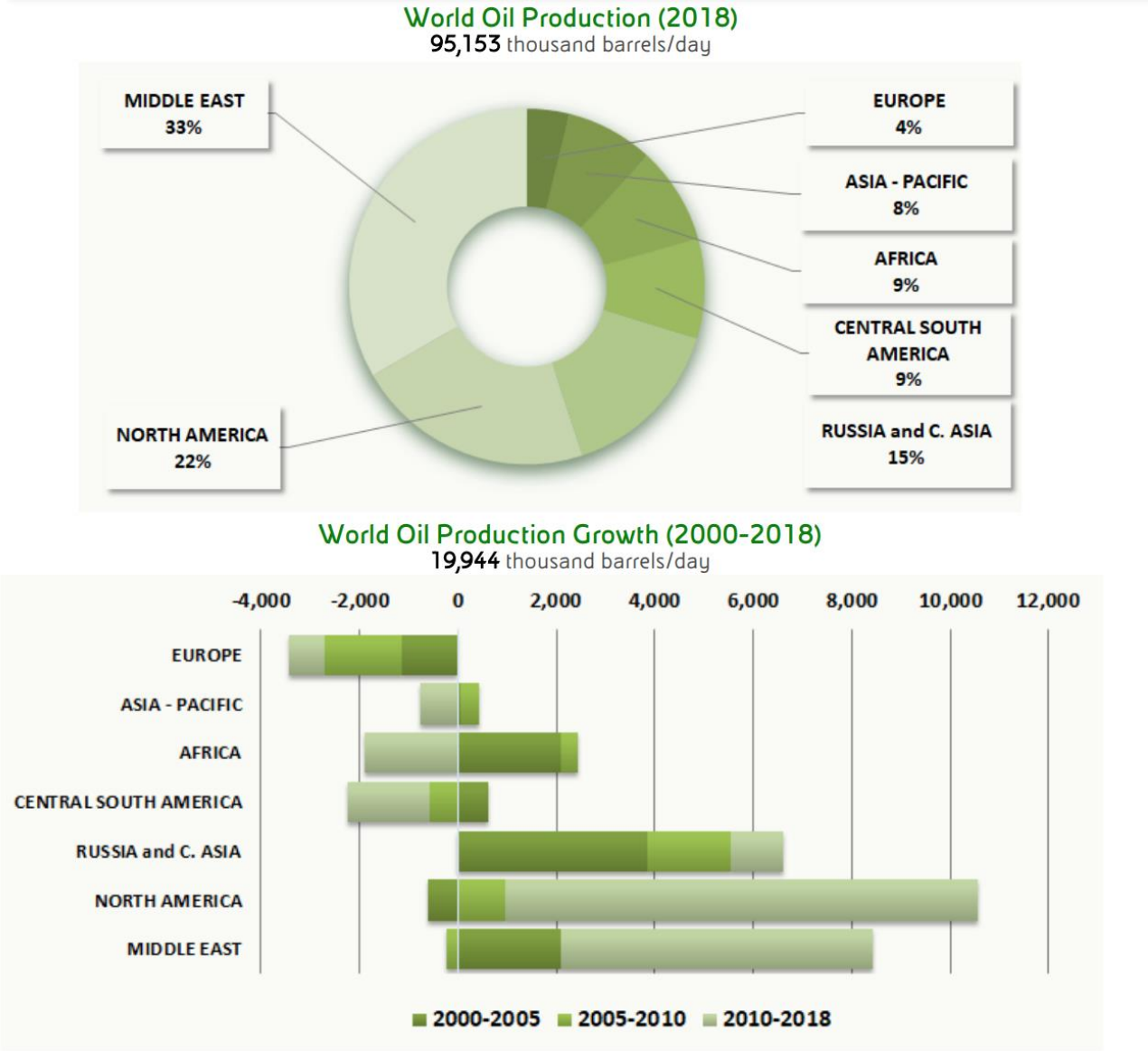

Figure 17 - ENI World Report 2019

In the first picture, we can see how the production of Oil is distributed across continents. European countries are facing a huge reduction at the expense of a massive growth presented by North America but still, the Middle East remains the largest producer of the planet.

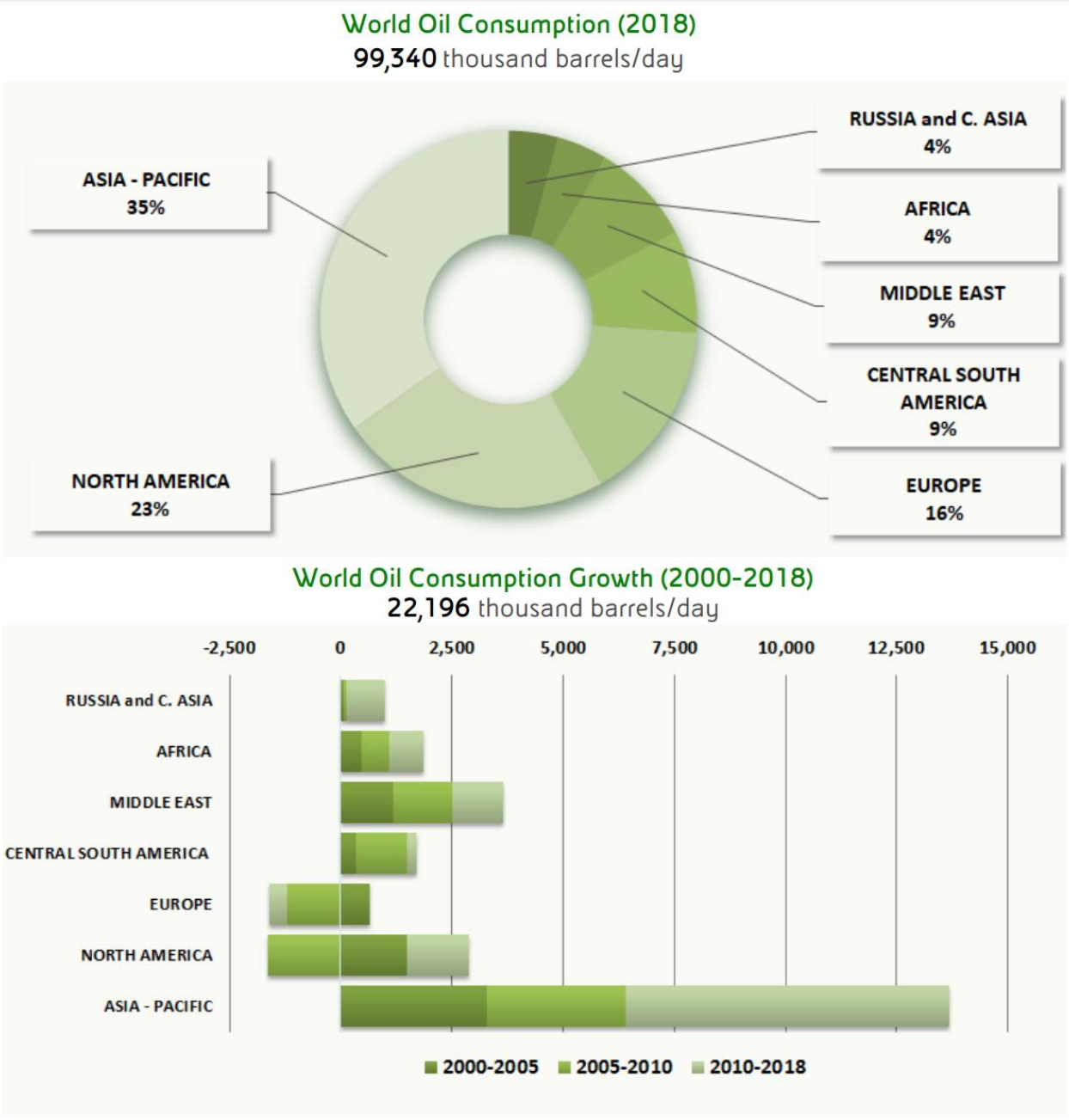

Figure 18 – ENI World Report 2019

On the other side, as far as consumption is concerned, Asian countries are those that mostly exploit this kind of resource, followed by North America and then Europe. However, it is noticeable the significant contraction of consumption in Europe, particularly in comparison with the growing trends presented by America and Asia.

Gas sector

Shifting the focus over the gas sector, we can have a holistic vision of the scenario with the statistics provided by ARERA.

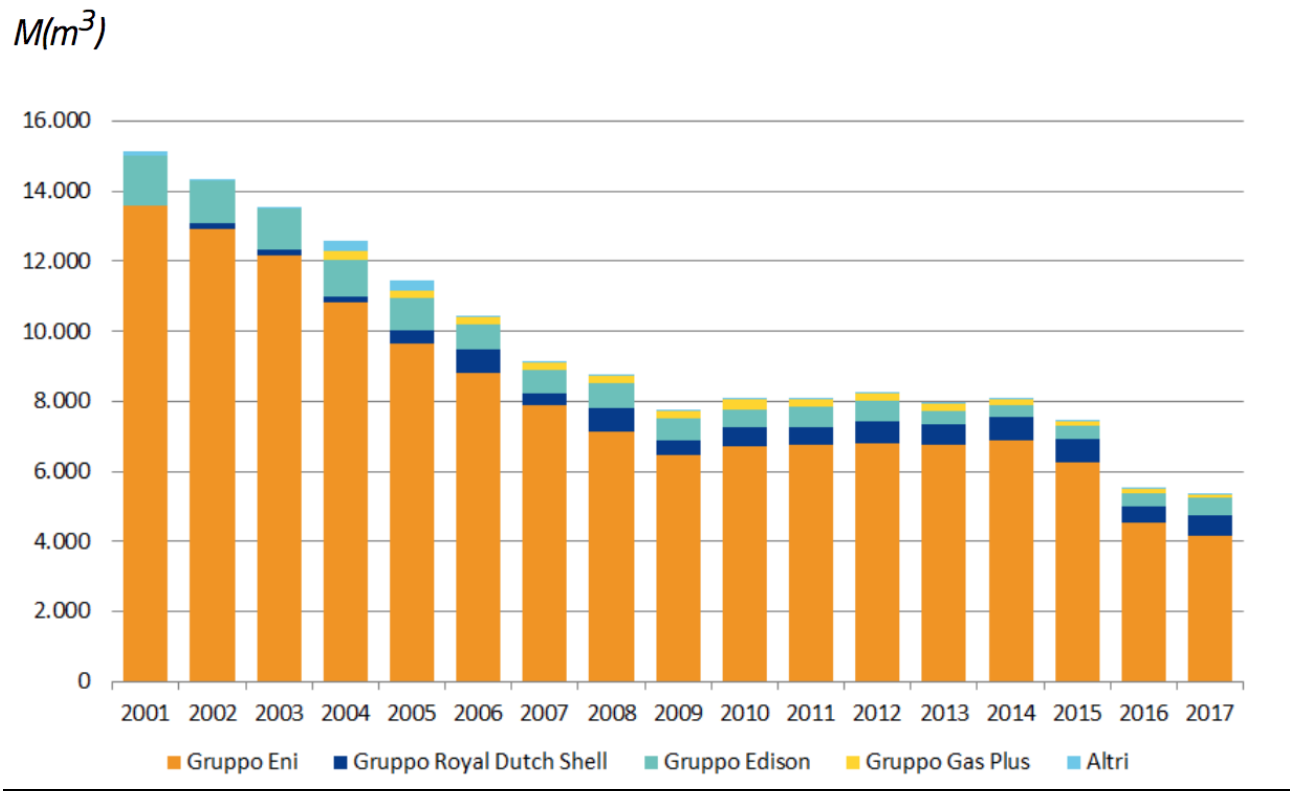

Figure 19 – Italian production of Gas, source ARERA

In the first chart, it is possible to notice how the Italian production is constantly declining from 2001, with the Eni Group that represents the major Italian extractor. This picture witnesses the reason under the great necessity for the nation of importing natural gas from other countries.

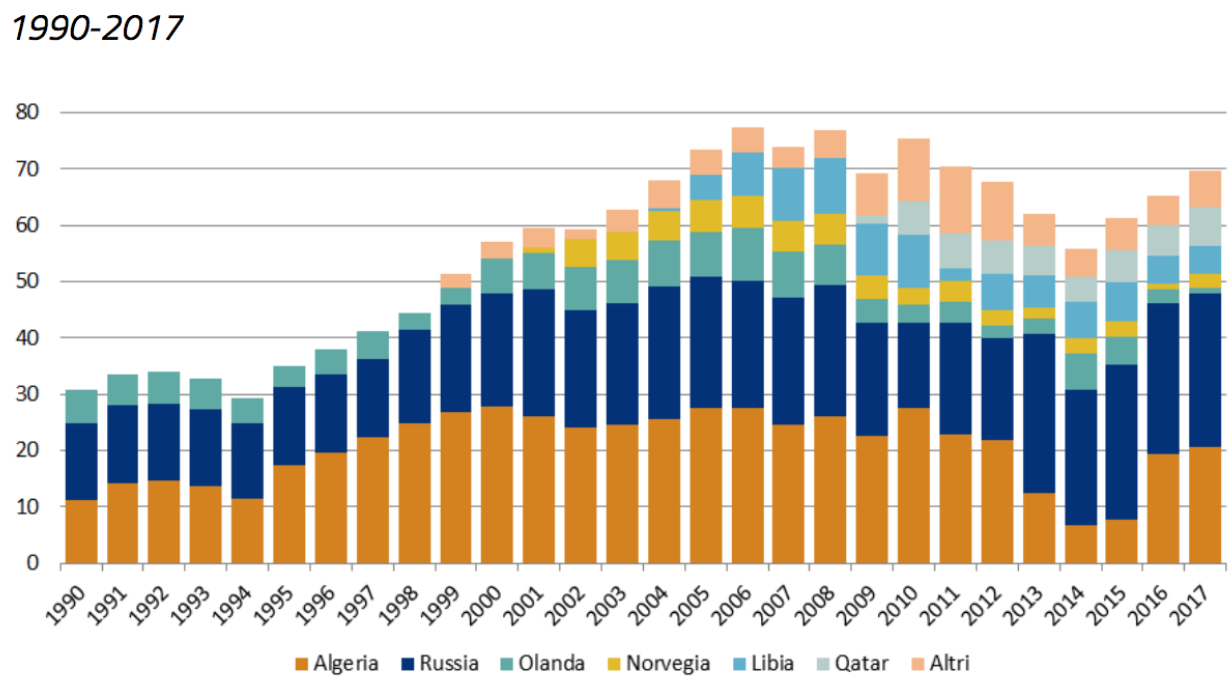

Figure 20 – Italian demand and suppliers, source ARERA

In the face of this need, the country demand of gas has increased across years, reaching peaks that double the requests in the 90s. As previously anticipated, the main suppliers are Algeria, Russia and, since 2005, Libya which has taken the place of Holland.

4.2.3 Barriers

There are two main obstacles regarding the adoption of digital solutions: the first one is represented by the actual normative which did not perceive the typology of data sharing actually used in many markets. The second one is the lack of standardization and exchange of data: typically, the race for the oil rewards who is faster rather than efficient, increasing in turn costs.

4.2.4 Benefits

Thanks to digitalization, in the upper side of the oil & gas supply chain there would be a saving up to 73 million dollars per year. This can be achieved through the exploitation of a massive amount of data for geologic purposes and collaboration of complex networks of offshore platforms. As stated by Wood Mackenzie, an international consultancy firm specialized in the energy sector, in order to reduce costs and risks it is necessary to adopt and exploit digital solutions already tested outside the energy sector, rather than relying on approaches built in-house. In the manufacturing and retailing side the adoption is easier and more general: it enabled companies to meet in a better way the demand, reducing potential bottlenecks and also increasing the efficiency. The usage of detailed data analytics permits to avoid potential expensive interruption of production, whilst the predictive maintenance can lead to a decrease of inactivity. Benefits can arise also from the exploitation of technologies such as IoT or AI that can lead, through automation, to a reduction of losses within the production systems.

4.2.5 Challenges

Despite the clear potential of digital technologies in this sector, a report of McKinsey (2017) states that even though there is awareness regarding this kind of technologies, the effective adoption of digital solutions within the supply chain does not reach the 43%. The typical causes rely on poor budgets and difficulty in the assimilation and integration of new technologies in the actual systems. So, the main challenge is to identify the right solution and make more transparent the effects that it can bring.

A solution is hypothesized by Achilles, a consultancy firm, which preaches that the integration of new solutions can be reached through the exploitation of the experience and competences

acquired from diverse sectors where these solutions are effectively adopted and used in the supply chain. In addition, they state that the sharing and learning of internal and external best practices are crucial in order to overcome and take advantage from potential benefits brought by digital technologies.

4.3 Technologies

In the following section, we will analyze from non-scientific papers the principal innovation trends that are running over the energy sector. In particular, we will start from a framework developed by Safe and Accenture regarding macro technologies and then we will go in depth with a research concerning all the enabling technologies that can unlock new value for the energy firms.

4.3.1 Analysis

The study carried out by Safe and Accenture on the future of the electricity market in Italy, shows how Italian and European utilities are going through a phase of strong change due to the evolution of the current competitive context, in which to undertake a success path it becomes fundamental to understand and satisfy the needs and expectations of an increasingly "aware" clientele. The market analysis highlights the low level of competition present in the energy sector in Europe. It is mainly due to the presence of regulated tariffs, which have an impact on consumer behavior, keeping them from seeking the best offer on the market. Moreover, in countries where regulated tariffs have been abolished, prices have not decreased, mainly due to the increase in taxes and the costs for the management of network infrastructures. Because

of these factors, consumers have hitherto been perceived as passive actors since the switching process from one supplier to another is often perceived as long and difficult.

However, the development of new technologies together with new digital trends and the attention to environmental issues are shaping a new generation of consumers. The latter present an ever-increasing demand for digital tools and customized offers in order to actively manage their energy supply and their consumption.

The evolution and technological innovation in the utilities' sector is therefore moving in two directions: a first axis of analysis is linked to technologies that can be defined as "Endogenous"; the second, instead, is linked to "Enabling Technologies".

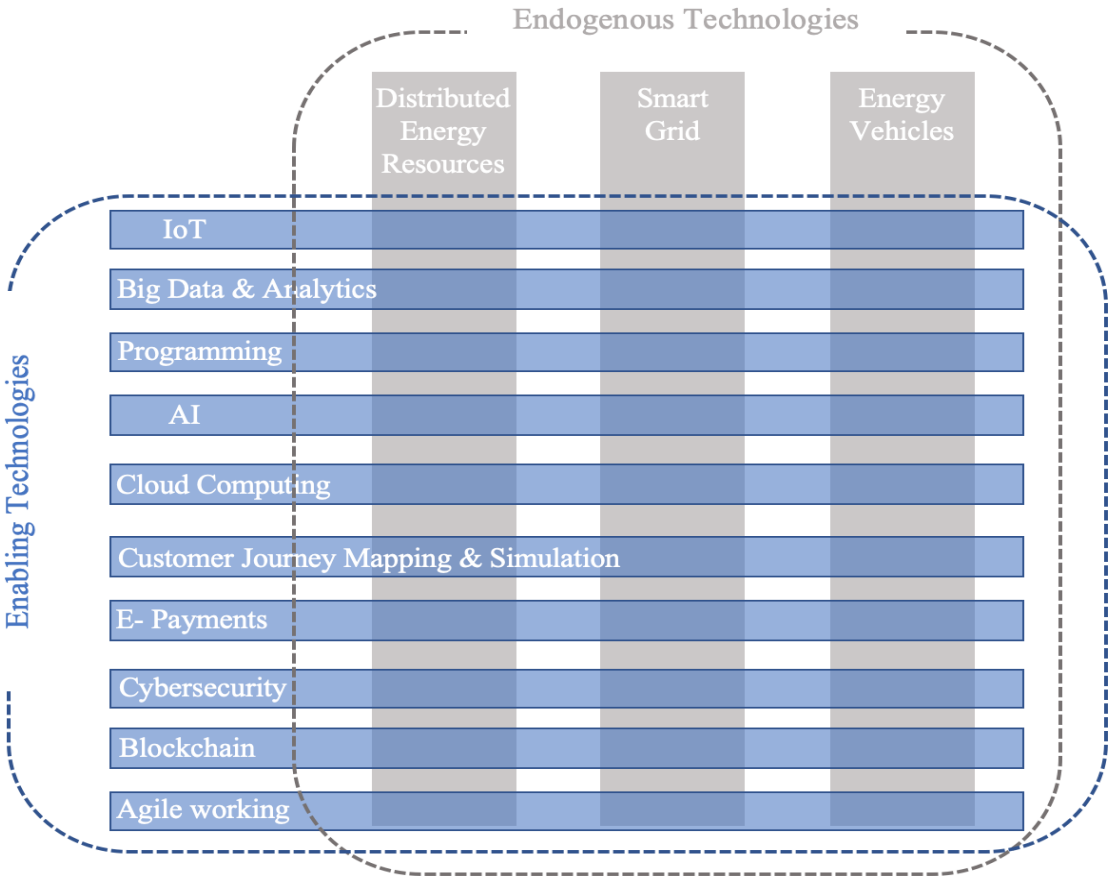

Figure 21 – Endogenous and enabling technologies

4.3.2 Endogenous Technologies

DER

With Distributed Energy Resources (DER) we refer to technologies that produce electricity from renewable sources and are distributed in micro production units (photovoltaic, micro hydro, mini wind). In addition to these, we refer also to all the technologies able to accumulate small or large amounts of energy that do not derive from fossil sources. The integration of the DER into the distribution network can be possible only through the development of an intelligent network supported by real time control technologies. Regarding the scenarios related to the energy storage in the decade 2016-2025, the compounded growth rate of the network of storage systems connected to the network is expected to be higher than 30% with a penetration rate above 2% (Source HIS - "Energy Storage forecast database", 2016.).

Smart grid

The birth of smart grids, therefore, arises from the need to create a new network infrastructure capable of effectively supporting the reliability, the efficiency of the service and the evolution of business processes along the value chain. The ultimate purpose is to manage the energy offer and distribution in the most efficient way through the use of software. Advantages are related to more flexibility in the energy consumption with the possibility to exploit renewable sources at lower costs. An example can be provided with the PAN Project (Puglia Active Network). Enel has implemented a project that integrates information and data with electricity distribution. Through wireless connections it is possible to know in real time the consumption trend and consequently to assess the environmental impact by minimizing the carbon dioxide emissions.

Electric Vehicles

As in the case of DER Electric Mobility the innovation in this field is not on the technical side but on its diffusion in the market. Thanks to the technological development of batteries reducing production costs and the growing social interest in reducing environmental impacts due to pollution, it is expected by 2020 in the Italian market a fleet of approximately 500,000 cars of both electric and plug-in hybrid electric vehicles. These numbers are still limited if compared to the over 37 mln of vehicles circulating in Italy at the end of 2015 but can be seen as a positive result in terms of growth rate and environmental impact. For what concerns the electric market, it is estimated that by 2020 these vehicles can generate an incremental value between € 500 million and € 1 billion (source Safe & Accenture report).

4.3.3 Enabling Technologies

As already anticipated, here we will go through all the technologies that allow to exploit these new technological opportunities. The analysis will start with the IoT trend, the soul of the digital revolution in the energy sector, and then it will continue with all the other enablers, from Big Data Analytics to the Blockchain.

IoT

IoT is the technological trend on which lot of firms base their new business models. Nowadays, more and more renewable energy sources are introduced into the network, increasing the challenges for energy operators. The more renewable energy sources are fed into the network, the more the IoT plays a crucial role in balancing the intermittency of renewable energy sources

with control algorithms managing the network, such as those for managing energy demand or for energy storage.

So, the supply between renewable and non-renewable sources is optimized.

We are therefore moving towards a new paradigm, a new generation of energy solutions that improve living conditions for citizens and lead to greater environmental sustainability. In addition to reducing costs for consumers, organized demand management and the use of smart meters optimizes energy consumption.

On the market, there are already solutions able to customize and automate the management of consumption (smart thermostats, remote electricity consumption control), the functioning of electrical appliances (smart appliances) and lighting. Controlling the evolution and spread of these potentially disruptive technologies will allow firms to understand how the energy of the future will be produced, distributed, consumed and "lived".

Big Data & Data Analytics

The first brick for building an effective IoT system is represented by Big Data and the utilization of data analytics algorithms. The flow of data generated by the energy sector is enormous: think about sensors, thermostats, networks connected to the cloud. The challenge of digitization is therefore to extract value from data in order to improve production processes and to generate new business models.

On the supply side, savings can be generated through the analysis of data based on deep learning algorithms capable of self-learning. The integration of weather data (temperature, atmospheric pressure, humidity, wind speed, direction of the sun, etc.), on energy production, consumption forecasts, characteristics of the territory (geolocation), makes it possible to optimize production and consumption derived from renewable sources. On the asset

management side, big data analytics applications provide improvements in the management of monitoring or scheduling of maintenance of production plants or networks.

The demand side is certainly the one that arouses the most interest. The spread of smart meters allows the consumer to access in real time the data concerning the electric consumption from any device (the smart meter, his own mobile phone, tablet, or pc), and to collect data that could be sell to third parties, such as example a home automation provider or a consumption analyst.

Programming

To manipulate Big Data and adapt technological systems inside the firm it is crucial to invest in informatics engineers. As stated by Prasant Bhatt, C programming languages are the best for energy engineer. Through this informatics language, the company is able to introduce more complex technologies like the AVR- Electrinify and implement robotic tools for automation.

Programming languages can provide the proper flexibility needed to embrace emerging digital technologies, from Blockchain to Cybersecurity or for managing complex clusters of IoT devices.

AI

Despite the massive amount of applications enabled by this branch of computer science, in the energy sector AI can have a huge impact on the development of intelligent energy storage technologies. This kind of technology allows to answer to the critical issue related to renewable energies: it's intermittent nature. As stated by Stephane Biloeau in the Toward Data Science Magazine, 'pairing Renewable Energy with AI-driven storage could be the change in paradigm

that differentiates projects going forward in this sector'. Indeed, it enables to reach customers' peaks of demand through renewable storages by means of predictive analysis, machine learning and grid-edge computing which, in practice, permit to drive real time adaptive storage dispatch through the energy network.

Cloud Computing

Cloud computing can be seen as a game changer in the energy sector since nowadays the demand is strongly increasing, leading to more and more strained IT infrastructures. Used in parallel with Big Data and related data analytics, many companies in the power generation industries are adopting new business models by making partnerships with cloud hosting service providers.

By doing so, the synergies can provide:

- Minimization of operational and maintenance costs with the maximization of productivity and assets' exploitation;
- Creation of flexibility and agility to respond to the changing customer needs.

Customer Journey Mapping & Simulation

Thanks to the previously analyzed technologies such as AI, Analytics and programming, companies in the energy sector are able to exploit a new marketing tool useful particularly for Retailing purposes: The Customer Journey Mapping.

As disclosed in the Energy Marketing Conference 2019, 'In a competitive choice market, a retail energy provider helps customers procure a supply of power while offering alternative

pricing options compared to utilities. In this type of market, far too often, customer satisfaction is left out of the equation when calculating a provider's success. With industry churn rates near 35 percent (and anecdotal evidence supporting that *monthly* churn rates loom around 4.5 percent), a customer journey map can be a powerful tool to help retail energy providers achieve differentiation and deliver competitive advantage over other providers'.

Indeed, many are the benefits achievable by companies such as:

- Better design of the customer experience
- Increasing capabilities for managing customer in real time
- Prioritization of customer's experience improvement efforts
- Opportunity for management and employees to discuss critically new products and services in a customer-centric approach

E-payments

As already highlighted, the rules of the energy sector are changing, going from seeing the final customer as a simple subscriber to the implementation of projects based on focusing on optimizing the customer experience, a key factor for the use of new smart payment methods.

Using e-payment tools, by accessing data on their own consumption, customers can acquire a greater awareness of their energy behaviors and consequently an eco-sustainable collective conscience.

The value of e-payment in the energy field enables pay-per-use business models, guaranteeing consumers greater flexibility, convenience and access to energy management. Naturally, all this is linked to the diffusion and development of IoT technologies.

Cybersecurity

With the rising trend of digitalization, many are the potential threats to be faced by companies. A clear example are the cyber-attacks made by skilled hackers. For this reason, Cybersecurity, as stated by the SETIS Magazine of European Commission, 'is of utmost importance in order to guarantee a safe EU transition to a decarbonized, decentralized and digitized system'. The combination of security algorithms with IoT application such as smart meters and appliances unlock many new safety services for the client. An example of the importance of this technology is provided by the 'Ukraine power grid attack (2016)', a cyber-attack which caused approximately 225 000 customers to lose power across the country.

Blockchain

The Distributed Ledger Technology was born principally for the use of cryptocurrencies. Nowadays, the improvement of the technology itself and the introduction of interesting smart features such as the smart contracts have launched the adoption of the technology in several different fields. One of them is the energy sector, where, according to PwC report, it can help companies in facing problems connected to an increase of energy costs and a reduction of revenues. Moreover, thanks to the technical characteristics of the technology, DLT can help utilities in improving their transparency in front of regulatory authorities, enhancing also the operations of energy systems.

Many are the application in this domain, from the synergies with IoT technologies for the development and management of Smart Grids, decentralized P2P systems that enable the trading between individuals of idle energy resources coming from the production of renewable energy sources, to the adoption of transactional digital platforms. A commercial report of

Deloitte states that "blockchain-enabled transactional digital platforms could offer operational cost reductions, increased efficiency, fast and automated processes, transparency and the possibility of reducing capital requirements for energy firms".

The technology is able to create many other benefits for firms like new business model through the creation of smart contracts (for example with suppliers) or as data transfer mechanism to improve the efficiency of operations with real-time information. In addition, the blockchain enables synergies with other emerging technologies further the IoT, such as cybersecurity and customer journey mapping.

4.4 Agile Working

Together with the development of digital technologies, a cultural change in organizations with the adoption of new methodologies for doing business is needed. One of the most important organizational trends is represented by the Agile Working.

The energy sector is rapidly changing year by year since 2000 and be the first to adopt a technology can be potentially disruptive. For this purpose, many small players started to offer Agile services to large energy companies, helping them in reacting to technology shifts and improving their innovation performances. In particular, as stated by Sau Sheong Chang, Managing Director SP Digital, Singapore Power Ltd, the adoption of software and hardware together with Agile Working techniques can strongly improve the communication across units of the firm, enhancing in turn the innovativeness of the entire organization.

The main pillars are:

- Delivery of training in Agile and Scrum methodologies;
- The creation of multidisciplinary teams;

- Assignment of agile coaches for the accompaniment during six sprints in the reformulation and digitization of business processes;
- Co-design with the client to identify the processes and activities that need to be adapted;
- Defining the role of the key stakeholders in the implementation of the Agile methodology in the company.

To sum up, each technology can be seen as a piece of a complex puzzle which has to be managed by firms to face up the digital transformation. The combination of them enables companies to create different products, services and processes that, in turn, have important impacts on company's performances. Thus, besides the specific purposes of a firm, we decided to comprehend all these technologies in the research with the aim to understand the overall level of Digital Strategic Orientation of firms.

5 RQ

From the analysis of both scientific and non-scientific papers belonging to the global literature we understood the importance to put under common factor the four areas of our research: ACAP, SO, Digital Skills and Trends of the energy sector. Indeed, the rise of the digital transformation is reshaping the structure of the supply chain and the rules of competition within the energy sector, pushing incumbents and newcomers to invest in technologies and internal changes. Hence, DSO represents the key mean to unlock companies from barriers and threats analyzed in the 'Sector Analysis' such as firms' Market Inertia, production decentralization and advent of new Big Players coming from other markets (IT, Digital). But still, how much have energy companies developed DSO to face new digital trends? How much energy companies are internally prepared for the digital shift? Those two general questions have been

processed and reorganized in order to build a theoretical framework. In particular, our first RQ aims at understanding which are the factors among managerial, interorganizational and intraorganizational antecedents that mostly impact on the development of the Technological Orientation of the firm. Indeed, those factors influence the DSO that is developed by the organization in order to spot and accumulate new knowledge, which, in turn, fuels the growth of ACAP and the improvements in the innovation performances. In details, our research aims at introducing DSO as a crucial component of ACAP antecedents, understanding the fundamental factor that influence DSO and finally, how each construct can contribute to the development of practical mechanisms for building the Digital Transformation process.

Ultimately, we want to investigate if differences are present between the impact that antecedents have on DSO measured as the current perception that the organization has today and in a five-year time horizon on new digital trends.

6 GAP IDENTIFICATION

The last section of the literature review is composed by the gap identification. After having analyzed more than 60 scientific papers and almost 30 scientific reports, some gaps have emerged, particularly after the analysis of the energy sector. Concerning the ACAP, we found a deep and structured literature with many different applications in diverse domains. Going on with the analysis, entering in the Digital Capabilities area, we have not found the same clearness of the previous topic, probably because Digital Skills and related technologies dramatically change in function of the research field. For this reason, we investigated the energy sector, trying to glimpse if that field needed this type of research or not.

What came out from the exploration was that many articles have been written for diverse technological applications and more technical purposes but still, in the scientific literature, there are few analyses regarding managerial implications that the digital transformation involves in the energy sector. It is missing the development of ACAP and organizational mechanisms together with managerial factors for those type of firms, which present a traditional static structure and an efficiency-focused vision of innovation (Guedes, Ziviani, De Paiva, & Herzog, 2017). Moreover, literature lacks a solid analysis on the state of the art of the digital technologies used in the energy sector, what digital competences are necessary to face the digital transformation of today and which of these are perceived to be more disruptive and therefore necessary to be integrated within the company in the next five years.

The Literature presents lots of developments regarding the concept of ACAP but some researchers have understood that more has to be discovered between the innovation process and related performances. ACAP represents just a part of the overall picture: it constitutes actually the bridge between Strategic Orientation and Innovation Performances. However, much more has to be discovered by investigating the Strategic Orientation of the firm, focalizing on its components and antecedents, but also on the effects that it brings to the prior related knowledge of a firm. Since the large width of the gap, we decided to focus specifically on the factors that, we think, can potentially affect the strategic direction of a firm. SO will be declined as Digital Strategic Orientation since the Digital Transformation is significantly relevant for mostly every type of organization, and few are the researches on the required Digital Skills for this technological transition.

Thus, we think that a more robust and quantitative analysis has to be carried out, analyzing the role of senior manager, dedicated BU, methods and organizational practices to undertake innovation projects for the DSO of the company. Considering also how much non-scientific papers are stressing the potential impacts that new technologies are bringing in terms of

operations, products/services and types of business models in the energy market, DSO is a key element for companies to evaluate new technological information and, in a second moment, to absorb them.

7 THEORETICAL FRAMEWORK

We propose a new framework that wants to represent the key antecedents of Strategic Orientation (SO) and their relative level of influence. To understand the reason under this choice, we must make a step back, returning to the concept of ACAP. We have largely discussed about this concept in the Literature Review, starting from the seminal studies of Cohen & Levinthal (1990) which declared ACAP as the firm's ability to recognize the value of new knowledge, assimilate it and exploit it for commercial purposes, arriving to a more complex and developed construct, where the ACAP represents a three-layer process of learning: the Exploratory Learning with the activities of Recognize and Assimilate, Transformative Learning with Maintain and Reactivate and finally Exploitative Learning with Transmute and Apply new external knowledge.

Many are the researchers that carried deeper studies on this field, trying to understand which were the specific rules to follow in order to exploit external sources of knowledge. Thus, by skimming and unpacking the concept, new insights came up and new lines of thought were drawn. One branch of these researches was focalized on what mostly characterize the ACAP, the prior related knowledge. Prior related knowledge represents the fundamental fuel of the construct (Cohen & Levinthal, 1990; Zahra & George, 2002), the key mean to understand which explorative direction to choose and how to effectively implement the knowledge

acquired from external sources. From studies emerged that companies require both market and technological knowledge to properly feed their ACAP (Narasimhan et al., 2006). Therefore, understood the importance of this construct, authors started investigating the nature of antecedents that influence it.

Zhou et al. (2005) proposed a new distinct construct, Strategic Orientation (SO), declining it in two dimensions: Market and Innovation Orientation. Those represent the firm's strategic directions to create proper organizational values to achieve better performances. This construct was further reprocessed and proposed again in the scientific literature, where it is seen as the direct antecedent of ACAP. In fact, besides they are different from a conceptual point of view, the values of a firm can strongly impact on the exploration, assimilation and exploitation of new knowledge. Going on with this logic, Atuahene-Gima, Slater, & Olson (2005) anticipated that SO may be essential determinant of ACAP because it is involved in the utilization of prior related knowledge.

Hence, conscious of these considerations, it is proposed a new vision: 'Absorptive Capacity may be an essential counterpart to internal innovation in linking Strategic Orientation with firm Performances'. In this way, a new line of thought has been drawn: ACAP represents the bridge to achieve higher performances, where SO represents the main antecedent to start the ACAP processes. By extending the work of Zhou et al. (2005), three types of SO are classified: Responsive market orientation, Proactive market orientation and Technological orientation. These three factors influence the three layers of ACAP: Knowledge Exploration, Retention and Exploitation. The synergies of the former three factors create a cocktail of effects that, in last analysis, have a positive impact on the overall level of ACAP which, in turn, improve the innovation performances of the firm. This literature excursus validates the importance of looking deeper into Strategic Orientation, trying to understand which are the factors that

influence it. Seminal studies of SO like the one of Zhou et al. (2005) proposed three kinds of antecedents: organizational support, market turbulence and technological turbulence. Focalizing on the first one, it represents the procedures and the culture structure which, in a proactive way, can have a positive impact on SO.

Another important study that focus on this argument is the one of Dahan & Shoham (2014), where the authors suggest new types of antecedents: the Managerial ones that refer to the emphasis of the top management and their risk-taking attitudes towards new technological directions; the Departmental ones that involve the management of conflicts and the connectedness of employees and finally the Organizational ones which focus on the concepts of formalization, centralization and Reward system.

Based on these analyses, we glimpsed some lacks in the scientific literature regarding those antecedents. In particular, we want to focus on the Technological Orientation of SO by investigating new antecedents that characterize it, remaining in line with the thoughts of authors. Therefore, we coined from the technological branch of SO the Digital Strategic Orientation, which represents the Strategic Orientation of the firm regarding the new emerging technological opportunities and their potential positive effects on the organization's performances and results. Linking DSO with firms' innovativeness, we studied firms' openness to new ideas, products, and processes, including their willingness to change and adapt to emerging technologies and market trends (Acur et al., 2012; Calantone et al., 2002; Hurley & Hult, 1998). So, Analyzing the perceived impact of new digital trends and technologies, it is possible to understand the state of art of the DSO of firms under examination. The aim is to provide a tool for firms and managers which would help them in understanding which are the internal conditions required for an organization in order to properly orient themselves across multiple technological directions.

In the next subsections, we will go through all the antecedents that compose our model and influence the Digital Strategic Orientation. The latter represents the declination of the construct Strategic Orientation in function of the Digital Transformation that is running over the energy Sector. In addition, we will iterate the analysis two times: in the first round, we will look through the influence that antecedents of SO will have on the Short-term, whilst in the second round on the Long-term. We expect that the following developed hypothesis are coherent both in a short-term and long-term perspective. In this way, by analyzing these two aspects of SO we can have a complete picture of a model that embraces some significant strategic aspects of firms that are facing the Digital Transformation. Before entering in detail, the whole model can be summarized with the following *Figure (23)*.

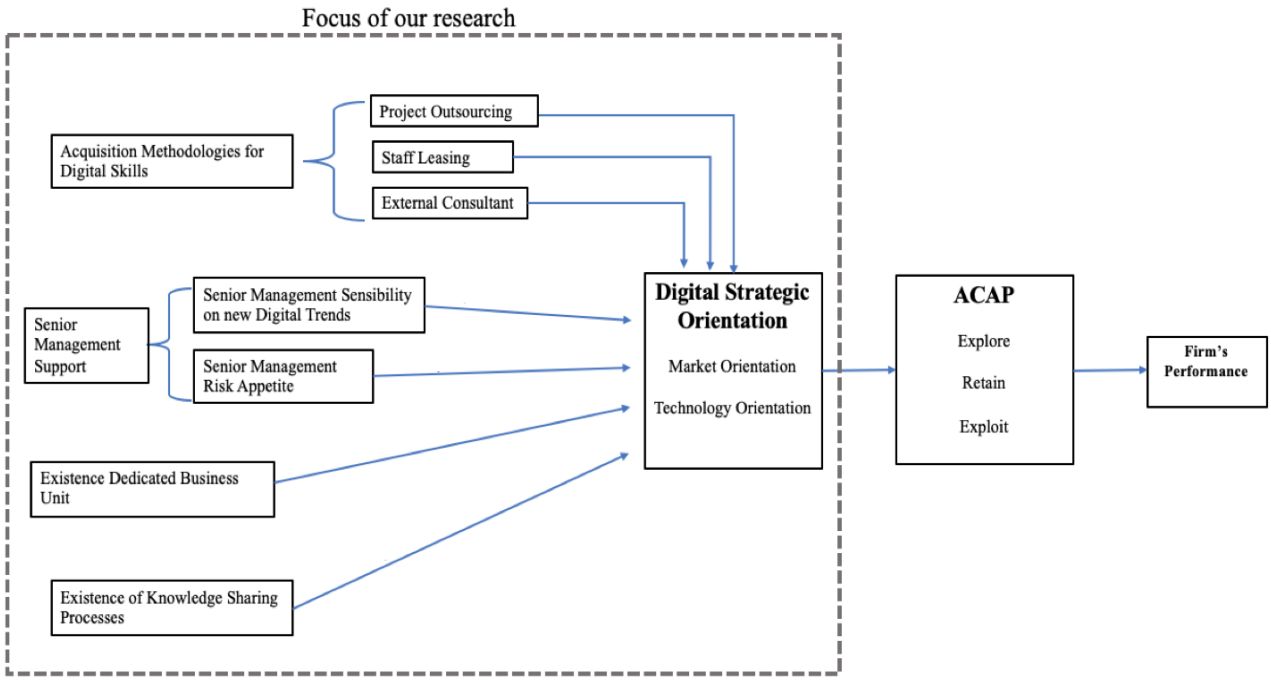

Figure 22 – DSO theoretical framework

Senior Management Support

The dependent variable which study the impact of senior management practices and orientation towards new digital trends on the overall DSO of the company is broken down into two sub-variables:

- *Senior Management Sensibility* on new digital trends
- *Senior Management Risk Appetite*

Senior Management Sensibility

The Attention Structures of an organization is a construct which represents the multiple factors around a firm that influence the settings and the allocation of effort, time and directions of the organization decision-makers during their activities (March and Olsen 1976). Those factors are typically connected with the cultural, economic, social context and also the competition, which have a significant impact on the identities and interests of those that take decision inside the firm. Thus, the attention of the firm is characterized by both the so-called Rules of the Game (Shepherd et al., 2017), the principles under the decision-making process which are influenced by diverse activation triggers (Zahra & George 2002) such as the technological shift involved by the digital transformation, and the most important Players within the organization. The Players are individuals or group of them that incline the attention in function of their skills, beliefs and values (March and Olsen, 1976). The most influential ones within a firm are typically the CEO and the Senior Management (Hambrick & Mason, 1984). Thus, the power, the position and role of individuals provide entrepreneurial directions, which, in turn, strongly influence the whole decision-making process within the firm.

In this study, we are interested in the connection between the Senior Management Sensibility, which is the propensity of the firm's top management in focalizing on external stimuli, and the Strategic Orientation of the firm. The latter, may be influenced by environmental factors, like market uncertainty, as well as by organizational characteristics, such as firm structure, culture, and systems (Ginsberg & Venkatraman, 1985). According to the context, some aspects have a higher impact than others. Zhou et al. (2005) investigate on the relationship between strategic orientation and two antecedents: Organizational Culture and Managerial attitudes towards changes. Group culture refers to employee unity, cooperation, and sense of belonging into the firm. The innovation orientation of firm is facilitated by managers willingness to change. Managers' attitude and organizational structure/culture both impact positively on market orientation which is one of the components of Strategic Orientation according to Moon (2013).

By following a market orientation, analyzing customers' current and future needs, technological trends and competitors' activities, a firm can acquire and disseminate market intelligence throughout the organization (Kohli & Jaworski, 1990; Narver & Slater, 1990). In order to develop this exploratory capability firms needed a stock of prior related knowledge to fuel it (Cohen & Levinthal, 1990; Zahra & George, 2002). Moreover, from studies emerge that companies require both market and technological knowledge to properly feed their ACAP (Narasimhan et al., 2006). These components strongly impact on the exploration, assimilation and exploitation of new knowledge linking SO, ACAP and firms' performances. Technological and market orientation allow firms to keep them adjourned on new innovation on the market. The last trends shown by different scientific and non-scientific sources highlight how much companies coming from many different sectors are investing in new digital technologies to improve the efficiency, performances and to offer new kind of services that can have a disruptive impact on the market. Reconnecting us to the Ocasio construct, the Rules of the

Game are changing also in the energy sector, modifying the Attention Structure of firms inside it (Shepherd et al., 2017). Thus, an increase of the Sensibility of the Senior Management may lead to a greater consciousness of the entire organization regarding Digital trends, improving the capability to recognize the value under new technologies and opening to the acquisition of Digital Skills needed for the Digital Transformation (Fernandes et al., 2017).

Hp 1.1

A higher value of Senior Management Sensibility on new digital trends is positively associated with the Digital Strategic Orientation of the organization.

Risk Appetite of Senior Management

Dynamic Managerial Capabilities (DMC) represent the capacities of managers to build, improve and transform the knowledge base of an organization (Adner & Helfat, 2003). We have previously cited the importance of the top management in the decision-making process as they have the power to incline the attention over some specific directions rather than others (Shepherd et al., 2017), which is a crucial part for the development of DMC but still we are missing another fundamental brick: the Regulatory Focus theory. It is a motivational theory with the target of studying the antecedents of strategic inclinations, focuses and behavioral changes (Kark & Van Dijk, 2007; Weber & Fried, 2011) and it funds its bases under psychological studies. Indeed, Higgins (1998) stated that there are two kinds of people in the world: those that seek pleasure and those that avoid pain.

Going deeper to this direction, Tuncdogan et al. (2017) proposed that individuals and groups of individuals can have generally two kinds of focuses: the first is the Promotion Focus, which is a proactive attitude that pursue the maximization of gains coming from external opportunities while the second is the Prevention Focus, which consists in the minimization of potential mistakes and focalization on actual performances and internal environment. The promotion focus is directly linked with the management team's willingness to take risks (Hamstra, Van Yperen, Wisse, & Sassenberg, 2011) and it is assumed, by the study of Tuncdogan et al. (2017), to increase the unit's attitude toward exploratory innovation. According to Miles, Snow, Meyer, & Coleman (1978), proactiveness reflects the behavior to continuously search to market opportunities and experimentation for potential responses to changing environmental trends. Proactiveness and Risk taking behaviors combined with other measurement variables are conceptualized as key dimension of a strategic orientation construct by Ginsberg & Venkatraman (1985). Moon (2013) suggests that this positive attitude toward changes, undertaken by top management, is essential to develop novel solutions. Following this path, as stated by Dahan & Shohan (2014), top management's favorable attitude toward risk-taking fosters strategic thinking within the organization.

Building around this concept, we expect that Senior Management Risk Appetite will represent a crucial factor for the development of the right SO. In particular, we think that this risk propensity may have a positive impact on the DSO of the firm.

Hp 1.2

The Senior Management Risk Appetite is positively correlated with the Digital Strategic Orientation of the organization.

Digital skills acquisition methodologies

Brady & Davies (2004) and Keegan & Turner (2001), suggest that HRM practices related to a project play a crucial role in enhancing a project team's potential ACAP by facilitating the accumulation of prior related knowledge through a knowledge management program. Thus, considering HMR as the various work contract methodologies, we analyze their impact on Digital Strategic Orientation.

Zahra 6 George 2002 theoretical framework divides ACAP into Potential and Realized considering as antecedents of the construct External sources and Knowledge complementarity. External knowledge sources significantly impact PACAP. These sources include licensing and contractual agreements (Grandstrand and Sjolander, 1990), acquisition (Chaudhuri & Tabrizi, 1999) and inter-organizational relationship such as R&D consortia, alliances and joint ventures (Vermeulen & Barkema, 2001). The development of future capabilities will be influenced by firm's exposure to knowledge within its environment (McGrath et al., 1995).

According to transaction cost theory (Williamson, 1989), markets' transactions always leads to higher technical efficiency compared to vertical integration. Jacobides & Winter (2005) have argued that firms internalize activities that they perform with greater capability. Thus, since the focus of our research is on Digital Skills which involve different processes and activities respect the ones of traditional energy firms, by looking at the study of Gabriel & Kirkwood (2016), we think that the adoption of external consultants represents a good way to overcome the digital transition compared to the internal development of new project. Indeed, in the research, the authors express the importance of external consultants as key stakeholder

for addressing SO into the right direction, thanks to their relevant technologies knowledge and their capabilities such as marketing analysis and forecasts support.

However, exposure to different external sources of knowledge is not sufficient for a firm to guarantee a higher level of PACAP (Fuller, Edelman, & Matusik, 2000). It should be supported by knowledge complementarity (Bunderson et al., 2000). This knowledge complementarity or "prior related knowledge" allows successful innovation transfers of technical and knowledge capabilities within an outsourcing relationship. Reliance on external consultants and contract leasing staff would create a customer-supplier relationship which is analyzed under the ACAP perspective by Thomason (2011). In this study, both client and supplier contribute to an outsourcing relationship from which innovation may emerge. Moreover, they suggest a different point of view: the innovation process can present higher performances if the firm Human Resource Management focuses on hiring from within than hiring externally.

Indeed, in a world in which DS are fundamental to firm survival, both internal and external sources should be considered, balancing the external knowledge acquisition with internal ACAP development. The methodology in digital skills acquisition which embraces these two aspects may be the consultancy. Gans et al. (2003) agree that consultants, exploiting their wider and sophisticated population of potential partners, can increase the operational effectiveness of markets for technology. Through networking with professionals in other organizations, they continuously keep themselves adjourned about technological developments in order to be more exposed to emerging opportunities and to identify value-adding knowledge to be absorbed (Allen & Lafollette, 1977). So, relying on external consultants allows the client firm to develop a first critical capability to identify external sources of innovation. In this way, the organization

can assess the right Strategic Orientation to follow for integrating Digital Skills within the company.

Therefore, we expect that work practices that rely on work contracts with external consultants and with external Staff Leasing companies can have a higher positive impact on the creation of a greater Digital Strategic Orientation as they develop internal knowledge integrating external knowledge components without encountering the same risks as for projects completely carried out by external companies (full outsourcing) which typically leads to potential spillovers. Indeed, opening itself up for a partnership generates the chance to gather valuable knowledge from external stakeholders. Despite this, it also involves risks related to the outflow of internal core competences, which represents a significant threat for the organization. The necessary openness is thus both a strength and a potential weakness (H Chesbrough, Vanhaverbeke, & West, 2006).

So, we imagined a continuum on the positive impact that this acquisition methodologies could have on Digital Strategic Orientation. For projects completely carried out by external companies (full outsourcing), we expect a lower impact on Digital Strategic Orientation considering also the fact that they are too disconnected from an internal organizational unit. The positive impact increases moving then from Staff Leasing to external consultants.

Hp 2.1

A higher level of the adoption of Staff Leasing for Digital Skills acquisition is positively associated with the Digital Strategic Orientation of the organization;

Hp 2.2

A greater level of the adoption of External Consultant services for Digital Skills acquisition is positively associated with the Digital Strategic Orientation of the organization;

Hp 2.3

A higher level of the adoption of Project Outsourcing practices for Digital Skills acquisition is positively associated with the Digital Strategic Orientation of the organization.

We expect that the magnitude of association of each acquisition methodology with DSO will be significantly different. In particular, we suppose that External Consultancy and Staff Leasing will have a higher correlation in respect to Project Outsourcing.

Existence of a dedicated Business Unit

Establishing a dedicated unit addressing Innovation or R&D functions allows companies to formalize decisions that deeply impacts the organizational existing structures and routines. The role of these units is to internally develop the firm's core technological competencies while exploring the market by structuring an open innovation processes. This unit allows the firm to effectively leverage on external sources of technology (Chiesa & Frattini, 2008), becoming a company warehouse for the know-how (Zollo & Winter, 2002).

According to the ACAP construct, Kale & Singh (2007) declined the concept of potential and realized ACAP within the functions of the BU dedicated to R&D: capture, integrate, and disseminate experience. Indeed, once the external technological knowledge is captured and assimilated by the BU, the latter has the purpose of synthesize, reconfigure and spread the knowledge inside other units, aligning it with companies' objectives. The existence of a dedicated BU focused on innovation denote an increase of ACAP leading to an integration to internal and external sources. (Faraj & Sproull, 2000; Kale & Singh, 2007).

Moreover, a dedicated BU allows firms to better assess the state of art of a specific technology by constantly monitoring the market and updating related technical skills. Hence, by adopting this structural solution, there is a reduction of the risks that critical technical competencies become too dependent from outsourcing technologies. BU allows to closely monitor changing in customers' behaviors supporting company market orientation in developing new product or services to address customers' needs. Its positive effect for inbound open innovation is also given by the creation of routines which aim is to organize and codify procedural knowledge gained from prior experience with R&D outsourcing. These routines are a direct consequence of the establishment of a dedicated BU (Kale & Singh, 2007), which helps manager thanks to a more formalized structure.

By integrating the focus on technological development with the continuous exploration of the market in search of innovative solutions, the creation of a business unit dedicated to digital innovation plays a fundamental role in increasing a company's SO. It may have a positive impact on both the components of SO: Market Orientation and Technology Orientation. In terms of ACAP, the BU has the task of exploring the market, assimilating external knowledge and then sharing and disseminating it within the organization, fostering its digital culture on new trends and technologies potentially disruptive for the energy sector, forcing the company to change and to acquire new competences.

Hp 3.1

The existence of a dedicated business unit for the digital innovation is positively correlated with the Digital Strategic Orientation of the organization.

Knowledge Sharing

In order to develop a Market Orientation culture, organizations need a wide use of coordination mechanism to disseminate information and to respond to market changes (Kohli & Jaworski, 1990; Narver & Slater, 1990). Taking up the concept of the role of group culture in developing a Strategic Orientation by Zhou et al. (2005), employees are encouraged to work together and participate in the firm's decision-making process. Innovation is facilitated by the dispersion of ideas within an organization, which in turn generate new ideas (Damanpour, 1991). Employees are more willing to accept new ideas and engage in innovative activities through the connection of functional units, rather than following their own routine modes of problem solving. It generates information sharing and interaction methodologies. (Han *et al.*, 1998).

Going back to Cohen & Levinthal (1990), they state that the ACAP of a firm does not reside in any single individual of the organization but actually it is the product of connections among individuals' capabilities. However, from a micro perspective, the ACAP strongly depends on each individual abilities and knowledge, but to obtain value from the construct it is crucial to build a social network within the firm (Tortoriello, 2015). In order to create this internal environment, Foss, Husted, & Michailova (2010) studied how to fill the gap between individuals and groups and claimed that the only way to solve this problem is to properly structure organizational mechanisms. In particular, they envisioned sharing activities as a key factor to create a scenario in which knowledge is processed and new directions are discovered. Sharing capabilities revolve around a set of different organizational mechanisms such as job rotation, mobility, leadership and socialization.

Jansen et al. (2006) together with Cohen & Levinthal (1990) and Zahra & George (2002) provided an overall picture of all the segments that constitute the absorptive capacity: exploratory, transformative and exploitative learning. Focalizing on the first factor, for the

studies were used two items that here we report: '*Employees regularly approach external institutions to acquire technological knowledge.*' and ' *We often transfer technological knowledge to our firm in response to technology acquisition opportunities*.' Hence, to explore properly the external environment the firm needs, almost with the same weight, being in contact with external sources to recognize and sharing internally the knowledge to assimilate (Lewin & Massini, 2011).

From this point of view, we expect that synergies may arise in the connection between the firm's ability to put under common factor knowledge inside the organization and the level of Market and Innovation Orientation. Specifically, knowing the positive impact of both in the development of SO which is directly linked with ACAP, we hypothesize that the Knowledge Sharing of the firm may have a positive influence on the SO of the organization.

HP 4.1

A higher value of Knowledge Sharing across the firm is positively associated with the Digital Strategic Orientation of the organization

8 RESEARCH METHODOLOGY

In this chapter, we report a detailed explanation of how data has been collected and consequently, how we built our database. Therefore, we start with the sample description, then we go through the variables selection and questionnaire development and finally we explain the linear regression model which is at the basis for the hypothesis tests.

8.1 Sample Description

As previously anticipated, the field of study of our research regards the energy sector. Being a complex market due to its particular supply chain and government normative, we decided to exploit, as primary resource of data, the AIDA database of the Bureau Van Dijk. It was the perfect starting point for our research since it presents already a structured segmentation of companies in very different markets. Entering inside the energy sector, we were initially able to decline companies in function of their segmentation: generation, transmission, distribution, development of technologies, energy management and retailing. Then, we filtered companies according to our objectives and requirements, starting from companies belonging to the Gas and Electricity sectors.

The main filters used are shown here:

- company name
- number of managers/employees
- current capitalization
- revenues
- ROA
- total immaterial immobilization
- index ATECO 2007 for the segmentation, clustered in:
    - Generation
    - Transmission
    - Distribution
    - Energy Management
    - Development of Technologies
    - Retailing

After a first skimming of the database, elaborated on Excel, emerged that approximately 1300 firms satisfy the minimum number of employees required for the analysis (>10). So, the first parameter was chosen in order to classify firms in function of their size, calculated through the number of employees/managers. Then current capitalization, revenues and ROA were added in order to provide a financial dimension and to have an overview of the actual performances of companies. Then, we identified total immaterial immobilization index as a good proxy of the innovation investments to complete the first holistic sight of our sample characteristics.
We exploited the ATECO 2007 index of AIDA to cluster companies in function of the activities that they perform inside the market, and the results can be seen in the next chart.

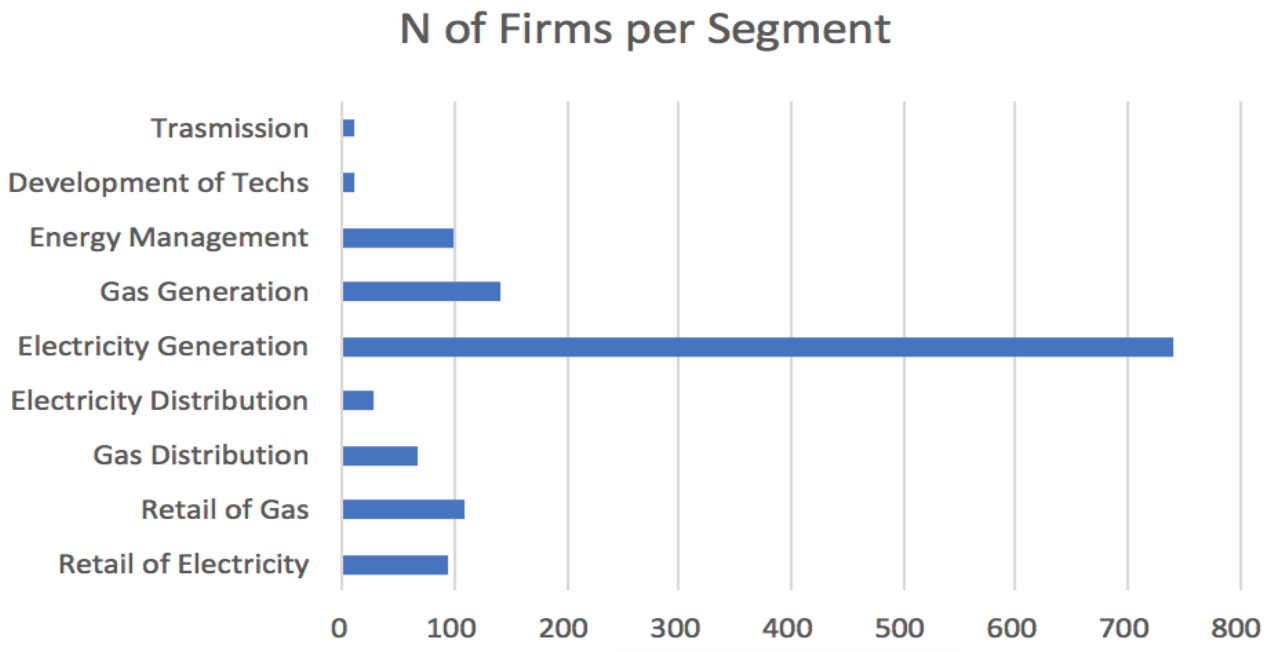

Figure 23 – Firms per segment, source AIDA

For simplicity, we grouped Electric and Gas figures to provide more concentrated sets of firms for the next steps of the analysis. The following chart provides the percentage for each cluster of firms.

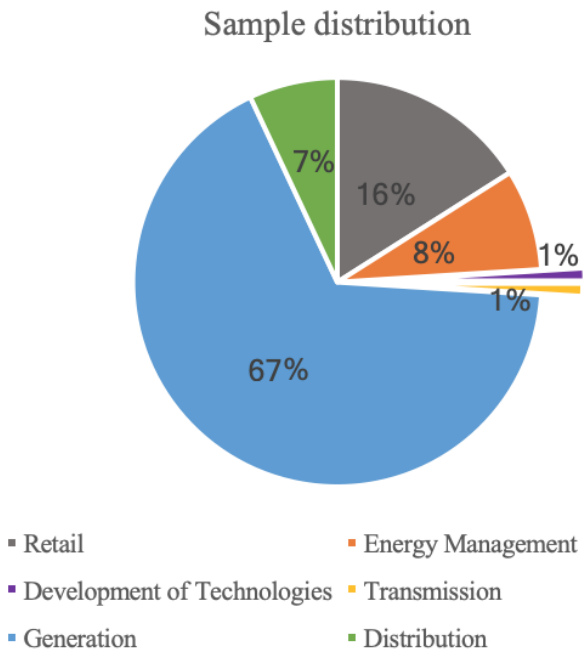

Figure 24 – Energy segment, source AIDA

As we can see, the sample is characterized by a strong participation of companies that belong to the Generation segments (67%), followed by a 16% of organizations dedicated to energy retailing activities, 8% of Energy Management and 7% of Distribution. The minority is represented by firms belonging to the Development of Technologies and the Transmission.

This sample constituted the starting point of our research: we analyzed the website of each company, gathering further information such as telephone number and email of managers in order to contact them after the development of a structured survey. However, the response rate for the survey was quite low, approximately 6,4 %. So, the final number of companies from which we collect data has been reduced to 83.

8.2 Questionnaire Development

The questionnaire was structured starting from a first analysis of scientific papers related to our research. The variables collected from previous studies were categorized into six macro

research areas. Having examined the structure of previous questionnaires and constructs we have therefore adapted the research variables by introducing the digital component that actually represents the key factor of our research. Then, a macro questionnaire was developed as shown in *Table (4)* and *Table (5)*.

Through a phase of skimming and selection of the questions most related to our research, we developed the final survey. DSO was composed integrating questions of what we called Digital Awareness and Strategic Orientation. The survey analyzes the relative importance of all the new digital solutions that are impacting the markets. For every single technology, the importance is being sought today and in five years. Then, we went on asking for some managerial and organizational mechanisms which could impact on DA and consequently to firms' ACAP performance.

Table 4 – Questionnaire development from literature

Construct	Questions	Sources
Strategic Orientation *Strategic direction of the company as a set of values, attitudes and objectives that allows to gather relevant prior knowledge from a technological and market point of view.*	· Our company pays close attention to innovation. · Our company emphasizes the need for innovation for development. · Our company promotes the need for development and utilization of new resources. · During the last three years, the company has introduced or improved new manufacturing methods. · During the last three years, the company has introduced new practices to improve knowledge management (internal or external knowledge). · During the last three years, the company has introduced new practices to improve work organization in the company. · During the last three years, the company has introduced or improved new delivery or logistical methods. · During the last three years, the company has introduced or improved new auxiliary processes.	Zhou et al., 2005; Molina-Morales, 2018; Andersen & Nielsen, 2009
Digital Awareness *Perception about new technologies and digitalization*	· Does your company perceive digital technologies as a threat or an opportunity? · To which extent digital transformation is necessary to cope with new technologies? · Is it possible to foresee the development of new disruptive technologies and react accordingly? · To which extent your past knowledge and experience influence the acceptance of new digital approaches?	Volberda et al., 2009; Ulrich Dolata, 2009; Liao & Fei, 2008

Construct	Questions	Sources
Managerial Antecedents *Managerial Practices, Processes and Vision that affect ACAP*	· Are all the senior team's members committed to the development of digital goals for the organization? · Is there total agreement on your organizational vision towards the digitalization of the company? · Is the innovation process based on one shot digital investment or is it based on continuous investments in new technologies which emerged during the period established for the innovation project? · To which extent is important for managers to show to employees the effects on the performances that digital brings in the short term? · To which extent the top managers support the development of digital innovation projects? · To which extent your organization is willing to take risks over new digital technology investments?	Tsai & Ghoshal, 1998; Sinkula et al., 1997; Lin & McDonough, 2012; Pasmore, 2015; Andersen & Nielsen, 2009
Inter-organizational Antecedents *Definition and classification of activities and coordination practices directed towards the achievement of organizational goals*	· Do your employees base their problem-solving approach on standardized and proven methods or do they try to adopt innovative approaches? · Do your innovation projects start from low level departments or from the top management? · Are there cross-functional teams working on innovative ideas? · Are there spaces or activities that enable employees to provide ideas and foster creativity	Andersen & Nielsen, 2009; Jaworski & Kohli, 1993; McKinsey, 2018

Construct	Questions	Sources
Intra-organizational Antecedents *Definition and classification of activities related to external sources of knowledge*	· In the past three years to what extent has your organization worked together with other organization for digital product and/or service innovations? · Did your firm acquired external R&D for digital purposes in the last five years? · Which is the level of relational specific investments with external companies for digital projects? · Based on past-experience to which extent the risk of spillover on digital projects is present in co-working partnering with external companies?	Alexiev, Volberda, & Van den Bosch, 2016; Zaheer, McEvily & Perrone, 1998; Heide &John, 1992; Fosfuri & Tribò, 2008; Tsai & Ghoshal, 1998; Sinkula et al., 1997
ACAP *Recognize, Assimilate, Maintain, Reactivate, Transmute, Apply*	· We frequently scan the environment for new digital technologies · We often transfer technological knowledge to our firm after the acquisition of new technologies from the market · Employees store technological knowledge for future reference · When recognizing a business opportunity, we are able to exploit our cumulated digital knowledge · We are proficient in exploiting digital knowledge for the development of new products or services · It is well known who can best exploit new digital technologies in our firm	Arbussà & Coenders, 2007, Jansen et al., 2005, Szulanski, 1996; Arbussà & Coenders, 2007, Marsh and Stock, 2006; Smith et al., 2005; Garud & Nayyar, 1994; Todorova & Durisin, 2007

Table 5 – Final questionnaire

To which degree the following digital skills are important in your company today? To which degree the following digital skills will be important in your company in five years?	-Digital Awareness (acquisition of awareness of the importance of digital transformation, anticipating changes and challenges) -Coding & Programming (use of programming programs and languages to implement theoretical specifications and develop computational thinking) -Agile Working (use of digital tools and solutions to enable remote work and remote interaction with colleagues) -Artificial Intelligence & Machine Learning (design and / or use of solutions based on artificial intelligence to optimize business processes or innovate the business model) -Blockchain & Cryptocurrencies (use of Blockchain-based tracking / exchange systems mainly in cryptocurrency) -Cloud Computing (use of cloud computing solutions for data storage, sharing and analysis) -Customer Journey Mapping & Simulation (design and / or mapping and / or analysis of the interaction process between consumer and company on the different channels) -Cybersecurity (design and / or use of solutions for the protection, availability, confidentiality and integrity of information assets) -Big Data & Data Analytics (use of big data and data analytics tools to support projects and / or business processes) -Digital Tools for Entrepreneurship (identification of innovative ideas based on digital innovation and knowing how to develop them in a business environment) -E-Procurement (design and / or management of the procurement process of goods and services using digital platforms) -Mobile Payments (use of mobile payment solutions and their effective use for the development of the relationship with the end customer) -Modeling, Simulation & Robotics (development of models applicable in the field of robotics and use of the most promising applications) -Technologies 4.0 (design and / or use of additive manufacturing and 3D printing solutions in the manufacturing context) -Virtual Communication (use of social network tools to communicate in a personal and corporate environment)

Regarding the acquisition of digital skills, to what extent does the company use the following practices? -Normal labor contracts -Administration Contracts / Staff Leasing -External consultant in "time & material" mode -Use of external outsourcing companies for specific projects
Which is the sensitivity of senior management to the importance of digital skills for the success of your business? How much is senior management available to take risks in investments in digital innovation projects? To which degree the company is able to share knowledge and share digital skills between different work groups and organizational units? Has an organizational unit been set up to develop new digital innovation projects? To whom does this unit report organizationally?

8.3 Variables

In this section, we will go through all the variables that constitute our model. As previously shown in the picture (*Figure 23*), our model is characterized by three types of variables:

- The dependent variables, which are the Digital Strategic Orientation (DSO) of the firm in the short term (TODAY) and in the long term (in 5 YEARS)
- The independent variables, which are 7 and are classified in 4 main clusters:
    - Senior Management Support, that comprehend Senior Management Sensibility and Senior Management Risk Appetite
    - Acquisition Methodologies, that comprise Staff Leasing, External Consultants and Project Outsourcing
    - Existence of Dedicated Business Unit
    - Knowledge Sharing
- The control variables, which are 3:
    - Age, which represents the number of years since the foundation of the company
    - Size, that describes the volume of the company in terms of revenues
    - Industry, which decline the company in function of the sector where it belongs

From this quick overview, we will show how each variable has been measured and processed in the research analysis.

8.3.1 Dependent Variables

The chosen dependent variable is the Digital Strategic Orientation. DSO represents the Strategic Orientation of the firm regarding the new emerging technological opportunities and their potential positive effects on the organization's performances and results (K. Z. Zhou & Li, 2010). As previously stated, we have adapted the former construct of Technology Orientation into DSO because our aim is to understand the strategic attitudes of companies in the energy sector towards new digital technologies that are reshaping the competitive scenario and the way of running businesses. Moreover, our study wants to extend the concept of technology orientation studied by Molina-Morales et al. (2019). In the carried research, the technological and organizational orientation of the firm represents a moderating factor for the development of ACAP, particularly for the Potential part regarding the construct of Exploration.

For this reason, we have crafted new items by recombining and adapting items adopted in the research papers of Molina-Morales et al. (2019); Reid et al. (2012); K. Z. Zhou & Li (2010). Therefore, to assess the DSO of the company we asked in the survey "*How much do you think the following digital skills are important in your company today…*" of 13 different technologies and, more generally, about the Digital Awareness. For each of the 14 questions provided, the answers were assessed through the adoption of a Likert Scale from 1 to 7. Numbers of the scale range from 1 (not important) to 7 (significantly important). In order to identify which could be the best indicator, we defined two alternative measures of DSO in the following way:

- *DSO 1* is evaluated as the mean of the 14 results
- *DSO 2* is evaluated as the occurrence of those results which have a value >= 5

In order to choose the independent variable, we have analyzed the correlation between the two possible DSO measurements. The first is measured as the average of the importance attributed to each technology under examination, the second as occurrence: only those technologies whose importance value is considered > = 5 are taken into consideration. As expected, the correlation between these two variables is high (0, 898) and is significant at the 0,01 level. This allows us to arbitrarily choose between the two variables. However, we think that the measure of the construct as an average better reflects the DSO construct for how we have analyzed it. In fact, a company could only pay attention to some specific technologies by attributing high values of importance while leaving out the others. In this case, DSO measured as an occurrence would not be a good proxy because companies' DSO would result low. However, the company could have a high strategic orientation towards digital trends but concentrated only on few technologies. This is the reason why the measure of DSO as an average appears to be better since it is able to incorporate the specific attitudes of the company.

As already anticipated, the questions have been asked in a short-term perspective (TODAY) and in a long-term one (in 5 YEARS) and the regression analyses were performed for both the constructs with each independent variable of the model as we will show in the next section 'Analysis'.

8.3.2 Independent Variables

The portfolio of items adopted for the analysis is characterized by 4 clusters of Independent Variables: Senior Management Support, Acquisition Methodologies, Existence of Dedicated Business Unit and Knowledge Sharing.

Senior Management Support

Within this set we find two managerial antecedents of the DSO: the Sensibility and the Risk Appetite of Senior Management.

For both the constructs we relied on items adopted by Andersen & Nielsen (2009) together with the ones of Reid et al. (2012); K. Z. Zhou & Li (2010). Even in this case, the items have been adapted with digital paradigms and the questions respectively for the two constructs are the following: "*Which is the sensitivity of senior management to the importance of digital skills for the success of your business?* "and "*How much is senior management available to take risks in investments in digital innovation projects?*". Again, the questions were measured with a Likert Scale from 1 to 7 that range respectively from 1 (not sensitive/ not available) to 7 (strongly sensitive/ strongly available).

Acquisition Methodologies

Similarly to Senior Management Support, Acquisition Methodologies contain 3 different variables: Staff Leasing, External Consultants and Project Outsourcing. The strategy under the choice of diverse practices for acquiring knowledge from external sources may influence the perception and the strategic orientation of the organization itself. The nuances under these 3 factors may have different influences in the development of a proper DSO (Allen, 1977). Therefore, we shaped three different items for each variable that were added in the survey in this way: *"With reference to the acquisition of digital skills, to what extent does the company use the following practices?"*. The measurement was always a Likert scale from 1 to 7 with a range of 1 that represents 'not used' and 7 which symbolize 'frequently used'. The regression will be carried by analyzing firstly the effect of each singular IV on the DV and then by watching the mixed effect of all the IVs together on the DV. The expectations over the behavior of these three layers of Acquisition Methodologies vary accordingly their nature: we imagined

a linear continuum between hierarchical and external market practices (Williamson, 1989), where the methodology which better combines these two has the higher positive effect on DSO, while lower is the positive effect on DSO with the practice which addresses to external mechanisms.

Existence of a Dedicated Business Unit

The third cluster of IV is the Existence of Dedicated BU. The variable represents the utilization of a formalized and almost autonomous BU that focalizes the efforts on the discovery and development of new technologies for improving business performances or launching new products (Bianchi et al., 2016). Coherently with the direction of our research, we asked for the existence of a BU which purpose is to catch opportunities coming from the digital transformation of the sector. Thus, the assessment of this construct was conducted through the following question: *"Has an organizational unit been set up to develop new digital innovation projects?"*. The possible answers were 'yes' or 'not' and we will consider them for the analysis as '1' and '0' respectively.

Knowledge Sharing

The last typology of IV is Knowledge Sharing. It expresses the ability of the company in sharing knowledge within the organization (Foss et al., 2010). The knowledge of companies resides in the connections among individuals, in a social network within the diverse functions of the firm (Tortoriello, 2015). For this kind of variable, we adopted an item of Jansen et al. (2005) and declined it focusing on the Digital Skills required for overcoming the digital transition: *"To which degree the company is able to share knowledge and share digital skills between different work groups and organizational units?"*. In this case, we selected a Likert scale which ranges from 1 (not able) to 7 (very skillful).

8.3.3 Control Variables

Concerning the control variables, by looking at researches made in the global literature regarding the concepts of ACAP and SO, we decided to embrace 3 variables: the Age, the Industry and the Size of firms.

Age

Starting from Age, it has been largely used by Jansen et al. (2005); Reid et al. (2012) and many other authors. Age and Industry (type) have significant effects on the innovation orientation of the company (K. Z. Zhou & Li, 2010). For this reason, firstly we collected the years since foundation of each company of the sample from their websites or from Linkedin, considering as a reference year 2019.

Industry type

As reported before, K. Z. Zhou & Li (2010)considered Industry Type as control variable due to its important impact in this research field. We have taken it since our sample comprehend companies that belong to diverse segments of the energy sector. Thus, following the ATECO 2007 label of each company found in the AIDA database, we created a dummy variable that is characterized by 5 layers:

- *Generation sector*
- *Distribution sector*
- *Retail sector*
- *Development of technologies sector*
- *Energy Management sector*

However, due to the size of the sample, we have furtherly processed the dummies classifying them in two macro categories:

- *Upstream*, which comprehends sectors that are in the upper part of the supply chain: Generation, Distribution and Development of technologies
- *Downstream*, which in turn includes the Energy Management and Retail Sectors

Therefore, at the end we have two dummies that describe the Industry type control variable. We suppose a positive correlation between those two and DSO, in particular, we expected an higher positive correlation with Upstream industry companies since they include the Development of technologies sector which could have a strong impact on DSO.

Size

The last type of control variable is the Size of the company. By looking at papers of the global literature, many are the ways through which Size can be calculated, like referring to revenues, number of employees, ROA index or many other indicators (Ben-Oz & Greve, 2015; Jansen et al., 2006; Lane, Salk, & Lyles, 2001). We skimmed the portfolio of choices by formerly selecting Revenues and Number of employees and then we asked these information in the survey. After a further analysis of the sample, we decided to choose the natural logarithm of Revenues as index for assessing the size of companies because the variance of the index 'Number of Employees' was much higher.

8.4 Linear Regression Models

To validate the assumptions of our model, firstly we decided to perform Correlation analysis to confirm the perceptions and expectations on the variables of the model that we built after the study of the literature and the sector.

Then, to validate the hypothesis of the model, we carried out Linear Regression analysis through the software SPSS of IBM.

The model analysis can be expressed through the following formula:

$$Y_i = \alpha + \sum_i \beta_i \, X_i + \sum_i \gamma_i \, Z_i + \varepsilon$$

The dependent variable Y_i expresses the DSO declined as 'today' and 'five years'. The β_i instead will be the focus of the study since it expresses the effect that the independent variable (X_i) has on the dependent one. On the other hand, the control variables are expressed through the Z_i with their relative effect γ_i .

We will analyze the results of the empirical tests following this approach:

- analysis of coefficient β_i which assesses the effect size: the quantitative measure of the magnitude of a phenomenon.
- analysis of the p-value that explains if a variable is statistically significant. The thresholds are:
    - p-value < 0,1 (marginally significant)
    - p-value < 0,05 (significant)
    - p-value < 0,01 (strongly significant);

- ultimately, a comment of the R-squared which represents how good the regressors predict the value of the DV of the sample for each model. We decided to consider a threshold of R-squared > 15%;

The relationship between the dependent variable, controls and independent variables has been expressed through the creation of 6 different models. Starting from the first model, which considers only control variables and the DV, we progressively added all the IVs. Each of them has been analyzed in a different model which considers the variables firstly one by one, then grouped into the macro-variables and finally all together. This approach was performed both for the evaluation of the dependent variables DSO_today and DSO_five years. So, *Hypothesis* will be declined considering both the time horizon (j) and the relation of each independent variables (i) and sub-variables (k) (es. *Hypothesis i. j. k.).*

	Control Variables	Sen_Man_Sen	Sen_Man_Ris	Staff Leasing	External Consultant	Project Outsourcing	Excistence DBU	Knowledge Sharing	DSO
Model 1	x								x
Model 2.1		x							x
Model 2.2			x						x
Model 3.1				x					x
Model 3.2					x				x
Model 3.3						x			x
Model 4							x		x
Model 5								x	x

Table 6 – Models' structure

As we can see from *Table* (6), the first model investigates the relation between CVs and DSO. The models 2.i and 3.i focus on the Senior Management Support and Acquisition Methodologies respectively. The models 4 and 5 refer to the Existence of a DBU and Knowledge Sharing mechanisms.

8.5 Descriptive Analysis

In this paragraph, we proceed by showing the descriptive statistics of the main variables of the dataset, the ones explained before and used as the basis of our model. *Tables (7)* shows the mean and standard deviation of each variable considering the number of observation that is 83.

Table 7 – Mean and Standard Deviation

Variable	Mean	Std. Deviation
DSO_today	4,27	1,05
DSO_five-years	4,83	1,02
Ln revenues	14,91	2,74
Ln employees	2,96	1,73
Age	16,83	18,51
Dummy Upstream	0,48	0,50
Dummy Downstream	0,52	0,50
Digital Awareness_t	5,39	1,42
Coding & Programming_t	4,02	1,96
Agile Working_t	5,38	1,44
Artificial Intelligence & Machine	4,33	1,99
Blockchain & Cryptocurrencies_t	2,93	1,73
Cloud Computing_t	5,04	1,80
Customer Journey Mapping &	4,20	1,85
Cybersecurity_t	4,95	1,65
Big Data & Data Analytics_t	4,82	1,85
Digital Tools for Entrepreneurship_t	4,46	1,70
E-Procurement_t	3,95	1,73
Mobile Payments_t	3,55	1,94
Modelling, Simulation & Robotics_t	3,27	1,92
Tecnologies 4.0_t	3,48	2,00
Virtual Communication_t	4,61	1,84

Variable	Mean	Std. Deviation
Digital Awareness_five	5,63	1,46
Coding & Programming_five	4,40	1,98
Agile Working_five	5,63	1,46
Artificial Intelligence &Machine Learning_five	5,13	1,67
Blockchain & Cryptocurrencies_five	3,70	1,99
Cloud Computing_five	5,40	1,50
Customer Journey Mapping & Simulation_five	4,98	1,61
Cybersecurity_five	5,06	1,67
Big Data & Data Analytics_five	5,56	1,60
Digital Tools for Entrepreneurship_five	5,19	1,46
E-Procurement_five	4,52	1,66
Mobile Payments_five	4,15	1,88
Modelling, Simulation & Robotics_five	4,00	1,96
Tecnologies 4.0_five	4,05	2,03
Virtual Communication_five	5,12	1,70
Senior Management Sensibility	5,04	1,44
Senior Management Risk Appetite	4,44	1,51
Staff Leasing	2,41	1,49
External Consultants	3,31	1,79
Project Outsourcing	4,07	1,81
DBU	0,30	0,46
Knowledge Sharing	4,41	1,50

The mean value is higher for the dependent variable DSO-five year (4.83) than for the DSO-today variable (4.27). However, both present low standard deviation values (≅ 1). Due to this

small variation, dependent variables will result more difficult to be predicted by the linear regression model. We decided to adopt DSO as the mean of companies' interest over the 14 different technologies of the survey. The maximum value of standard deviation does not exceed 2.00 for 'today' variables and 2.03 for 'five-years' ones. Hence, despite the range of our Likert is from 1-7, the volatility of variables involved for calculating the DSO is not too high, justifying our decision to study DSO with this methodology. It is also important to notice that for each technology in question, the importance attached increases if we consider the comparison between today and five years.

For what concerns IV, Senior Managements sensibility and Risk Appetite show the highest mean value. Standard deviation increases in respect to the one of the DVs. Ranking variables according to the mean value we find Knowledge Outsourcing (4,41), Project outsourcing (4,07), External Consultant (3,31) and Staff Leasing (2,41). Being a binary variable, value related to the DBU should not be considered.

Correlation Matrix

The two matrixes that are displayed below show the Pearson correlation coefficient which measures the degree of linear correlation between two variables X and Y whose value is between 0 and 1. Furthermore, the analysis of the main components makes it possible to highlight the variables that mostly impact on the relation.

Table 8 – Correlation matrix DSO_today

Correlation Matrix		1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	11)	12)	13)	14)	15)	16)	17)	18)	19)	20)	21)	22)	23)	24)	25)	26)	27)	28)
1)	DSO_today	1	,0189	,029	-,168	,065	-,065	,554***	,643***	,511***	,727***	,669***	,495***	,663***	,615***	,673***	,640***	,501***	,445***	,624***	,485***	,543***	,443***	,469***	,106	,163	,233**	,314***	,294***
2)	Ln revenues		1	,842***	,247**	,142	-,142	-,094	-,228**	-,136	-,060	,032	,067	,164	,268**	,137	,007	,088	,073	-,020	-,134	-,095	-,191*	-,031	,107	-,033	,043	,034	-,281**
3)	Ln employees			1	,259**	,265**	-,265**	-,114	-0,195*	-0,204*	-,059	-,009	,046	,240**	,257**	,119	-,027	,085	,194	,002	-,127	-,065	-,141	-,039	,233**	,012	-,037	-,019	-,235**
4)	Age				1	,107	-,107	-,235**	-,165	-,215*	-,137	-,088	-,248*	-,178	,027	-,067	-,007	-,065	,059	-,086	-,032	-,075	-,171	-,308***	-,021	,005	,0167	,107	-,153
5)	Dummy Upstream					1	-1***	,003	-,049	-,043	,119	,059	,021	-,088	,014	,061	-,183*	,125	,135	,153	,154	,073	-,007	-,137	-,034	-,149	-,052	-,055	-,046
6)	Dummy Downstream						1	-,003	,049	,043	-,119	-,059	-,021	,088	-,014	-,061	,183*	-,125	-,135	-,153	-,154	-,073	,007	,137	,034	,149	,052	,055	,046
7)	Digital Awareness_t							1	,339***	,648***	,329***	,237**	,538***	,245**	,368***	,328***	,340***	,250**	,183*	,027	,017	,340***	,370***	,312***	,063	,038	,133	,211*	,297***
8)	Coding & Programming_t								1	,286***	,587***	,458***	,304***	,332***	,414***	,400***	,283**	,101	,011	,409***	,310***	,237**	,314***	,334***	,089	,002	,071	,194*	,247**
9)	Agile Working_t									1	,324***	,168	,436***	,224**	,190*	,280**	,342***	,271**	,146	,138	,027	,231**	,273**	,325***	-,048	,044	,045	,274**	,196*
10)	Artificial Intelligence & Machine Learning_t										1	,608***	,215*	,468***	,344***	,642***	,499***	,202*	0,050	,360***	,305***	,248**	,409***	,517***	-,083	-,102	,127	,236**	,356***
11)	Blockchain & Cryptocurrencies_t											1	,226**	,458***	,399***	,464***	,313***	,194*	,217**	,373***	,338***	,373***	,345***	,355***	,119	,183*	,228**	,316***	,257**
12)	Cloud Computing_t												1	,321***	,267**	,335***	,171	,302***	,219**	,087	-,179	,402***	,244**	,206*	,077	,032	,186	,104	,018
13)	Customer Journey Mapping & Simulation_t													1	,474***	,416***	,502***	,150	,319***	,280**	,241**	,408***	,299***	,357***	,257**	,155	,132	,173	,140
14)	Cybersecurity_t														1	,431***	,321***	,231**	,267**	,191*	,231**	,310***	,315***	,171	,250**	,078	,141	,227**	,156
15)	Big Data & Data Analytics_t															1	,537***	,120	,042	,295***	,245**	,148	,271**	,310***	,053	-,100	,133	,191*	,206*
16)	Digital Tools for Entrepreneurship_t																1	,223**	,160	,349***	,279**	,274**	,250**	,395***	-,007	,172	,225**	,367***	,185*
17)	E-Procurement_t																	1	,489***	,435***	,196*	,465***	,115	,173	-,076	,214	,282***	,063	,115
18)	Mobile Payments_t																		1	,381***	0,154	,449***	0,117	0,089	0,148	,371***	0,130	0,022	0,050
19)	Modelling, Simulation & Robotics_t																			1	,633***	,307***	,195	,241**	,003	,120*	,057	,078	,043
20)	Tecnologies 4.0_t																				1	,299***	,175	,105	,028	,055	,052	,191*	,184*
21)	Virtual Communication_t																					1	,245**	,154	,164	,087	,146	,149	,147
22)	Senior Management Sensibility																						1	,556***	,057	,127	,176	,221**	,632***
23)	Senior Management Risk Appetite																							1	-,037	,064	,199*	,322***	,477***
24)	Staff Leasing																								1	,323***	,031	,005	-,035
25)	External Consultants																									1	,460***	0,186*	,070
26)	Project Outsourcing																										1	,149	,304***
27)	DBU																											1	,109
28)	Knowledge Sharing																												1

***. La correlazione è significativa a livello 0,01 (a due code).

**. La correlazione è significativa a livello 0,05 (a due code).

*.La correlazione è significativa a livello 0,1 (a due code).

We crafted two correlation matrices according to our field of study which wants to analyze the DSO of energy companies today and in a five-year time horizon. As expected from our researches and analysis of the scientific literature together with our perceptions, the DSO_today is positively correlated with the first set of independent variables which is the Senior Management Support. Indeed, for both the sub-variables there is a positive and significant correlation with the dependent variable. Senior Management Sensibility shows a correlation of coef. = 0,443 with p-value < 0,01 and Senior Management Risk appetite of coef. =0,469 with p-value < 0,01.

For what concerns Knowledge Sharing and Existence of a Dedicated Business Unit, the correlation figures confirm the expectations with a positive coef. = 0,294 and p-value = 0,01 and coef. = 0,314 and p-value = 0,01 respectively on the current Digital Strategic Orientation of the firm.

However, by looking at the Acquisition Methodologies, we cannot find a significant correlation for all the items. In fact, the only one which presents a p-value lower than 0,1 is Project Outsourcing with a coef = 0,233 and p-value < 0,05. Despite what we have thought about the control variable 'Industry', there are not significant correlations between both Upstream and Downstream sectors with DSO_today.

Table 9 – Correlation matrix DSO_five years

Correlation Matrix		1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	11)	12)	13)	14)	15)	16)	17)	18)	19)	20)	21)	22)	23)	24)	25)	26)	27)	28)
1)	DSO five-years	1	0,057	0,061	-0,101	0,067	-0,067	,588***	,633***	,635***	,690***	,661***	,557***	,701***	,609***	,652***	,711***	,599***	,462***	,538***	,436***	,566***	,443***	,391***	0,125	,252**	,315***	,248**	,370***
2)	Ln revenues		1	,842***	,247**	0,142	-0,142	0,157	-0,197*	-0,070	0,039	0,087	0,138	0,118	0,111	0,126	0,048	0,101	0,070	-0,071	-0,065	0,016	-0,191*	-0,031	0,107	-0,033	0,044	0,034	-0,281 ***
3)	Ln employees			1	,259**	,265**	-,265**	0,075	-0,126	-0,095	0,008	0,063	0,102	0,150	0,062	0,106	0,042	0,125	0,162	-0,024	-0,066	0,022	-0,142	-0,039	,233**	0,012	-0,037	-0,020	-0,235**
4)	Age				1	0,107	-0,107	-0,027	-0,132	-0,158	-0,110	-0,041	-0,147	-0,071	-0,062	-0,179	0,007	-0,017	0,123	-0,133	-0,037	0,051	-0,171	-,308***	-0,021	0,005	0,017	0,107	-0,154
5)	Dummy Upstream					1	-1,000***	0,031	-0,037	-0,052	-0,040	0,109	0,069	-0,031	0,052	0,070	-0,141	0,132	0,120	0,124	0,061	0,080	-0,007	-0,137	-0,034	-0,149	-0,052	-0,055	-0,047
6)	Dummy Downstream						1	-0,031	0,037	0,052	0,040	-0,109	-0,069	0,031	-0,052	-0,070	0,141	-0,132	-0,120	-0,124	-0,061	-0,080	0,007	0,137	0,034	0,149	0,052	0,055	0,047
7)	Digital Awareness five							1	,223**	,616***	,341***	,261**	,596***	,470***	,437***	,314***	,324***	,381***	,316***	0,004	-0,051	,378***	,276**	,317***	0,076	0,013	0,103	,234**	,254**
8)	Coding & Programming five								1	,391***	,599***	,416***	,247**	,295***	,310***	,411***	,443***	0,189*	0,090	,446***	,340***	0,169	,357***	,359***	0,077	0,094	0,166	0,184*	,372***
9)	Agile Working five									1	,470***	0,192*	,533***	,380***	,290***	,401***	,476***	,434***	0,154	0,170	0,125	,360***	,320***	,431***	0,059	0,094	0,171	0,214*	,341***
10)	Artificial Intelligence & Machine Learning five										1	,505***	,311***	,459***	0,165	,658***	,509***	,245**	-0,020	,452***	,325***	0,204*	,397***	,476***	-0,006	-0,010	0,200*	,269**	,367***
11)	Blockchain & Cryptocurrencies five											1	0,178	,490***	,411***	,400***	,426***	,299***	,316***	,273**	,300***	,339***	,265**	0,211*	0,176	,217**	,251**	,269**	,266**
12)	Cloud Computing five												1	,343***	,332***	,507***	,399***	,431***	,237**	0,026	-0,147	,382***	0,173	,248**	-0,015	0,015	,291***	0,093	0,112
13)	Customer Journey Mapping & Simulation five													1	,446***	,486***	,583***	,298***	,324***	,295***	0,149	,421***	,347***	,305***	,241**	,230**	0,126	0,190*	0,098
14)	Cybersecurity five														1	,385***	,352***	,332***	,354***	0,134	,287***	,286***	,298***	0,124	0,096	0,126	0,183*	0,150	,251**
15)	Big Data & Data Analytics five															1	,535***	,283***	0,021	,277**	0,161	0,178	,304***	,336***	0,017	-0,004	,251**	0,074	,276**
16)	Digital Tools for Entrepreneurship five																1	,313***	0,147	,384***	,317***	,305***	,328***	,311***	0,196*	,319***	,254**	,280***	0,188*
17)	E-Procurement five																	1	,469***	0,180	0,104	,549***	0,160	0,086	0,120	,272**	,316***	0,054	0,161
18)	Mobile Payments five																		1	,242**	0,014	,440***	0,106	-0,002	0,139	,334***	0,193*	0,031	0,088
19)	Modelling, Simulation & Robotics five																			1	,590***	0,094	,285***	0,182*	-0,062	0,185*	0,082	-0,027	0,176
20)	Tecnologies 4.0 five																				1	0,083	0,165	0,117	0,041	0,135	0,022	0,166	0,142
21)	Virtual Communication five																					1	,236**	0,105	-0,014	0,191*	,265**	0,080	,229**
22)	Senior Management Sensibility																						1	,556***	0,057	0,127	0,176	,221**	,632***
23)	Senior Management Risk Appetite																							1	-0,037	0,064	0,198*	,322***	,477***
24)	Staff Leasing																								1	,323***	0,031	0,005	-0,036
25)	External Consultants																									1	,460***	0,186*	0,070
26)	Project Outsourcing																										1	0,149	,304***
27)	DBU																											1	0,109
28)	Knowledge Sharing																												1

***. La correlazione è significativa a livello 0,01 (a due code).
**. La correlazione è significativa a livello 0,05 (a due code).
*.La correlazione è significativa a livello 0,1 (a due code).

Concerning the Digital Strategic Orientation projected to 5 years, results appear similar to the previous *Table (8)*. In fact, both Senior Management Sensibility and Risk Appetite present positive correlations with coef. = 0,443 and coef. = ,391 with a p-value < 0,01. It is worthy to notice that Risk Appetite presents lower figures respect to the impact that it has on DSO_today. The same happens for Existence of Dedicated Business Unit and Knowledge Sharing, even though they show positive and significant values, coef. = 0,248 (p-value < 0,05) and coef. = 0,370 (p-value < 0,01), the effects are different from the analysis with DSO_today. Indeed, the first one presents lower correlation values (0,314 (t) vs 0,248 (5y)), while the second one higher (0,294 (t) vs 0,370 (5y)).

However, by looking at the Acquisition Methodologies, we can see that correlations change. In this case, two out of three items are significant: as in the previous correlation matrix, Project Outsourcing displays a coef = 0,315 but with a lower p-value (p < 0,01), while External Consultants appears significant with a coef = 0,252 and p-value < 0,05. Even in this case, Staff Leasing and the control variables present non-significant values in correlation with DSO_5years.

9 RESULTS

In this chapter, we report the results emerged by the linear regression analysis of the models explained above (*Chapter 8*). The analysis is shown in the following tables.

Table 10 – Linear regression results, DSO_today

Dependent variable: DSO_today								
Variables	Model 1	Model 2		Model 3			Model 4	Model 5
Control variables								
Firm size	0,021	0,049	0,010	0.016	0,022	0,017	0,019	0,052
Age	-0,011*	-0,007	-0,002	-0,011*	-0,011*	-0,011*	-0,013**	-0,009
Industry type Upstream	0,164	0,136	0,276	0,174	0,221	0,194	0,214	0,164
Independent variables								
Sen_Man_Sen		0,325***						
Sen_Man_Ris			0,330***					
Staff Leasing				0,071				
External consultant					0,107*			
Project outsourcing						0,139**		
Existence DBU							0,783***	
Knowledge Sharing								0,217***
R^2	0,038	0,226***	0,239***	0,048	0,071	0,095*	0,154***	0,126**
$Adjusted\ R^2$	0,002	0,186	0,200	0,000	0,023	0,049	0,110	0,082

*p<0,1 **p<0,05 ***p<0,01

Table 11– Linear regression results, DSO_five years

Dependent variable: DSO_five years								
Variables	Model 1	Model 2		Model 3			Model 4	Model 5
Control variables								
Firm size	0,029	0,326	0,020	0.024	0,031	0,063	0,028	0,069*
Age	-0,007	-0,004	-0,000	-0,007	-0,007	-0,007	-0,009	-0,005
Industry type Upstream	0,141	0,113	0,234	0,152	0,224	0,180	0,179	0,141
Independent variables								
Sen_Man_Sen		0,326***						
Sen_Man_Ris			0,275***					
Staff Leasing				0,081				
External consultant					0,155**			
Project outsourcing						0,180***		
Existence DBU							0,592**	
Knowledge Sharing								0,279***
R^2	0,022	0,224***	0,170***	0,036	0,094*	0,123**	0,093	0,177***
$Adjusted\ R^2$	-0,015	0,184	0,128	-0,013	0,048	0,078	0,046	0,134

*p<0,1 **p<0,05 ***p<0,01

9.1 Hypotheses testing

DSO_today

Now we proceed with the analysis of the results. By looking at *Table (10),* it is possible to notice that the *Hypothesis 1.1.1* is verified. Indeed, Sen_Man_Sen presents an R^2= 0,224, higher than the threshold established. A positive and significant coefficient (β) = 0,326 with a p-value < 0,01. The positive result reported above confirms that the Senior Management Sensibility towards new digital trends represent an important antecedent for the development of the Digital Strategic Orientation of the organization.

As far as the *Hypothesis 1.1.2* is concerned, the results are supported by an R^2= 0,170, a positive coefficient of 0,275 with a p-value = 0.01. Therefore, *Hypothesis 1.1.2* is verified, confirming also the conceptual work of Daham and Shoham (2014), Senior Management Risk Appetite constitutes another solid antecedent of the SO also from a digital perspective.
Therefore, the overall effect of the Senior Management Support (Model 2.3), which is composed by the previous cited variables, appears to be relevant and positive with an R^2= 0,287.

Considering the set of *Hypotheses 2.1* that involve the Digital Skills Acquisition Methodologies, the results do not behave as we supposed. Indeed, *Hypothesis 2.1.1* is not statistically significant while *Hypothesis 2.1.2* present a positive coefficient of 0,107 with a p-value < 0,1. However, the $R^2$is lower than 15% with a value of 0,071. The *Hypothesis 2.1.3,* which is on Project Outsourcing that we consider having a less positive effect on SO respect to the other acquisition forms, instead, presents the highest level in terms of coefficients (β =0,139

and a p-value < 0,05). Therefore, *Hypothesis 2.1.1* is not verified whilst *2.1.2* and *2.1.3* are validated. However, from an analysis of the R^2, all the models present values lower than 15%.

As results show, *Hypothesis 3.1* seems to be verified. We can find the highest value of the coefficient (β = 0,783) with a strong level of significance (p-value <0,01). Moreover, the R^2shows a good fitting of the model with a value of 0,154. Hence, the *Hypothesis 3.1* is confirmed, showing a positive linear relationship between the existence of a dedicated BU for the digital innovation process and the DSO of the firm.

Finally, focusing the attention on *Hypothesis 4.1*, the positive linear effect (β = 0.217) with a significant p-value < 0,01 supports our predictions. Regarding the goodness of the regression of model 5, it is just below the threshold of 15% (R^2= 0,126).

DSO_five years

By looking at the *Table (11),* it is possible to notice that the entire set of *Hypotheses 1.2*, which comprehends the impact of Senior Management Support on the DSO_five years is confirmed with a positive and significant effect similar to the values for the analysis of DSO_today.

Regarding the set of *Hypotheses 2.2,* even in this case the independent variable related to Staff Leasing does not show significant values but, concerning External Consultancy and Project Outsourcing, they present higher figures for both effect coefficients and significance: respectively β = 0.155 with p-value < 0,05 and β = 0.180 with p-value < 0,01. Thus, *Hp 2.2.1* is not verified, whilst *Hp 2.2.2* and *Hp 2.2.3* are supported.

However, data about how good is the fitting of the model result low with an R^2= 0,094 for *Hp 2.2.2* and an R^2= 0,123 for *Hp 2.2.3.*

For what concerns the existence of a dedicated business unit analyzed on a five years period, the effect size of the independent variable slightly decreases but conserves a high level of statistical significance. It is also worth to notice the behavior of R^2, which drops under the threshold of 15%. By the way, the *Hypothesis 3.2* results verified.

Finally, focusing the attention over *Hypothesis 4.2*, the effect size presents increased figures (β= 0,279) with a p-value < 0,01. In this case, the *Hypothesis 4.2* is validated with a p-value < 0,01, presenting also a good fitting of the model due to a higher R^2= 0,177.

After having discussed results from the linear regression model, in the next chapters we aim at stating our hypotheses and identifying the plausible consequences of our findings for energy companies, supporting the adoption of a Digital Strategic Orientation. Subsequently, some limitations and possible further correlated research topics are addressed to identify new future directions of study and to understand the main constraints met during the elaboration.

10 DISCUSSION

Before focusing on a quantitative discussion of the questionnaire results, we want to show some figures to picture the technological state of art of Italian companies belonging to the energy sector. We will go through the technologies that mostly attract the firms' attention, showing related percentages that represent the importance that the organization puts for a specific tech measured with a Likert Scale that range from 1 to 7.

Firstly, it's important to highlight a huge interest by almost all the firms of the sample regarding the Digital Awareness. Indeed, more than the 80% of companies answered ">5" in a Likert Scale from 1 to 7. By going deep in the analysis, the most attractive technologies are Cloud Computing (>60%, always with answers ">5"), Big Data & Data Analytics (>60%) and Cybersecurity (70%) while the lowest are Blockchain & Cryptocurrencies (almost 50% answered "1 or 2"), Mobile Payments (40%) and Technologies 4.0 (40%). To better comprehend these figures, we juxtapose them with the results coming from the same questions but projected in a five years horizon. By doing this, we are able to understand how the technological orientation of companies changes across time. The most interesting shifts regard Artificial Intelligence, BD, Blockchain & Cryptocurrencies and Digital Tools for Entrepreneurship. For these tech fields, almost 30% of companies that answered "<5" veered to an interest of ">5", except for Blockchain that presents a positive change of more than 20% but achieves only the 40% of sample's firms. From this perspective, it seems that technologies that present high flexibility in terms of exploitation such as BD analytics, AI and Cloud Computing are more appealing for this kind of firms. On the other hand, companies seem to consider Blockchain not enough mature yet to be currently implemented in their processes or products. However, the increase in a five-year horizon displays a shared consciousness of its potentialities.

To conclude this qualitative analysis, we divided results in function of the researched five segments of the energy sector: retail, distribution, energy management, development of technologies and generation. Starting from the retail segment, quickly emerge that AI and Machine Learning are seen as important factors for the future competition (five years horizon), whilst unexpected were the results regarding Mobile Payments. In fact, just the 40% of companies are interested in it, going against the EY report "Digital Utilities 2017" which

declares that the major investment for this sector would be focalized on Mobile Payments innovations.

Shifting on the distribution segment, it seems the market where Blockchain finds the highest interest together with Modelling and Technologies 4.0. However, even in this case, companies see more potential benefits in a five-years horizon rather than today, confirming the apprehension regarding the problems and costs related to the development of such technology. Concerning the Development of new technology field, crucial is the role of BD, Cloud Computing and Cybersecurity, with a particular attention also to technologies related to the Customer Journey Mapping. Results seem coherent with the processes and purposes of companies that belong to this sector. Indeed, the support of BD and Cloud Computing can unlock huge potentialities to track customers, understand their behavior and innovate according to their needs.

By looking at the energy management segment, practices of Agile Working are positively observed, while Cloud Computing appears as the fundamental factor in order to improve the organization and products performances. Finally, the highest scores for Cloud Computing and Virtual Communication is witnessed in the generation sector. The management of big data regarding the production, maintenance and upstream transmission of energy requires investments on these technological fields.

After this qualitative introduction of the results, we shift the focus on the quantitative contribution of the research. The Strategic Orientation represents the firm's' openness to new ideas, products, and processes, including their willingness to change and adapt to emerging technologies and market trends (Rakthin et al., 2016). The concept has been juxtaposed to the

concept of ACAP since it represents a fundamental dowel for the development of prior related knowledge which in turn feeds all the segments of the ACAP: the exploration, assimilation, transformation and exploitation of new external knowledge. The new concept of DSO has been declined from the construct of the Technology Orientation (Zhou et al., 2005). It belongs to the macro-construct SO, but it is specifically focused on the Digital Skills required for facing the Digital Transformation of the energy sector. We have researched and selected some antecedents of the DSO to investigate their relative effects on the construct itself.

The results of the research validate almost all the hypothesis except for *Hp 2.2.1* which regards the adoption of Staff Leasing contracts as a form of knowledge acquisition. Concerning the point of view based on the time horizon (DSO_today, DSO_five years), what comes up is that there are no controversial results between them in terms of hypothesis validation. In fact, outcomes are quite the same in terms of coefficient and significance.

10.1 Contribution

The current writing allows to extend the emerging literature about the connections between Strategic Orientation and the ACAP. Their relationship has been reinforced by focalizing the attention towards Digital Skills. Thus, we can summarize our research outcomes with three main contributions:

- Development of a new theoretical construct, DSO;
- Theorization of its antecedents;
- Analysis of the quantitative effect size of each component.

DSO construct has been developed starting from the need of firms of the energy sector to acquire and exploit digital skills in order to keep themselves updated on new digital trends and technologies. To respond to this challenge, by examining the current literature, we spot a gap between the traditional construct of ACAP and the SO, which we decided to fill up with the creation of a new construct. We elaborated on the concept of K. Z. Zhou & Li (2010) of Technology Orientation by declining it into the perception of energy companies towards new digital technologies which are reported in *Table (5).*

As a second contribution, we defined the most important factors that could significantly impact on the development of the DSO, selecting them from a set of antecedents previously analyzed in the literature review.

Ultimately, the results of a linear regression analysis of them with DSO have shown that the influence of the top management, represented as the attitudes of recognizing the opportunities underlying in new technologies and proactivity in risk taking, is more than significant for the development of an accurate DSO. Furthermore, the existence of knowledge sharing mechanisms within the organization helps in cultivating a clear awareness of what is happening around the company and how the whole organization can react to new digital trends. In the same way, the existence of a BU dedicated for capturing and assimilating digital skills for the exploitation of new technologies represents a fundamental organizational investment in order to build a solid DSO.

By looking at the analyzed acquisition methodologies, the Staff Leasing seems not to be significantly important in relationship with our concept of DSO, whilst, on the other hand, the adoption of External Consultancy practices seems to have a beneficial effect. Contrary to our

expectations, Project Outsourcing is the IV with the highest positive contribution in comparison with the others acquisition methodologies, with an increase of the value in a five years' perspective. All the reflections that we have discussed so far are in line with both the DSO_today and the DSO_five years.

Results involve new implication for future researches. Starting from the hypothesis developed in the theoretical framework, we can assume that the effect of the constructs under the set of Senior Management Support is in line with the authors Moon (2013) who state that managers' attitude and organizational structure/culture both impact positively on the Strategic Orientation of the firm. Results from *Hp1.1* and *Hp 1.2* are also in line with the research of Zhou et al. (2005) which declares that managers play a fundamental role to create an innovation-oriented company. For what concerns Risk Appetite, the research outcomes are in accordance with the study of Tuncdogan et al. (2017) in which a proactive behavior of the top management is directly linked with the management team's willingness to take risks (Hamstra et al., 2011) and it is assumed to increase the unit's attitude toward exploratory innovation.

Regarding the Acquisition Methodologies, the results are different from the expectations that we built from the works of Williamson (1989) and Gabriel & Kirkwood (2016). Our idea was that in order to create value from new competences, firms should both develop internal capabilities and gather valuable external knowledge. The results of our research are partially in accordance with these claims: external consultants show positive coefficients with DSO but the most impactful IV is Project Outsourcing. This could probably imply that the development of some specific technologies, which are particularly complex and distant from the knowledge base of the organization, require the complete outsourcing of projects due to the lack of internal competences. Indeed, historically, the decision of outsourcing was more focused just on

peripheral activities to protect the core business (Ang & Straub, 1998). Nevertheless, this mindset has been challenged due to the rise of globalization, the explosion of new technologies and the need to be always flexible and efficient. Hence, the rationale under the outsourcing choice no longer focus on traditional paradigms but relies on the adaptation of core activities to digital technologies. Moreover, for what concerns Staff Leasing practices, the insignificance of results could be related to the fact that this methodology is not widely used in the energy sector as shown by the results of the research.

Shifting the focus to the existence of a dedicated BU, results confirm the strategic role that this solution has in order to acquire innovations from the outside (Bianchi et al., 2016). As far as Knowledge Sharing is concerned, it represents one of the most significant variable of our model if connected to the concept of DSO. Therefore, it validates the previous studies of Zhou et al. (2005), where employees are encouraged to work together and participate in the firm's decision-making process. In fact, innovation is facilitated by the dispersion of ideas within an organization, which in turn generate new ideas (Damanpour, 1991).

Contrary to what we supposed in the RQ section (*Chapter 5*), the behavior of the IVs does not change in respect to the measurement of the DSO as today and five years. IVs represent internal mechanisms that aim at supporting exploratory and strategic activities of the firms. We thought that if the contribution of all these independent variables is perceived as high, the attention that the organization will puts on a future technology development would be stronger, thus higher correlation would be present. This reflection is justified by the fact that selected technologies will be further developed and adopted in the following years.

Focusing on the behavior of the control variables, we thought that their contribution would be significant for the regression model. We selected them after an investigation of the most used items in the ACAP and SO literature. Despite they have a significant contribution in the analyzed scientific papers, it wasn't the same for our research with the exception of the variable Age, which in *model 1, 2* and *4* of the *Table (10)* and *Table (11)* presents negative coefficients with a p-value < 0,1. It means that younger firms are more innovation oriented from a digital perspective in respect to the older ones, contributing to the opinion that organizational change is hard for established companies. Indeed, as reported by Tushman & O'Reilly (1996) technological changes represent a threat for established companies because they often face problems of organizational inertia. Moreover, we expected a sharper difference across firms belonging to our two sets upstream and downstream sectors. This claim was not confirmed because almost every firm in both the categories presents on average high values of importance for each technology.

In light of these considerations, which are the future developments that researchers have to pursue? As demonstrated, top management support is strongly significant in relation with the DSO. Two sub-variables have been considered in this study, but further researches can expand this antecedent by adding new dimensions. Usually, employees are stacked in routine activities and may hardly accept the changes involved by digital transformation. They may not perceive the benefits coming from new digital solutions. So, the extent to which the senior management involves employees and shows them the effect brought by digital solution can be considered as a potential new dimension. From a financial point of view, the continuity of the investments for gathering digital knowledge might be interesting to be analyzed since one-shot investments usually do not create an innovation culture within the organization. A measurement can be a quantitative analysis on the periodicity of investments and their relative effects on DSO.

Furthermore, since our analysis is bounded into the concept of methodologies for digital skills acquisition, it could be worth to investigate which kind of relationship the company has established with companies in the digital sector. Joint ventures, partnership or acquisition can be useful to examine the path toward the digital transformation. Moreover, new HR activities such as hackathon or crowdsourcing challenges could positively impact on the development of the DSO. At the same time, the source from which knowledge is acquired can reveal some stimulating insight. Potential sources could be:

- Other organization within the business group;
- Competitors and other enterprises from the same industry;
- Suppliers of equipment, materials, components or software;
- Clients or customers;
- Consultants;
- Laboratories or R&D companies;
- Universities or other higher education institutes;
- Government or private non-profit research institute.

As previously reported, the existence of a dedicated BU plays a crucial role in the development of DSO. However, as researched by the 'Osservatori Digitali' of Politecnico di Milano, many are the adoptable forms to organize the BU and the data science team:

- Business driven: the team is located across the organization directly within the business functions of reference.
- Centralized: there is a structure dedicated to data science, and the formal identification of a Chief Data Scientist.
- Business requests are collected by the data science team and prioritized according to directions from Top Management.
- Matrix: Data Scientist team is spread within the various business functions and is characterized by its dual reporting: to the units' business managers and to the Chief Data Scientist.
- Hybrid: the coexistence of an independent organization structure and the presence of Data Science resources within individual business lines.

For those companies that present a dedicated BU, it could be promising to study how companies' DSO changes in function of the chosen DBU methodology. In addition, it might be interesting to understand to which degree digital project start with a top-down or bottom-up approach.

By concerning the existence of Knowledge Sharing practices, our study demonstrates a positive association of these with DSO. Further researches have to be carried out in order to deeply analyze the construct. For example, as mentioned by Fong et al. (2011), diverse are the activities that improve the knowledge sharing within an organization:

- Recruitment and Selection
- Performance Appraisal
- Teamwork
- Training and Development

A deepening of the effects of each factor on DSO could enlarge the scope of the importance Knowledge Sharing for developing specific Prior Related Knowledge.

10.3 Limitations

The present study has several limitations that should be noted. First, the sample size represents a significant limit since the number of firms interviewed is just 83. Moreover, is also important to highlight that the size of companies, considering mainly the number of employees is quite small. Indeed, most of the companies surveyed (77%) are small (<50 employees) and therefore we lack an equally distributed sample. In addition, companies which have less than 10 employees may do not have a real organizational structure which implies the presence of BUs.

In regard to missing data, there was a conspicuous problem mainly for two potential variables we wanted to adopt: the R&D expenses (% of total revenues) and about who is the reference point for digital innovation within the company. This two factors could have been useful as control variables. Furthermore, missing data were present throughout the database which have been filled up with the average of relative results. Hence, all these issues have compromised the significance of the entire research. Due to the low level of standard deviation related to the dependent variable DSO, it is more difficult to capture data heterogeneity. In fact, another practical limitation is characterized by low levels of R^2in some models of the regression. To overcome this problem, more control variables would have been necessary.

Future researches could try to solve the problem related to the measurement of DSO. In order to have a higher response rate, the survey administered to managers should have been short and concise. Indeed, although we have examined an important number of antecedents, just few have been considered. Due to this, a higher number of antecedents should be investigated in future researches.

Considering the Likert scale adopted for the assessment of items, it might be too related to the perception that managers have of their company and thus, too subjective. This bias could be solved by adopting more quantitative and objective items. Examples could be 'how many times the company scans the market for discovering new technologies in a three-month period?' or 'How much money are invested in digital innovation projects?' or 'How many patents has the company produced regarding digital innovations in the last year?'.

Despite the numerous researches related to ACAP, many gaps are still not addressed in the literature. One of these is represented by the SO as antecedent for the acquisition of prior related knowledge of the firm. We considered that digital skills are a necessary tool to develop each single component of the ACAP. The positive impact of digital propensity on this construct is validated by the literature, however, there is no quantitative measure on how much these competences impact on the ACAP and therefore on how the new construct of DSO influences it. Moreover, considering how our results stress the importance of top management behaviors in order to acquire and develop digital culture within the firms, as stated by Tronina et al. (2019) if we consider the capability of top managers to absorb digital competences, there are few studies investigating those factors that drive top management's' ability to absorb IT governance knowledge within organizations

10.2.2 Managerial Implications

In order to face challenges related to new technological trends, companies are called to develop a specific strategic path which follows digital transformation rules. Managerial implications that arise from this research can be summarized following a structured stepladder. Ranking the components that we analyzed, what emerges is that firstly organizations need to build a digital culture which enables to understand the underlying potential value of digital technologies. Senior Management Support appears to be the most relevant aspect to do so. Thus, top managers are called to be aware of new opportunities and, at the same time, proactive in taking risks investing in new and innovative digital technologies.

Comparing the two themes of Sensibility and Risk-taking, from the dataset emerges a gap between the consciousness of the importance of acquiring Digital Skills (68%) and the effective implementation of them through projects/investments (48%).[2] The misalignment between sensitivity and actual implementation also reflects the insight generated by the figures of the dataset considering the two-time horizon perspectives, today and five-years: results show higher values for questions concerning the five-years period. Hence, we suppose that companies tend to postpone problems concerning the digital innovation. This adversity in undertaking this type of project could be due to a "commoditized" and not very flexible structure and culture of the energy sector.

[2] Data refer to value >= 5 and the effective implementation means taking risks in doing investments

In order to develop this kind of culture, it is necessary to frame the internal problems and external opportunities with the aim of setting future goals and objectives. Therefore, managers should set control systems which allow to monitor the progresses of the development of new digital technologies and performances. Following this direction, from a micro-level perspective, the involvement of all the employees it's fundamental to root a proactive attitude towards the digital trend.

In practice, the organization should hire and train employees that present the so-called 'T-shaped' skills (Madhavan & Grover, 1998). People with these T-shaped skills have the following characteristics: relating to the vertical stroke of the letter 'T', these persons have deep knowledge about relevant technologies in a particular field. Referring to the horizontal stroke of the letter 'T', they also have sufficient, although less deep, insights into potential markets. By facilitating the identification of new applications, these individuals may contribute to developing a proactive DSO. The lighthouse that lead the path for facing the digital transformation is represented by a dedicated BU, which focalize on technological opportunities coming from the market and the development of innovation projects. The adoption of such solution allows to scan, process and spread knowledge coming from external sources.

Following the statements of Bianchi et al. (2016), the establishment of DBU appears to be more in line with those firms that present important financial outflows for R&D outsourcing and, therefore, have to deal and process a continuous flow of tech-knowledge coming from the external environment. In situations where there is too much cognitive distance between the organization and a new technology, firms need to rely on the service of external actors such as consultants or independent firms. The involvement of external consultants and a dedicated BU is fundamental for innovating, but they could have diverse influences. As a matter of fact, the

adoption of external consultants improves the sensibility of the firm's innovation performances in relation with opportunities coming from the environment. This new efficiency allows to achieve better innovation output even with low external knowledge outsourcing. To connect all the dots that drive to the digital transformation, knowledge has to be translated and transferred to all the individuals within the organization throughout new forms of interactions such as agile working, job rotation, flexible work schedules and interfunctional team-working.

11 CONCLUSIONS

We have examined the construct of Absorptive Capacity and we have understood the importance of the Strategic Orientation as its antecedent. Declining this concept into the Digital Transformation trend, we have developed a new construct: Digital Strategic Orientation. To investigate it, we identified seven major antecedents that influence its growth: Senior Management Sensibility and Risk Appetite, three Acquisition Methodologies to acquire and integrate digital skills, the role of Dedicated BU and the existence of Knowledge Sharing processes. This research highlights the need for energy companies to have a supportive top management towards technological scanning activities and investments. Moreover, the existence of knowledge sharing processes in parallel with dedicated business units is fundamental to address the focus towards new tech trends and generate prior related knowledge. Afterwards, those components flow into the ACAP processes which are known to improve firms' innovation performances. From a statistical point of view, not all the Acquisition Methodologies seem to play a crucial role in the development of DSO.

Furthermore, the research suggests a theoretical path for managers that highlights the fundamental rules to follow in order to face the digital transformation of the sector.

To conclude, we hope that this study could encourage future researches in investigating the dimensions and contributions of the construct, using our literature and quantitative analysis as a support.

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