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Master of Science in Management Engineering

HOW AGILE PRACTICES DRIVE CORPORATE ENTREPRENEURSHIP: THE ROLES OF DIGITAL SKILLS AND AMBIDEXTERITY

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ABSTRACT

Corporate Entrepreneurship, which is intended as the capability of firms to identify and pursue new business opportunities, is recognized by researchers as a fundamental driver for innovation of both startups, new venture and incumbent companies. Many researches about this topic revolve around the concept of Entrepreneurial Orientation (EO) as a fundamental attitude of firms to achieve sustained entrepreneurial behaviors over time. However, many recent studies are extending the construct of Entrepreneurial Orientation to the individual-level level of analysis. While many have started to acknowledge the importance of individual EO, very few evidence is provided about its antecedents and the mechanisms that allow to foster it. Recently, the trend of digitalization and the subsequent digitization of organizational processes, as well as the diffusion of experimental methodologies like Agile, have generated new opportunities for employees to discover and generate new ideas. In this context, it is more and more relevant to investigate how the concept of Corporate Entrepreneurship is evolving. Firms' entrepreneurship starts from individuals and understanding how organizations can drive employees to participate or initiate corporate entrepreneurial is fundamental. In this research, entrepreneurial attitude of individuals is measured through their Entrepreneurial Orientation. Therefore, this research investigates in what measure agile practices and digital skills promote Entrepreneurial Orientation among employees and which role is played by the individuals' capability of being ambidextrous. Moreover, the relationship between an individual's Entrepreneurial Orientation and Entrepreneurial Intention is assessed. To answers these research questions, data has been gathered by means of survey with a total amount of 299 individual responses gathered. Findings show that (1) the use of agile practices positively influence the level of digital skills and

individual ambidexterity, (2) digital skills mediate the relationship between the use of agile practices and entrepreneurial orientation, (3) individual ambidexterity has a positive moderating effect on the relationship between digital skills and entrepreneurial orientation and finally (4) there is a positive and significant relationship between entrepreneurial orientation and entrepreneurial intention.

SOMMARIO

L'imprenditorialità delle aziende, intesa come abilità nel perseguire nuove opportunità di business, è riconosciuta dalla comunità scientifica come un driver fondamentale per l'innovazione di aziende giovani e mature. Molte ricerche in questo campo sono volte ad analizzare il concetto di Orientamento Imprenditoriale, inteso come attitudine fondamentale delle aziende ad avere comportamenti imprenditoriali sostenuti nel tempo. Tuttavia, molti studi recenti hanno iniziato ad estendere il concetto di Orientamento Imprenditoriale al livello dei singoli individui. Nonostante molti hanno iniziato a sottolineare l'importanza di questo concetto, la letteratura presenta un numero molto limitato di ricerche volte a spiegare i meccanismi che consentono alle aziende di aumentare l'imprenditorialità dei singoli individui. In recenti anni, il crescente trend di digitalizzazione dei mercati e dei processi organizzativi e il diffondersi di metodologie sperimentali come Agile, hanno generato nuove opportunità per i dipendenti di scoprire e generare nuove idee. È sempre più necessario, infatti, indagare come il concetto di imprenditorialità stia evolvendo. L'imprenditorialità delle organizzazioni inizia dai singoli individui, per cui capire come le aziende possano spingere i propri impiegati a partecipare o iniziare attività imprenditoriali è fondamentale. In questa ricerca, il concetto di imprenditorialità a livello individuale è misurato tramite il concetto di Orientamento Imprenditoriale. L'obbiettivo è, perciò, investigare in che misura le pratiche agile e le competenze digitali promuovano l'imprenditorialità degli impiegati e quale ruolo ricopre la capacità dei singoli di essere ambidestri. Inoltre, la relazione tra orientamento ed intenzione imprenditoriale degli individui è investigata. Per fornire una risposta alle domande che sono alla base della seguente ricerca, sono stati raccolti dati tramite questionario, con un totale di 299 risposte registrate. I risultati mostrano che (1) l'utilizzo di pratiche agile impatta positivamente sia il livello di skills digitali sia in livello di ambidestria degli individui, (2) le skills digitali mediano la

relazione tra l'utilizzo di pratiche agile e l'orientamento imprenditoriale degli individui, (3) l'ambidestria degli individui modera positivamente la relazione tra le skills digitali e l'orientamento imprenditoriale e infine (4) esiste una relazione positiva tra l'orientamento imprenditoriale degli individui e la loro intenzione imprenditoriale.

EXECUTIVE SUMMARY

INTRODUCTION

Research on the topic of Corporate Entrepreneurship (CE) continues to proliferate. Firms strive to increase their entrepreneurial level to improve or maintain their performance, which can be declined in terms of profitability, innovativeness, the identification of new streams of revenue, internationalization or obtaining a competitive advantage in a market. Corporate entrepreneurship has been defined as "the process whereby an individual or group of individuals, in association with an existing organization, create a new organization or instigate renewal or innovation within that organization" (Sharma & Chrisman, 1999, p.18). Nonetheless, the conceptualization and measurement of this construct are matters of ongoing discussion and debate. In particular, the current discussion revolves around the concept of Entrepreneurial Orientation (EO), which is defined as the "extend to which top managers are inclined to take business-related risks, to favor change and innovation in order to obtain a competitive advantage for their firm" (Covin & Slevin, 1989, p.77). If CE describes different ways in which proactive new entry can be pursued by organizations, EO describes the organizational characteristics and attributes which allow the regular manifestation of CE over time (Covin & Wales, 2019). In fact, EO is not a static concept that firms or individuals possess or not, but it can vary in time. Therefore, it is necessary to understand how firms can encourage sustained entrepreneurial behaviors, particularly because there is evidence showing its positive impact to performance (Rauch et al., 2009). Traditionally, the construct of EO has always focused on organizations' top managers, not regarding them as individuals but rather only as representatives who speak for the whole company. However, such perspective denies the possibility that EO might exists at other levels within organizations

(Covin & Wales, 2019) and fails to explain the exhibition of entrepreneurial behavior elsewhere in the organization (e.g., Wales et al., 2011). Yet, employee participation in firms' ventures is a key part of their success (Hornsby et al.,2002). Businesses depend on entrepreneurial activities to survive and thrive in competitive markets but even more they depend on their employees to willingly engage in projects that extend the firm in new directions (Monsen et al., 2010).

For these reasons, many recent studies are extending the construct of Entrepreneurial Orientation to the individual-level (Bolton & Lane, 2012), creating a connection between different level of analysis. The fact that the construct of EO can transcend from individuals to teams to the entire organization is more and more shared (Covin et al. 2020). However, while the importance of Individual Entrepreneurial Orientation (IEO) in association to Corporate Entrepreneurship is starting to be acknowledged by more and more scholars (e.g. Covin et al., 2020, Kraus et al., 2019, Bolton & Lane, 2012, Covin & Wales, 2019), little evidence is provided on the antecedents of IEO, the mechanisms that lead to it and which tools companies can use to foster it.

Distinguished researchers are arguing that methodologies that emphasize the need of continuous testing and experimenting, can drive entrepreneurial mechanisms. Some argue, in fact, that "entrepreneurship is fundamentally about experimentation because the knowledge required to be successful cannot be known in advance or deduced from some set of first principles" (Kerr et al., 2014, p.1). Many notorious practitioners' approaches like agile software development, lean startup or growth hacking are considered successful for this exact reason: they are rooted in a series of fundamental principles all linked to the traditional scientific method which dates back to Leonardo and Galieo. Such methodologies are creating a shift among firms. Traditionally, established firms have primarily pursued experimentation and innovation in specialized R&D units, however, through the implementation of those practices, experimentation is spread throughout the entire organization at every level, promoting entrepreneurship in a new paradigm (Hampel et al., 2020).

Among the different experimental methodologies, many incumbent companies are investing in the adoption of agile practices among their employees (VersionOne 13th Annual State of Agile Report, 2018) with the goal of adapting to hostile and dynamic environments. However, these investments are often made with limited knowledge about the impact they have on individuals and

organizations. The introduction of agile practices, in fact, requires an important effort from organizations in terms of resources, culture adaptation and change management and often times it is difficult to predict the benefits beyond the most tangible ones (Tolfo et al., 2011).

The themes of entrepreneurship and experimentation become even more relevant in a context of digitalization. Digital technologies are, in fact, reshaping the way competition works, altering fundamental market dynamics (Nambisan, 2017; Autio et al., 2018). This shift makes the role of Corporate Entrepreneurship even more relevant, since more and more industries are requiring shorter response time and shorter life cycles and companies needs to foster their ability of sustained entrepreneurial behaviors. The ability of companies to leverage on digital means, in fact, may fundamentally reshape the entire entrepreneurial process (von Briel et. al, 2018). In this scenario, the role of Agile methodologies becomes critical.

The debate about the role of digitalization in the process of venture creation, however, is evolving mainly at firm level and with reference to startups (e.g. Cavallo et al., 2019). Although, the effects of digital technologies can be observed also at individual level in the form of employees' digital skills and abilities, and in the context of incumbent companies. For incumbent firms, which are more likely to subject skills and resources inertia, having a strong set of digital skills may enable them to improve processes, products and services as well as help creating new ones. Employees, in fact, need possess a specific set of skills that allows them to operate in a digital world (Van Laar et al., 2017). Such skills may impact the entrepreneurial orientation of individuals in the context of incumbent companies, which, in turn, affects the process of venture creation known in literature as "Corporate Entrepreneurship" (Stevenson & Jarillo, 1989; Burgelman, 1983). In this sense, agile practices, other than being an experimental approach based on opportunity identification and adaptation to change, also offer a set of tools that allow individuals to improve their competencies in a digital environment. The agile approach was, in fact, first developed in relation to the software development process (Beck, 2000), and its practices are aimed at supporting individuals in dealing with IT complexities.

We argue that the use of agile practices can foster individuals' digital skills by providing the tools to manage challenges in a digital environment and develop the related set of skills. In turn, digital skills work as a mediator, enabling and fostering individuals' entrepreneurial orientation.

However, when considering the relationship between digitalization and entrepreneurship, the ability to balance exploration with exploitation is critical. Such concept, in a digital context, takes the acceptation of IT ambidexterity (Lee et al., 2015) which is conceptualized as combination of IT exploration and IT exploitation. IT exploitation permits to develop information systems more rapidly due to the benefits of reusing developed digital artifacts, while IT exploration refers to acquiring or experimenting new digital technologies and processes. Since digital skills may be applied both to improving existing business lines as well as creating new ones, higher level of ambidexterity among employee is needed to balance the effect of digital skills. At the same time, it has been argued that an individuals' Entrepreneurial Orientation is driven both by exploration and exploitation, in a way that entrepreneurs are able to find new opportunities and act on them to create value (Kraus et al., 2019). Moreover, it has been shown that ambidexterity plays a role in reducing tensions between IT exploration and IT exploitation activities in organizations' agility, improving a firm's digital innovation capability (Leonhardt et al., 2017; Tai et al., 2017).

Therefore, we argue that individuals with a greater level of ambidexterity, who are able to combine exploitative and explorative activities, are more likely to benefit from the use of agile practices and that individuals' ambidexterity moderates the effect of agile practices and digital skills towards entrepreneurial orientation.

Once analyzed the antecedents of Individual Entrepreneurial Orientation and the mechanisms that lead to it, it is also important to assess the relationship that transforms ideas to entrepreneurial actions. At individual level, it has been shown that employees' Entrepreneurial Intention (Liñán & Chen, 2009) often becomes actual behavior when the right organizational conditions are met (Lee et al., 2011; Fayolle, 2014). Therefore, Individual Entrepreneurial Orientation, when linked to Entrepreneurial Intention can create value for organizations, since the intention of becoming an entrepreneur is highly correlated to becoming one (Bolton & Lane, 2012). In this optic, entrepreneurial behaviors start from individuals with their skills, attitude and orientation and is then transformed into behavior when paired with positive and strong intention. In turn, this creates value for the entire organization.

For these reasons, the relationship between Individual Entrepreneurial Orientation and Entrepreneurial Intention is investigated.
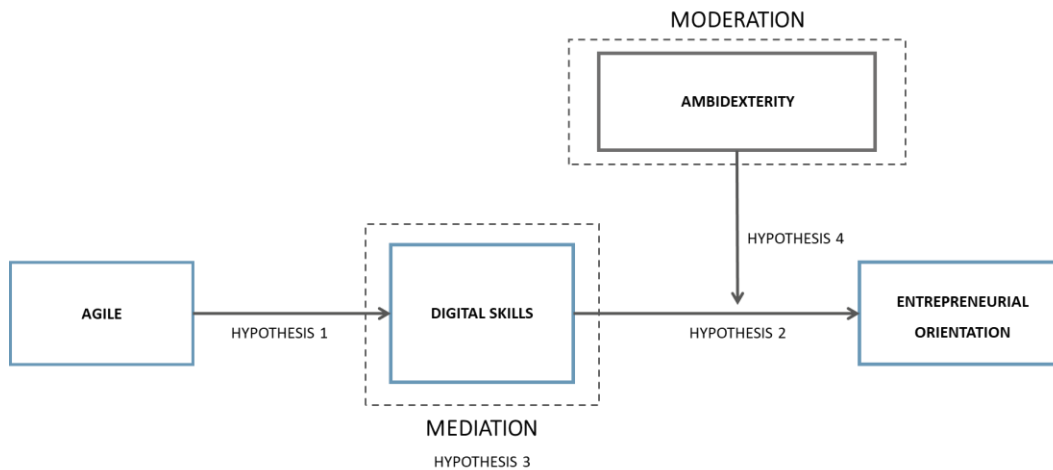
FIGURE 1: CONCEPTUAL FRAMEWORK

THEORY AND HYPOTHESES

AGILE AND DIGITAL SKILLS

Agile Software Development, as first introduced in the manifesto (Beck et al. – 2001), shows a strong relationship with the themes of digitalization. Agile methodologies and practices, in fact, were first conceptualized to address the process of software development, substituting a traditional Stage-Gate approach with an iterative one based on the continuous delivery of value. Their origin is therefore strictly related to manage the complexities introduced in a digital environment. Besides affecting an organization's culture through a series of values and principles, the agile approach offers a series of tools and practices to manage complexities that are typical of digital and software environments.

Agile practices like daily scrum meetings, sprint retrospectives, sprint planning, sprint reviews, pair programming or metaphors, for example create a positive impact on factors like communication. They facilitate individual interactions according to the first agile principle, therefore their application puts individuals

in a position where they are exposed to frequent but fast and efficient interactions. Similarly, practices like user stories, continuous integration, pair programming or coding standards have an impact on individuals' problem solving skills. People are, in fact, required to make decisions on a daily basis in a much shorter time span, therefore learning and flexibility become essential characteristics of their problem solving behavior. Given the relevance of practices, in this research, we propose a new measurement of agile practices based on the concepts of Breadth and Depth presented by Laursen & Salter (2006). In this case, "Agile Breadth" measures the number of agile practices used, while "Agile Depth" measures the number of agile practices used in a frequent way.

With the trend of digitalization, the complexities that were associated solely to high-tech and software environments are starting to be present in all kinds of environments, from manufacturing to project management. For these reasons agile methodologies are exiting the boundaries of software development and are being used more and more in multiple environments that were once considered far from digital. Therefore, given the rapid rate of change, the continuous evolution of technology and the fast digitization of processes, employees need to develop a set of digital skills that allows them to thrive in a changing world. Van Laar, E. et al. (2017) define a set of 21st century digital skills, recognizing that in a global knowledge economy those skills determine organizations' competitiveness and their ability to drive innovation. Due to the changing environment, organizations require more and more employees who can find, process and structure information, solve problems, be creative innovators and exhibit effective communication and cooperation abilities.

The proposed framework of digital skills is based on six core aspects: technical information management, communication, collaboration, creativity, critical thinking, and problem solving (Van Laar, E. et al. – 2017). All these skills are considered fundamental in a wide range of occupations, making their applicant relevant to multiple contexts of application far beyond the high-tech industry.

We argue that individuals using agile practices are more likely to develop a set of digital skills that allows them to create value and innovation from digital technology. Accordingly, we propose the following hypothesis:

H1: *The adoption of Agile practices is positively related to individuals' Digital Skills*

AGILE, DIGITAL SKILLS AND ENTREPRENEURSHIP

The concept of Corporate Entrepreneurship in the literature is often associated to companies' performance. However, different definitions of performance have been given, ranging from profitability to innovativeness, to the identification of new streams of revenue, to internationalization or to obtaining a competitive advantage in a market.

Corporate Entrepreneurship, in fact, can manifest in different forms which allow companies to achieve multiple outcomes and objectives. According to Covin & Miles (1999), Corporate Entrepreneurship can be expressed through: (I) Sustained Regeneration, which is the ability to introduce new products and services into the market, (II) Organizational Rejuvenation, which is the improvement of internal processes, structure and/or capabilities, (III) Strategic Renewal, which is the redefinition of a company's relationship with its markets or industry competitors and (IV) Domain Redefinition, which is the creation of a new product-market arena that others have not recognized or actively sought to exploit.

The literature has always tried to define the characteristics of Corporate Entrepreneurship with the goal of understanding which factors companies can leverage on, to increase their entrepreneurial level. One of the most important construct related to Corporate Entrepreneurship is the concept of Entrepreneurial Orientation (Covin & Slevin, 1989; Miller, 1983; Lumpkin & Dess, 1996), which is conceptualized as an attribute of organizations defined by the combination of different factors: mainly (I) Proactiveness, (II) Innovativeness, (III) Risk-Taking. Both organizational factors and environmental characteristics concur to define a company's Entrepreneurial Orientation and therefore affect companies' performance.

Traditionally, this construct has been used from an organizational perspective, however, there are also studies focusing at the individual level. From an individual perspective, in fact, the literature often focuses on Entrepreneurial Intention (Liñán & Chen, 2009), which can be defined as the intention of an individual to start a new business. It has been shown that this construct of intention is connected to the entrepreneurial orientation of individuals (Bolton & Lane, 2012). In fact, individuals' entrepreneurial orientation is the factor that pushes employees towards opportunity recognition and gives them the attitude to pursue them, while the intention is what makes individuals act upon ideas and

opportunity to transform them into reality (Lee et al., 2011). This, in turn, creates value for the entire organization. In this perspective, therefore, individual entrepreneurial orientation is the first critical factor to understand if organizations want to foster their level of Corporate Entrepreneurship.

A company's entrepreneurial orientation, however, is not a static concept. In fact, firms need to maintain a sustained entrepreneurial behavior over time (Covin & Wales, 2019). This means adapting to market shifts and new trends.

In particular, the recent trend of digitalization has strongly shifted market dynamics, creating new affordances (Autio et al., 2017): (I) Decoupling, which is the possibility to use the same resource to achieve multiple outputs, (II) Disintermediation, which leads to the reduction of intermediaries and the possibility of reaching directly the end user and (III) Generativity, which allows to scale solutions at a fast paste and low cost. In this context, the digital entrepreneur faces increasingly dynamic paths, determined by diverse activities with uncertain time frames (Nambisan, 2017).

Moreover, entrepreneurial inputs are progressively becoming interrelated, making most of innovation endeavors happening in inter-organizational ecosystems of actors. At the same time, innovation processes are gradually being compressed, anticipating and enhancing the phases in which customer feedback is gathered and employed. Finally, innovation outputs are increasingly taking the form of platforms used to create value by matching the supply of an asset with demand (Agostini et al., 2019).

Hence, there is a necessity to consider the concept of Corporate Entrepreneurship through digital lenses. In such context, in fact, the level of IT capabilities can enable Corporate Entrepreneurship (Chen et al., 2015). Hence, Digital Skills become fundamental in the debate on Digital Corporate Entrepreneurship. Therefore, considering that this research is carried at an individual level of analysis, following the previous arguments linking Corporate Entrepreneurship to employee entrepreneurship and to Entrepreneurial Orientation (e.g. Covin et al., 2020, Kraus et al., 2019, Bolton & Lane, 2012, Covin & Wales, 2019), the following hypothesis will be tested:

H2: *Individuals' Digital Skills are positively associated to Entrepreneurial Orientation*

Moreover, since we also argued that agile practices are positively related to digital skills (H1), the latter will be investigated as a mediator in the relationship between agile and individual entrepreneurial orientation. Hence, the following hypothesis will be tested:

H3: *Individuals' Digital Skills mediate the relationship between the use of Agile Practices and Entrepreneurial Orientation*

THE MODERATING ROLE OF AMBIDEXTERITY

As previously discussed, the concept of Corporate Entrepreneurship had always been linked to the one of performance. In order to achieve high levels of performance, companies need to combine both exploratory activities and exploitative ones (Birkinshaw & Gibson, 2004).

At the individual level, exploration might be conceptualized as the search for novel ideas, technologies, paradigms and general knowledge to shake up existing processes and find superior ways to conduct business (March,1991). On the other hand, individual-level exploitation consists of improving, standardizing and elaborating established processes by collecting best practices from other departments and applying those to one's own departments (Birkinshaw & Gibson, 2004). From a research perspective, the interest on individual level ambidexterity is justified by the positive relation between individual ambidexterity, team performance and organizational results (Schnellbächer et al., 2019).

In this sense, agile practices offer a set of tools to improve both individuals' exploitative abilities and individuals' explorative skills. Agility, in fact, can be defined as the "ability to sense and respond swiftly to technical changes and new business opportunities, enacted by exploration-based learning and exploitation-based learning" (Lyytinen & Rose, 2006).

In a context of digitalization, the concept of ambidexterity often takes the acceptation of IT ambidexterity (Lee et al., 2015) which can be conceptualized through the combination of IT exploration and IT exploitation. IT exploitation

permits to develop information systems more rapidly due to the benefits of reusing developed digital artifacts, while IT exploration refers to acquiring or experimenting new digital technologies and processes.

In such context, agility may create tensions between IT exploration and IT exploitation activities inhibiting a firm's digital innovation capability (Leonhardt et al., 2017; Tai et al., 2017). In this sense, individuals' Ambidexterity needs to regulate the relationship between agile, digital skills and entrepreneurial orientation. We argue that individuals are able to combine explorative and exploitative abilities benefit more from the use of agile practices. As a consequence, their level of digital skills leads to greater levels of entrepreneurial orientation. To investigate this relation, the following hypothesis will be tested:

H4: *Individual Ambidexterity moderates the relationship between Digital Skills and Entrepreneurial Orientation*

RESEARCH METHOD

SAMPLE AND DATA COLLECTION

To test the various hypotheses, data was collected through survey. In particular, the company from which data was taken, works in the IT industry supporting other firms in their IT strategy working as system integrators. The survey was issued to a total of around 1500 individuals. The number of final responses were 299, indicating a response rate of 20%.

The questionnaire was designed mainly based on scales developed by previous studies which have shown high reliability and validity (Bolton & Lane, 2012; Liñán & Chen, 2009; Van Laar, et al., 2017; Zhang et al., 2019) and it is aimed at measuring the different construct used in the research: (1) Individual Entrepreneurial

Orientation, (2) Individual Entrepreneurial Intention, (3) Individual Ambidexterity and (4) Digital Skills.

Among these conceptual scales, however, two of them are composed by different sub-attributes. In particular:

- **Entrepreneurial Orientation**
  - Innovativeness
  - Risk-Taking
  - Proactiveness

- **Digital Skills**
  - Communication
  - Information Management
  - Collaboration
  - Creativity
  - Problem Solving
  - Critical Thinking

Regarding the agile scale, another approach was taken. We developed the concept of Agile Breadth and Agile Depth adapted from Laursen & Salter (2006). In particular, Agile Breadth measures the number of agile practices used by each individual, while Agile Depth measures the number of agile practices used frequently. The sample, in terms of demographics, is described in table 1. To prepare data for the analysis, categorical variables needed to be pre-processed. Hence, numerical values were attributed to them:

- **Gender**: 1 = Male, 0 = Female

- **Study Title**: from 0 to 4, the higher the value, the higher the education level

- **Family Background**: 1 = having an entrepreneurial parent, 0 = otherwise

- **Entrepreneurial Experience**: 1 = previous entrepreneurial experience, 0 = otherwise

- **Position**: from 0 to 3. The higher the value, the higher the position in the company (0 represent employees and 3 represents top managers).

	N	%
Gender		
Male	204	67%
Female	101	33%
Age		
21-30	27	9 %
31-45	96	32 %
46-60	164	55 %
>60	12	4 %
Study title		
Diploma	161	53%
Bachelor's degree	41	13%
Postgraduate degree	93	30%
Higher	6	2%
Other	4	2%
Position		
Employee	201	66%
Manager	80	26%
Senior manager	16	5%
Other	8	3%
Entrepreneurial background (family)		
No	259	85%
Yes	46	15%
Previous entrepreneurial activities		
No	270	89%
Yes	35	11%

TABLE 1: SAMPLE DEMOGRAPHICS (N=299)

RELIABILITY AND CONSTRUCT VALIDITY

The first step after acquiring and cleaning the data was to perform some preliminary analysis to guarantee the quality of the analysis. Since the used variables are derived from survey data, several measures were taken to mitigate concerns of common method bias (Kammerlander et al., 2015). First, in designing the survey, was decreased the respondents' motivation to provide answers driven by social desirability by assuring strict confidentiality, anonymity and embedding questions related to our variables in a comprehensive survey. Second, an exploratory factor analysis was performed to ensure that no dominant factor explained variance in our sample (which would indicate the presence of common

method bias). The largest factor, in fact, explained less than 28% of the total variance. Further, a confirmatory factor analysis showed that the data structure proposed in the study fits the data significantly better (as revealed by Chi-squared test) than a model with only one dominant factor. For these reasons, it is possible to conclude that the risk of common method bias is low.

Moreover, the attributes, except the control variables, were standardized to reduce the likelihood of multicollinearity and ensure the quality of the model (Cohen & Cohen, 1983). This step is critical to ensure that the predictive variables are not linearly correlated, avoiding that the significance of the model is compromised. After this operation, multicollinearity was checked by examining the variance inflation factors (VIFs). All of the VIF values were below 2, indicating that multicollinearity is not a problem in the analyses.

It was also necessary to check for non-response bias. The non-response bias refers to the possibility that people who didn't respond to the survey are very different from people who responded. This creates a problem of sample significance and generalization of the results, particularly since the survey represents the 20% of the entire population. In this case, the non-response bias was tested by comparing two sub-samples: early respondents and late respondents (Borg & Tuten, 2016; Dalecki, 1993). Both the T-test and the Levene's Test performed on demographic variables among the different sub-samples show that there are similar means and standard deviations, therefore the risk of non-response bias can be ruled out.

Besides checking the quality of the sample, reliability and validity were tested (table 2). The reliability test shows that Cronbach's alphas for all constructs exceeds the threshold of 0.7, indicating sufficient reliability (Cronbach, 1951).

CONSTRUCT	# ITEMS	ALPHA	AVE	SOURCE
ENTREPRENEURIAL INTENTION	7	0.90	78.6%	Linan & Chen (2009)
ENTREPRENEURIAL ORIENTATION	10	0.817	54.8%	Bolton D.L. & Lane M.D. (2012)
AMBIDEXTERITY	4	0.808	91.6%	Zhang et al. (2018)
DIGITAL SKILLS	59	0.965	37.2%	Van Laar E. et al. (2018)

TABLE 2: CONSTRUCTS, RELIABILITY AND VALIDITY

Moreover, the fact that the minimum value reported is 0.807 allows to classify the measured constructs between "Good" and "Excellent" (George & Mallery, 2003). The variables of Agile Breadth and Depth were excluded from this analysis, since they don't measure conceptual construct but merely the use and frequency of use of specific practices.

To validate the scales, factor analysis was performed. Since the survey was composed of scales taken from the literature, it was enough to check the constructs by means of confirmatory factor analysis (CFA) to understand if there is a correspondence between the conceptual scales and the data. The average variation extracted (AVE) values of all variables except digital skills were greater than the cut-off value of 0.5. Although the construct of digital skills is unique, it is composed by 6 different skills that are potentially heterogeneous from one another. Thus, we believe that the AVE level is acceptable. Looking at table 3, in fact, the construct of Digital Skills is decomposed into the 6 sub-attributes that constitute it. Results show that in this case, the variance explained by each is significantly higher when compared to the previous case, proving that the low AVE is due to the heterogeneity of the attributes composing Digital Skills. Following the factor analysis, items in the same factor were aggregated. In this case items within each factor had similar loadings, hence it was possible to aggregate items by simply computing their average.

CONSTRUCT	# ITEMS	# FACTORS	AVE
DIGITAL SKILLS			
INFORMATION MANAGEMENT	5	1	65.2 %
COMMUNICATION	17	1	65.7 %
PROBLEM SOLVING	8	1	85.9 %
COLLABORATION	11	1	78.7 %
CRITICAL THINKING	12	1	79.1 %
CREATIVITY	6	1	88.1 %

TABLE 3: FACTORS OF EO

ANALYSIS AND RESULTS

From the empirical analysis, some important results emerged. First, the correlation analysis is reported in table 4.

By looking at correlations, some insights can be extrapolated. In fact, Entrepreneurial Orientation shows to be correlated with Digital Skills, Ambidexterity, Agile Breadth, Agile Depth and Entrepreneurial Intention. Also, Digital Skills shows to be correlated with Agile Breadth, Agile Depth and Ambidexterity. These findings give preliminary confirmation regarding the hypothesis of this research, however, in order to have empirical proof, relationships need to be tested by means of regression analysis.

VARIABLES	MEAN	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13
ENTREPRENEURIAL ORIENTATION	3.40	0.58	1												
ENTREPRENEURIAL INTENTION	3.72	0.80	0.53**	1											
DIGITAL SKILLS	3.30	0.58	0.51**	0.33**	1										
AGILE BREADTH	3.80	5.80	0.18**	0.12**	0.27**	1									
AGILE DEPTH	0.78	2.67	0.11**	0.01	0.17**	0.46**	1								
AMBIDEXTERITY	3.41	0.95	0.59**	0.43**	0.49**	0.16**	-0.02	1							
AGE	46.26	9.48	0.007	-0.06	-0.1	-0.07	-0.04	0.01	1						
TENURE	12.29	9.08	-0.08	0.01	-0.18**	0.006	0.003	-0.09	0.41**	1					
STUDY TITLE	1.85	0.99	0.11**	0.04	0.17**	0.13**	0.001	0.11*	0.008	-0.13*	1				
GENDER	0.67	0.47	0.09	0.11*	0.18**	0.13*	0.08	0.10*	0.05	-0.08	-0.08	1			
POSITION	0.45	0.72	0.16**	0.12**	0.17**	0.06	-0.04	0.25**	0.38**	0.07	0.22**	0.020	1		
FAMILY BACKGROUND	0.15	0.36	0.07	0.01	0.13*	-0.07	-0.03	0.12*	0.003	-0.03	0.04	-0.08	0.06	1	
ENTREPRENEURIAL EXPERIENCE	0.11	0.31	0.09*	0.07	0.09	-0.06	-0.05	0.10*	0.24**	-0.10	-0.04	0.157*	0.20**	0.09	1

TABLE 4: CORRELATION MATRIX (N=299)

To test Hypotheses, hierarchical and moderated hierarchical OLS regressions were used. Results of the regression analysis are reported in table 5. In order to develop the empirical model, multiple hierarchical regression analysis (Cohen & Cohen, 1983) was used to test and verify the research questions. Starting from a base model, which in this case includes only the control variables, the remaining independent variables are added according certain criteria. Then, the variation of R^2 and the significance are analyzed to draw conclusions about the impact of the new variables.

In the first three models reported, Digital Skills is used as dependent variable to test its relationship with agile practices according to the first hypothesis. In model 2, the variable of Agile Breadth is added. Results show that the variable results to be significant at p<0.001 and the variation of R^2 is relevant. In model 3 the variable of Agile Depth is added alone, however, in this case, the model shows a smaller variation of R^2 when compared to the base model. Finally, in model 4, both variables are included and in this case only Agile Breadth shows to be significant.

This allows to conclude that hypothesis 1 is supported. However, only the number of agile practices used (Agile Breadth) positively impacts individuals' digital skills. The number of agile practices used frequently (Agile Depth) is, instead, not significant when paired with Agile Breadth.

In the following models, instead, the relationship between Digital Skills and Entrepreneurial Orientation is tested. In model 5, only control variables are used as predictors. In model 6, the variable of Agile Breadth is added. Results show that the variable is significant at p<0.05 and that there is an increase in R^2, confirming that there is a positive relationship between the use of agile practices and Entrepreneurial Orientation. In model 7, the variable of digital skills is introduced without Agile Breadth. In this case, digital skills is significant at p<0.001 and there is a very strong increase in R^2. Finally, in model 8, both the variables of Digital Skills and Agile Breadth are used as predictors of Entrepreneurial Orientation. However, the increase in R^2 is close to zero and only the variable of digital skills is significant.

These findings allow to confirm both hypothesis 2 and 3. In fact, there is a strong positive relation between Digital Skills and Entrepreneurial Orientation (HP2) and that Digital Skills moderate the role of Agile Breadth (HP3). In particular, moderation can be confirmed because different criteria are met (Baron & Kenny, 1986; De Carolis et al., 2009):

1. Agile Breadth is positively associated to Digital Skills (model 2)

2. Agile Breadth is positively associated to Entrepreneurial Orientation (model 5)

3. Digital Skills are positively associated to Entrepreneurial Orientation (model 6)

4. Digital Skills significantly reduce the effect of Agile Breadth on Entrepreneurial Orientation (model 7)

In model 9, the variable of Ambidexterity is added as predictor of Entrepreneurial Orientation. Results show that the variable is significant at p<0.001 with a relevant increase in R^2, confirming that there is a positive association between individuals' Ambidexterity and Entrepreneurial Orientation.

To test for the moderation, however, also the interaction between Digital Skills and Ambidexterity needs to be tested (Hayes, 2013). If the interaction variable is significant, moderation occurs. For this reason, in model 10 the product of the standardized variables measuring digital skills and ambidexterity is added. Results show that the interaction variables, as well as the single variables, is significant with p<0.05. Hypothesis 4, therefore, is confirmed. Individual ambidexterity moderates the relationship between Digital Skills and Entrepreneurial Orientation.

After testing the hypothesis at the foundation of this research, a further analysis was performed to study the connection between an individual's entrepreneurial orientation and his intention to act upon that (Bolton & Lane, 2012). The following hypothesis is tested:

Post Hoc Hypothesis: *"Entrepreneurial Orientation is positively associated to Entrepreneurial Intention"*

Results of model 11 show that the hypothesis can be confirmed and that the two variables are positively associated in an empirical way. However, not enough evidence is provided to discuss about the way this relationship manifests or which factors may influence it. More and comprehensive evidence is required to empirically find a complete model that ties together both entrepreneurial orientation and intention.

	DIGITAL SKILLS				ENTREPRENEURIAL ORIENTATION						EI
	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5	MODEL 6	MODEL 7	MODEL 8	MODEL 9	MODEL 10	MODEL 11
CONTROL VARIABLES											
CONSTANT	3.388***	3.291***	3.352***	3.291***	3.393***	3.324***	1.687***	1.709***	1.467***	3.413***	1.677***
AGE	-0.009*	-0.007	-0.008	-0.007	-0.004	-0.003	0	0.001	0.001	0.000	-0.012*
GENDER	0.232**	0.188**	0.212**	0.186**	0.113	0.082	-0.004	-0.011	-0.020	-0.031	0.107
TENURE	-0.006	-0.007	-0.006	-0.007	-0.003	-0.003	0.000	0.000	0.001	0.001	0.008
STUDY TITLE	0.078*	0.060	0.077*	0.063	0.043	0.030	0.004	0.001	0.003	-0.005	-0.010
POSITION	0.147**	0.130**	0.149***	0.134**	0.128*	0.116*	0.054	0.052	-0.012	-0.012	0.092
ENTREPRENEURIAL EXPERIENCE	0.098	0.121	0.112	0.124	0.104	0.121	0.055	0.062	0.050	0.057	0.116
FAMILY BACKGROUND	0.204*	0.227**	0.209**	0.226**	0.102	0.118	-0.001	0.007	-0.035	-0.050	-0.058
INDEPENDENT VARIABLE											
AGILE BREADTH		0.023***		0.019**	0.016**			0.005	0.003	0.004	
AGILE DEPTH			0.036***	0.018							
MEDIATOR											
DIGITAL SKILLS							0.503***	0.491***	0.290***	0.172***	
MODERATOR											
AMBIDEXTERITY									0.276***	0.267***	
INTERACTION											
AMBIDEXTERITY*DIGITAL SKILLS										0.048*	
POST HOC ANALYSIS											
ENTREPRENEURIAL ORIENTATION											0.704***
R-SQUARED	0.144	0.192	0.172	0.198	0.056	0.080	0.269	0.271	0.416	0.425	0.300
R-SQUARED ADJ.	0.123	0.170	0.149	0.173	0.033	0.055	0.249	0.249	0.397	0.403	0.280
ΔR-SQUARED		0.048	0.032	0.054		0.024	0.191	0.003	0.145	0.09	
F	6.973	8.641	7.58	7.930	2.459	3.169	13.350	11.960	20.528	19.273	15.51

*$p<0.05$; **$p<0.01$; ***$p<0.001$

TABLE 5: RESULTS OF REGRESSION MODELS

CONCLUSIONS

Entrepreneurial Orientation is often described as vital to organizational performance. The positive effect of EO on a firm's performance is often reported and investigated in the literature (Rauch et al., 2009). However, there remains a theoretical and conceptual leap from organizational EO to entrepreneurial behaviors and intrapreneurial outcomes elsewhere in the organization and especially among individuals. It is ultimately upon the behaviors of individuals that organizational activity and corporate entrepreneurship depend (Hornsby et al.,2002; Monsen et al., 2010). This study investigated the relationship of Individual Entrepreneurial Orientation with the use of agile practices. In particular, the aim is to understand whether the use of agile practices has an impact in increasing the entrepreneurial orientation of employees and which are the underlying mechanisms behind it.

The development of the research questions was mainly driven by the intention to deepen the link between the use of practices based on the scientific method and the entrepreneurial level among individuals in organizations, a topic that lacks researches in the existing literature particularly in a digital context (Covin et al., 2020, Kraus et al., 2019). Merging the empirical perspective of data analysis and the theoretical background provided by the literature review, it is possible to draw some valuable conclusions.

The first finding of this study, confirming that the use of agile practices is positively related to individuals' digital skills, shows that agile practices are valuable tools to help organizations to face the challenges of digitalization. However, results show that, while the number of practices used is significant, the number of practices used frequently doesn't bring additional value. These finding highlight that a successful investment in agile needs to be balanced and that agile practices need to be fit to a problem rather than fixing problems to agile.

Similarly, the fact that Digital Skills are positively associated to Entrepreneurial Orientation and that they mediate the effects of agile show that the skills needed to survive in a digital environment are the same skills that allow firms to be more entrepreneurial. In fact, digitalization increases complexity making environments more turbulent and uncertain. However, these are the same conditions that entrepreneurs need to face when pursuing new opportunities.

Moreover, results allow to confirm the moderating role of individual's ambidexterity over digital skills, proving the importance of balancing exploration and exploitation in an entrepreneurial context. The intrapreneurial process, in fact, can be divided into two parts. The first is the recognition of opportunities and the second is the exploitation of such opportunities. Often employers are afraid that employees concentrating on the identification of new opportunities are less effective in exploiting opportunities (Kraus et al., 2019). In a context of digitalization, in fact, individuals' Digital skills can both be used to efficiently perform daily activities but also to pursue new opportunity. The ability of individuals to balance both is critical for firms to ensure the maintenance of their current competitive advantage and the achievement of a new one over time. A characteristic that is even more fundamental in a digital context where the life cycle of products and services is shortening.

Finally, the post hoc analysis shows the existence of a positive relationship between individuals' Entrepreneurial Orientation and their intention to act in an entrepreneurial way. Even though this connection needs to be further validated and investigated, it may explain further connection between individuals' Entrepreneurial Orientation and firms' Corporate Entrepreneurship. In fact, orientation is often described as an attitude of individuals. Intention however shows to be correlated with actual behavior. When individuals have both, and the necessary organizational conditions are met, people are more likely to create value for their firms through entrepreneurial acts.

CONTRIBUTIONS TO RESEARCH

Our findings contribute to existing literature in four main ways. First, the findings extend our understanding of the role that experimental approaches plays in facilitating entrepreneurship. In this research, in fact, it is shown that the use of Agile practices has a positive effect on individuals' entrepreneurial orientation. The theoretical connection between entrepreneurship and experimentation is something of growing interest in the literature and, even though some conceptual

contribution is provided (Kerr et al., 2014), the stream of research lacked empirical evidence.

Second, this research clarifies entrepreneurial concepts in a context of digitalization. Changes introduced by digital technologies are, in fact, fundamentally shaping markets and competition, offering new opportunities that have the potential of disrupting the way most traditional industries work (Autio et al., 2018). In this scenario, the role of the entrepreneur needs to be revisited (Nambisan, 2017). To cope with such shift, this research ties together the concept of Entrepreneurial Orientation, which is one of the most relevant constructs associated to Corporate Entrepreneurship, with the perspective of digital skills, intended as capabilities required in a context of digitalization.

Third, the results further develop the role of ambidexterity in relationship to entrepreneurship and digitalization. Such contribution in the literature can be consider as novel and relevant. In fact, many authors in this research stream have started to investigate the concepts of digital capabilities in relation to exploration and exploitation mainly through the concept of IT ambidexterity (Lee et al., 2015) in different ways. Some argue that IT ambidexterity fosters a firm's digital innovation capability (Tai et al., 2017), some focuses on the alignment between digital capabilities and business objectives (Bot & Renaud, 2012) and others focus on the role of ambidexterity as alignment between entrepreneurial agility and adaptive agility in a digital context (Röder et al., 2014). However, many of those researches are focusing on linking together organizational construct. This research, instead, offers a more empirical approach at an individual level of analysis, showing that there is a moderating effect of ambidexterity in the relationship between digital skills and entrepreneurial orientation. With respect to extend research, this approach offers many more implications for practitioners.

The fourth important theoretical contribution is represented by the analysis around the concept of Entrepreneurial Intention. Findings show that there is a positive relationship between Entrepreneurial Orientation and the intention to pursue business opportunities. This link is potentially very important both for practitioners and conceptual researches. In fact, it has been shown that there is a connection between intention and action in the venturing process (Fayolle, 2014). Therefore, this relationship has much practical and theorical potential. However, at the current state of the research, more evidence is needed.

PRACTICAL IMPLICATIONS

Besides the theoretical contribution to the different streams of literature, this research has also many implications for practitioners and firms.

First, the research clarifies the benefits for firms in investing in experimental approaches such as Agile. In fact, besides the practical benefits of adopting agile practices to improve the processes of software development or project management, results show that the adoption of agile practices leads to positive effects in terms of digital skills and entrepreneurial orientation of individuals. In particular, the adoption of agile methodologies is something exogeneous for organizations, meaning that companies have the opportunity to guide their use and implementation. By leveraging this factor, firms can have multiple additional benefits which range from developing internal IT capabilities that allow them to survive in a digital context to fostering entrepreneurial attitude among employees that allows them to discover and pursue new opportunity to obtain a sustained competitive advantage over time.

Second, findings show the importance for companies of fostering individuals' ambidexterity. It is critical, in fact, that firms and employees deploy both exploitative and explorative behaviors. The investment in agile practices and the cultivation of digital skills, in fact, needs to be balanced. The immediate risk, in this sense, is to be stuck in a mechanism where capabilities and procedures inhibit individuals' creativity and attitude towards opportunity recognition. This idea is confirmed by the findings. The models, in fact, report that using agile practices is more significant than using practices with high frequency. Moreover, results show that being ambidextrous enhances both sides of the spectrum (exploration and exploitation), with a subsequent increase in entrepreneurial levels.

Finally, an important contribution is made in explaining the process of venture creation starting from an individual level. The positive relationship between Entrepreneurial Orientation and Entrepreneurial Intention, in fact, demonstrates that peoples' attitude towards new opportunity is related to their intention to pursue them.

LIMITATIONS

Apart from the contributions made by this research, there are some limitations to discuss. In fact, despite methodological rigor has been devoted in the empirical analysis, there are some limitations due to the nature of the available data and the way they were operationalized.

First, results of this paper are based on the analysis of data gathered by means of a survey issued to a company working in the IT sector. Even though the response rate (20%) is in line with extend researches and tests were made to ensure that the sample gathered is representative of the entire population, one important limit is the fact that data is referred to a single firm. To further validate the findings, in fact, a wider sample of firms should be considered.

Second, in relation to the methodology used, a potential limitation is the fact that the variables analyzed are all gathered through survey. While there is much evidence that the construct of Entrepreneurial Orientation is linked to performance (Rauch et. al, 2009) and researches validate the use of Entrepreneurial Intention as proxy for performance (Bolton & Lane, 2012), a real parameter of firm performance is lacking. Having an objective quantitative parameter not depending on individuals' responses, in fact, can be a way to validate the findings.

Moreover, the cross-sectional design of the research limits the possibility of attributing further causality to the relationships highlighted by the empirical analysis of the data. This is given by the issue that data gathered in the form of survey usually describes the picture of a population in a specific moment in time. Therefore, obtaining full causality related to correlations is challenging.

FUTURE DIRECTIONS

The findings of this research, while answering some research questions and providing value to the literature, also open up new research opportunities. First, it is important to acknowledge the limitation presented and encourage future researchers to fill the gap.

First, researchers could validate the findings by increasing the sample of firms and industries and by defining an objective parameter of performance not depending on the survey methodology. As previously illustrated, in fact, this research already explicates the relationship between the variable of Entrepreneurial Orientation and performance. Moreover, results are considered to be generalizable to different industries depending mainly on the dynamicity of the environment. However, these statements are mostly supported by studies in the literature (Rauch et. al, 2009; Bolton & Lane, 2012; Hampel et. al, 2020). Therefore, further researches with empirical evidence may be valuable to confirm the findings.

Moreover, to expand the perspective of this research, future scholars could integrate different methodologies to gather more insights, especially from a practical point of view. In this study, in fact, the perspective of quantitative data analysis is combined with theoretical consideration to provide a unique framework of causality. However, the additional use of case studies or interviews could allow to tie together the current perspectives with more organizational ones. They could allow to deepen the optimal organizational conditions to integrate the individual level with the firm one. This is particularly relevant since in all the literatures of reference the importance of organizational factors is critical. Regarding agile, it has been proven the importance of the context and the organizational culture (Tolfo et al.,2011; Misra et al., 2006). Similarly, for Corporate Entrepreneurship, factors like control systems (Morris et al., 2006), leadership styles (Dess, 2003), managerial practices (Barringer & Bluedorn, 1999) or organizational culture (Ireland et al., 2009) are fundamental. In this sense, studies that clearly link together individual quantitative results with data about firm level factors could be of much value. Such perspective can allow to further understand the link between individual level of abstraction with firm level (Covin & Wales, 2019). Moreover, to solve the limits created by the cross-sectional design nature of the research, experiments could be carried out to attribute further causality to the findings. In fact, this methodology is more and more used among management scholars since it allows to obtain targeted and precise insights to complement theoretical or empirical evidence.

An important direction that emerged from this research is the one linking Entrepreneurial Orientation with Entrepreneurial Intention. As mentioned, our findings show that the two constructs have a positive relation and previous literature shows that intention is further associated with entrepreneurial action.

Further investigating this link has much value for both scholars and practitioners. From a theoretical perspective, in fact, this relationship could be a bridge between the individual level of analysis and the corporate one. In fact, if entrepreneurial orientation can be linked to entrepreneurial action in such way, it means that fostering individuals' attitude, is intrinsically linked to fostering a firm's Corporate Entrepreneurship in a sustained way over time. Moreover, from a practitioner perspective, proving this connection implies maximizing the probability of entrepreneurial behaviors, which in turns implies being able to have a sustained competitive advantage over time.

Finally, from a practical point of view, further research could be made in relationship to agile practices tailoring in a context of digitalization (Campanelli et al., 2018; Bass, 2012). In fact, this research treats agile practices in an aggregated way through the concepts of Agile Breadth and Agile Depth. However, investigating the effect of different clusters of practices is very important especially for practitioners deciding on which practices they should invest.

xxx

CHAPTER 1

CORPORATE ENTREPRENEURSHIP

The concept of Corporate Entrepreneurship (CE) has a long history among scholars but is always in continuous evolution. In order to understand this concept, it is necessary to define why it matters for companies, what are the main attributes related to it, which are its enablers and how it is changing contextually with external trends. The construct of Corporate Entrepreneurship is, in fact, multi-dimensional, hence understanding it requires deepening all the elements that affect it.

DEFINITIONS AND CONCEPTUAL ASPECTS

The concept of entrepreneurship in the literature can be traced back to almost one century, nonetheless it's something that it's more actual today than ever before, due to the way external forces are shaping firms and competition. Schumpeter (1934) is considered by many as the father of the theory of modern entrepreneurship, since he's been the first to elaborate on its role both in the economy and in society. He described entrepreneurship as a process of "creative destruction", which is generated by the discovery of new opportunities that reshape the image of the future. Although Schumpeter focused primarily on the individual entrepreneur, since his first definition many others were elaborated, extending the concept to a corporate dimension of analysis. Throughout the years, the literature often linked Corporate Entrepreneurship to different purposes, like firm's profitability (Zahra, 1991 & 1993), Strategic Renewal (Guth & Ginsberg,

1990), firm's innovativeness (Baden-Fuller, 1995), new revenue streams (McGrath et al., 1994), internationalization (Dess et al., 2003) or more in general achieving a competitive advantage (Covin & Miles – 1999). Nonetheless, before considering the applications of Corporate Entrepreneurship, it's important to focus on its definition. In the past, the strategy literature associated Corporate Entrepreneurship with three main types of activities. The first is what is referred to as corporate venture or intrapreneurship (MacMillan et al., 1986) which is ultimately linked to the creation of new businesses within existing organizations. The second is more related to the transformation or renewal of existing organizations (Beer et al., 1990), while the third is related to changing the competitive landscape as suggested by Schumpeter (1934). Although these studies all concurred to contextualize Corporate Entrepreneurship and give it a characterization, Covin & Miles (1999) were among the firsts to give an empirical and multi-dimensional connotation to CE by defining it as "the presence of innovation plus the presence of the objective of rejuvenating or purposefully redefining organizations, markets, or industries in order to create or sustain competitive superiority". In this sense, this definition starts to build Corporate Entrepreneurship as a complex phenomenon that has both strategic and practical implications. Others describes Entrepreneurship as "a dynamic process of vision, change, and creation. It requires an application of energy and passion towards the creation and implementation of new ideas and creative solutions. Essential ingredients include the willingness to take calculated risks, formulate an effective venture team, marshal the needed resources, build a solid business plan, and, finally, the vision to recognize opportunity where others see chaos, contradiction, and confusion" (Kuratko, Entrepreneurship: Theory, process, practice (8th ed.), 2009).

Besides the various conceptual shades that are attributed to entrepreneurship, an important contribution in the field was given by Covin & Miles (1999) who were able to give it a taxonomy of reference and identify *four forms* of this phenomenon:

1. **Sustained Regeneration**: it can be defined as the ability of an organization to "regularly and continuously introduce new products and services or enter new markets" (Covin & Miles, 1999). In order to be successful in implementing such form of CE, firms should have cultures, organizations and structures to support innovation whether it's aimed at competing for

market share or at launching new products and entering in new markets. It's important to clarify that Corporate Entrepreneurship in the perspective of Sustained Regeneration is not only confined to new product development, but it can be classified as a phenomenon of continuously and systematically expanding the company's boundaries to secure long-term competitiveness and a sustained competitive advantage over time.

2. **Organizational Rejuvenation (OR)**: it's a phenomenon of corporate entrepreneurship in which organizations seek to improve their internal processes, structure and/or capabilities. In this sense, the phenomenon of Organizational rejuvenation is strictly related to forms in which the target of innovation is the organization itself and the activities in its Value Chain. An important effort was made by the authors in specifying that when we refer to Organizational Renewal "it is important to recognize that firms [don't necessarily need to] change their strategies in order to be entrepreneurial. Rather, Corporate Entrepreneurship may involve efforts to sustain or increase competitiveness through the improved execution of particular, pre-existing business strategies" (Covin & Miles, 1999). This position opened up new studies and researches aimed at deepening the relationship between Corporate Entrepreneurship and a phenomenon which is referred to as Organizational Renewal or Corporate Renewal or Corporate Rejuvenation. In fact, Joshi et al. (2019) were able to link corporate entrepreneurship as a corporate-level construct to Organizational Renewal and in particular to a more operation-level construct as 'process renewal'.

3. **Strategic Renewal**: it can be considered as a phenomenon in which "the organization seeks to redefine its relationship with its markets or industry competitors by fundamentally altering how it competes" (Covin & Miles – 1999). In this particular form of corporate entrepreneurship, the focal point is the firm within its context and the underlying strategy that mediates the interface between the firm and its environment. The term Strategic Renewal was also used by Simons (1994) to consider phenomenon leading to the definition of a new business strategy. Although it is argued by Covin

& Miles (1999) that the term Strategic Renewal in the context of Corporate Entrepreneurship should not merely be associated with a new business strategy but to a business strategy that can be considered significantly different from previous ones and that allows the firm to leverage on emerging opportunities from the market.

4. **Domain Redefinition**: it's the final form of CE proposed by the authors and it can be described as a phenomenon whereby the organization proactively creates a new product-market arena that others have not recognized or actively sought to exploit" (Covin & Miles, 1999). In doing so the firm can be able to enter a market being a first or early mover and set up its structure. This way, the firm can work to obtain a sustainable competitive advantage and at the same time shape the market for future competition by defining industry standards or creating entry barriers.

The study made by Covin & Miles (1999) can be considered as a first attempt to give a comprehensive and clear taxonomy of Corporate entrepreneurship, and its acceptance make it still very relevant. Many of the articles that are published even in recent years, in fact, use these forms as foundations to build upon.

FORM OF CORPORATE ENTREPRENEURSHIP	FOCUS ON CORPORATE ENTREPRENEURSHIP	TYPICAL BASIS FOR COMPETITIVE ADVANTAGE	TYPICAL FREQUENCY OF NEW ENTREPRENEURIAL ACTS	NEGATIVE IMPACT IF NEW ENTREPRENEURIAL ACT IS UNSUCCESSFUL
SUSTAINED REGENERATION	New Products or New Markets	Differentiation	High Frequency	Low
ORGANIZATIONAL REJUVENATION	The Organization	Cost Leadership	Moderate Frequency	Low-to-Moderate
STRATEGIC RENEWAL	Business Strategy	Varies with Specific Form Manifestation	Less Frequent	Moderate-to-High
DOMAIN REDEFINITION	Creation and Exploitation of Product-Market Arenas	Quick Response	Infrequent	Varies with Specific Form Manifestation and Contextual Considerations

TABLE 6: ADAPTATION OF THE TABLE BY COVIN & MILES (1999)

Dess et al. (2003), for example, used this taxonomy to study the impact of each form of Corporate Entrepreneurship (Sustained Regeneration, Organizational Rejuvenation, Strategic Renewal and Domain Redefinition) in shaping the firm's knowledge through learning. They show that there is a strong direct relationship between Sustained Regeneration and acquisitive learning, which is public domain knowledge that can be internalized by companies in their innovation-production capabilities to support the creation and introduction of new products on the market.

In the literature, there are some features that are commonly attributed to Corporate Entrepreneurship. Regarding the attributes of Corporate Entrepreneurship, however, the most recognized concept is the one of Entrepreneurial Orientation (EO). Miller (1983) was the first to lay out certain characteristics of a firm that promote the process of organization renewal. Such characteristics were defined as entrepreneurial orientation through the combination of 3 dimensions which describes how a new entry is undertaken: (I) proactiveness, (II) innovativeness, (III) risk-taking. Hence, the concept of Entrepreneurial Orientation can be defined as the "extend to which top managers are inclined to take business-related risks, to favor change and innovation in order to obtain a competitive advantage for their firm" (Covin & Slevin, 1989, p.77). This construct is particularly relevant in today's research because it has been shown to be strongly related to a firms' performance (Rauch et al., 2009). In general, these 3 attributes are the most commonly used when referring to EO (Covin & Slevin, 1989; George & Marino, 2011), however, the literature often tries to add different ones. Lumpkin & Dess (1996) for example, add the attributes of autonomy and competitive aggressiveness. Stopford & Baden-Fuller (1994) instead defined Corporate Entrepreneurship through 5 different characteristics: (1) the capability to resolve dilemmas, which can be achieved with the use of creative processes, (2) learning capabilities, essential for managers to exploit new opportunities and avoid being stuck in the same patterns that limit growth, (3) proactiveness, (4) having high aspirations beyond current capabilities and (5) being team-oriented and to recognize the contribution made by top and middle managers alike in giving value to individual ideas and propositions. These characteristics can be considered as a first approach taken by researchers to define the main organizational attributes related to Corporate Entrepreneurship. In this sense, however, scholars believe that the construct of Entrepreneurial Orientation needs to be defined only by the 3 attributes identified by Miller (1983) and that every

variation, even if valuable, is either measuring a different conceptual construct related to Corporate Entrepreneurship or measuring a sub-set of EO (George & Marino, 2011).

Moreover, an entrepreneurial act is also affected by the context, both internally and externally. Lumpkin & Dess (1996) provide a framework of reference to link together all the different attributes linked to the concept of entrepreneurial orientation.

ENVIRONMENTAL FACTORS

Dynamism

Munificence

Complexity

Industry characteristics

ENTREPRENEURIAL ORIENTATION

Autonomy

Innovation

Risk-taking

Proactiveness

Competitive aggressiveness

ORGANIZATIONAL FACTORS

Size
Structure
Strategy
Strategy-making processes
Firm resources
Culture
Top management team characteristics

PERFORMANCE

Sales growth

Market share

Profitability

Overall performance

Stakeholder satisfactory

FIGURE 2: EO FRAMEWORK BY LUMPKIN & DESS (1996)

Originally, the entrepreneurial orientation was conceived as an attribute of the organization, while corporate entrepreneurship as a set of activities within the organization with practical implications in one of the forms identified by Covin & Miles (1999). However, more recently the EO is being considered as a form of CE. Bouchard & Fayolle (2017, pp. 27–28) observe that:

> ''Corporate Entrepreneurship is now an 'umbrella' topic that shelters quite heterogeneous viewpoints and approaches. One stream of literature defines Corporate Entrepreneurship as something that happens within the firm; that is, it is an intra-firm process resulting in innovation and business creation, another

defines Corporate Entrepreneurship as a characteristic of the firm's strategy, which is a firm-level orientation towards risk-taking, innovation and responsiveness.''

In both cases, however, a firm's EO is considered as an attribute of a firm that leads to innovation rather than something meaningful "per se". Many researchers, in fact, show how a company's EO fosters different capabilities. Anderson et al. (2019), for example, show that there is a relationship between a company's entrepreneurial orientation and its strategic learning capability. Taking risks, exploring new domains and experimenting with new processes are all factor that contribute to make the firm a better learner.

Moreover, Lumpkin & Dess (2001) show that a firm's EO is directly affected by the industry life cycle and the environment. Different stages of development, in fact, require different capabilities: in early development stages performance is associated with proactivity while in the mature phase competitive aggressiveness can be more effective. Similarly, in dynamic environments, where conditions are rapidly changing and opportunities for advancement are numerous, proactive firms showed higher performances. On the other hand, firms in mature industries where competition for customers and resources is intense, are more likely to benefit from competitive aggressiveness. This research is particularly important because it is among the first to underline that a firm's Entrepreneurial Orientation becomes an advantage and a performance driver only when environmental characteristics are considered.

Another important aspect of the Entrepreneurial Orientation construct is the discussion on whether EO can be considered as a behavioral element or as a disposition. On this matter, Covin & Lumpkin (2011) review the main points of view and discuss on the fact that there are many elements that can be associated with EO (organizational culture, entrepreneurial climate, mindset etc.) but that an entrepreneur is defined by its actions and therefore there is a behavioral connotation to this construct. This means that there are many organizational factors that affect on a firm's EO but that it ultimately depends on individuals' actions and behaviors.

Starting from the construct of entrepreneurial orientation, Wiklund & Shepherd (2011), made a further specification. Originally, in fact, the concept of EO had always been linked to the one of performance. However, firms usually have to deal both with exploratory activities and exploitative activities and their performance

depends on both. This underlines the necessity for organizations to be ambidextrous.

Besides being related to performance, the construct of EO is also relevant because it is often conceptualized as the attitude of firms towards Corporate Entrepreneurship (Covin & Wales, 2019). In environments characterized by high hostility, heterogeneity and dynamism the presence of corporate entrepreneurship is particularly relevant for firms of different sizes and characteristics (Covin & Slevin, 1989; Lumpkin & Dess, 2001; Zahra, 1991). However, it is important to define its enablers both internally and externally.

From an internal perspective, in fact, Corporate Entrepreneurship often fails because large organizations present hostile environments for creative ideas (Sharma & Chrisman, 1999). In this spirit, Zahra (1991) showed what are the factors that are directly associated with CE and that are contributing to its success. The study empirically suggests that Corporate Entrepreneurship is correlated positively or negatively with many factors that are both internal and external to the firm, creating a solid basis for all the future researches. Results highlight a positive association with the presence of growth-oriented strategies much more than with stability strategies due to environmental characteristics, and the presence of a series of factors related to the internal organization that may push or be an obstacle for the adoption of Corporate Entrepreneurship. In particular, the findings led to a positive association among CE, environmental scanning and internal communication and a negative association between a strict control system and entrepreneurial behaviors. Moreover, the organizational culture and internal values play an important role in supporting Corporate Entrepreneurship. Person-related values nurture tendencies towards internal Corporate Entrepreneurship or intrapreneurship, while competition-oriented values are more likely to nurture tendencies towards external Corporate Entrepreneurship or corporate ventures. Finally, Zahra's researches (1991 & 1993) also shows positive correlations between the adoption of Corporate Entrepreneurship and the financial performance of firms by analyzing different accounting indicators like the ROI or the Net Income to Sales. Some of these factors, have been subjects of further studies by many other authors. Morris et al. (2006), for example, confirmed and reinforced the ideas of Zahra providing further insights. They empirically defined that there is a complex multivariate non-linear relationship between Corporate Entrepreneurship and control systems. A control system that is very formal, performance-oriented and

focused on efficiency and effectiveness may push managers and individuals to spend more time and attention on standard procedures rather than engaging in more entrepreneurial behaviors. In fact, since they perceive to be evaluated on strict metrics, they will tend to focus more on those rather than looking for opportunities and creativity. On the other hand, having a formal system is fundamental for companies, in particular when they have to deal with external stakeholders like suppliers or banks that are requiring stricter KPIs. In this context, sizing the system to balance formality requirements and informality can be challenging. Besides understanding the main internal and external components of Corporate Entrepreneurship, the review showed a growing interest in defining bundles of attributes that can be related to entrepreneurship both from an individual and from a corporate perspective, with the perspective of measuring and assessing a firm's entrepreneurial level.

Keeping the attention to a corporate perspective, it's critical to set up an organizational culture that supports entrepreneurial behaviors (Ireland et al., 2009) in a way that each individual aims at earning other's respect, is highly committed, is willing to accept responsibilities and desires for high standards. In some cases, the organizational culture can be a fundamental driver for Corporate Entrepreneurship. Rule & Irwin (1988) identified that intrapreneurship within organization can be fostered by a culture that spurs the generation of new ideas, evaluates options and supports teams throughout the development. On top of this it's critical to promote flexibility, rewards contributions and uses the adequate leadership style to share power whenever needed. In this context, the role of top managers in shaping and nurturing these values inside the organization is fundamental, since they have the responsibility to use the most appropriate leadership style to nurture the right social context to enable entrepreneurial behaviors. Dess et al. (2003), summarize how leadership, trust, consensus, opportunism and conflicts are all factors that can affect Corporate Entrepreneurship according to the literature. Different managerial beliefs and visions can likely lead to conflicts in terms of implementation and definition of roles, creating tensions and potentially opportunistic behaviors. On the other hand, a shared vision and an understanding of the reasons why changing is important can lead to positive effects in terms of consensus, building a sense of dominant logic and nurturing trust at all levels of the organization.

From a strategic standpoint the literature is focused on conceptualizing Corporate Entrepreneurship and defining the importance of external factors like environmental hostility and dynamicity, internal factors like innovativeness, risk-taking and proactiveness and organizational structures that enable entrepreneurial orientation and foster its intensity. On the other hand, from an operational point of view it is very important to define entrepreneurship as a more structured methodology. The first step is to understand how entrepreneurial opportunities are put into practice. Kuratko, Covin & Hornsby (2014) reviewed what are the most critical issues that lead to unsuccessful implementations. In their paper they defined that there are four main critical points. First, is understanding the type of innovation, which means that there is a lot of fuzziness mostly at top levels of the company in defining the actual objectives. Second, the coordination of roles at different levels of the company. An unclear definition of what are the responsibilities and the roles of the different actors involved can lead to undesired outcomes. Third, the presence of performance-oriented control systems based mostly on financial and operational indicators (as previously discussed here) and finally the training and preparation of individuals towards entrepreneurship and opportunity recognition. In the same way, it's necessary to consider how daily behaviors and practices create an impact over entrepreneurial outcomes. In this sense, Barringer & Bluedorn (1999) provide a study about the application of five operational management practices in relationship with entrepreneurial intensity. The research suggests that four out of five practices are positively related to entrepreneurship intensity and they are scanning intensity, planning flexibility, locus of planning and control attributes. In particular, scanning intensity reports a particularly strong relationship as previously theorized (Miller, 1983; Zahra, 1991; Zahra – 1993), suggesting that opportunity recognition does not occur with "the flash of a genius" but it's the result of a more structured process of environmental scanning and awareness. Planning flexibility also showed a strong positive relationship to entrepreneurial intensity, in the sense that firms subjected to uncertainties are favored if they are able to ease their plans in response to environmental changes. This point is very critical for the authors because the effort in terms of time and cost that is put into the planning phase creates a fear of deviation and a consequent reduction of entrepreneurial capabilities. Moreover, they gave further proof that a control system which is able to measure and reward creativity and the pursue of opportunities together with a locus of planning with

a high involvement of employees are other two managerial practices that show positive correlation.

Another important contribution to highlight that operational aspects of organizations have an impact on entrepreneurial activities, was given by García-Sánchez et al. (2018). The authors also proved that there is a significant correlation among corporate entrepreneurship and daily operational factors like the exploitation and integration of external knowledge and stakeholder integration. All these factors are usually related to practices through which companies deliver value, but the literature shows that the use of one practice or another has significant impact on the organization itself and its capacity to self-generate an entrepreneurial orientation that is then linked to other forms of corporate entrepreneurship.

Even though efforts are made to link organizational concepts to operational ones, the literature is quite far from making such connection clearly explicit in a unique way. Describing Corporate Entrepreneurship as a process is still something very difficult. In fact, if "on one hand, studies of entrepreneurship must generate generalizable conclusions about variables relevant to all new firms, on the other hand, each business is conceived in extremely individualistic and personal ways, with myriad circumstances" (Bhave, 1994), hence giving a unique practical model of reference can be challenging.

INDIVIDUAL ENTREPRENEURSHIP

Corporate entrepreneurship can take place at the corporate, divisional, functional or project level in a company (Zahra, 1991). Therefore, it's critical to understand how the literature links the organization to middle management and then to individuals when considering entrepreneurial behaviors as a mean to Corporate Entrepreneurship's success. Recognizing level-of-analysis differences between individual and organizational level is critical. It is important to understand how and whether individual-level entrepreneurial behaviors can aggregate to the firm-level (Covin & Wales, 2019).

Hornsby et al. (2002), shift the attention of analysis from an organizational perspective to different layers underlining the importance of middle managers. The research proves that in organizations with high levels of autonomy in decision making, possibility to be creative and make mistakes free of judgment, positive reinforcements and manifested appreciation for good performances, time availability beyond daily tasks, presence of a light organizational structure without standard procedures or methodical evaluations and a good level of encouragement and support from the top level, middle management's initiatives towards Corporate Entrepreneurship are enhanced.

From an even more individualistic perspective, however, the literature presents different ideas according to which it would be possible to determine the level of entrepreneurship. Generally speaking, researches tend to focus either on the personal traits or the intention of individuals, however new researchers are pursuing different directions. Among those following the line of study about personality traits, Farrukh et al. (2016) show that individual behavior and more specifically the individual personality has effects on the entrepreneurial activity of employees; in particular, extraversion, emotional stability and openness to experiences positively correlate with intrapreneurial behaviors, while consciousness and agreeableness record a negative correlation.

Hayton & Kelley (2006), however, adopted a competency-based approach to better define the competencies needed to foster CE. In their research this approach shows to be more promising than the traditional job-analytic approach from many perspectives. First, it's difficult to define clear and specific behavioral profiles that are fitting for a better CE spirit. Second, it's not possible to anticipate who in the organization will identify new opportunities and who will sponsor and sustain them. Third, entrepreneurial activities are more likely to be initiated voluntarily by individuals, therefore pushing the idea of CE may produce opposite results to those intended. For all these reasons, it can be more suiting to ensure the access to understand what are the desired competencies that lead to Corporate Entrepreneurship among employees and find ways to foster them, without pushing excessively on individuals' traits and personal factors. In particular, the authors find that entrepreneurship can be promoted by the simultaneous presence of competence in the four roles: (I) innovating, (II) brokering, (III) championing, and (IV) sponsoring. While in big corporations, the roles can be taken on by different individuals, in small firms they may be also collocated in a single

individual. The innovator is the individual who catches the opportunity and recognizes the benefits of its application to the company or the final users. In order to be innovators, individuals need to have specific and technical competencies as well practical experience and creativity. The second important role is the broker, who has the task of linking different perspectives and contrasting ideas together combining existing sources and new ones. A broker can be identified with what the innovation literature calls Gatekeeper, which is someone with the role of acquiring, translating and disseminating information. The third role identified is the champion, who is responsible for the project and who "inspires and enthuses others with their vision on the potential of an innovation […] show extraordinary confidence in themselves and their mission, and […] gain the commitment of others to support the innovation" (Howell & Higgins, 1990). Finally, the sponsor is the one who helps to get resources for the development of the project, support its legitimacy and provide guidance for the best way to deploy it. In this sense, it is also important to understand what are the factors that drive individuals to first engage in entrepreneurial behaviors. Besides studies on personal traits and characteristics, the second most common approach to assess individual entrepreneurship is to measure the entrepreneurial intention (Liñán & Chen, 2009), which in most of the cases is analyzed under the lenses of the *theory of planned behavior* (TPB) developed by Ajzen (1991). According to this theory, intentions can be considered as actively and continuously initiating something. When this model is applied to entrepreneurial concepts, intention is influenced by 3 main factors:

1. *Personal Attitude* (PA) towards the behavior: individual's personal evaluation of the entrepreneurial behavior.

2. *Subjective Norms* (SN): individual's perception of the social pressures to engage in that behavior.

3. *Perceived behavioral control* (PBC): individual's perception of their ability to perform that behavior.

The majority of the literature in this stream of research, applies this model to entrepreneurial concepts to empirically define what are the attributes that affect

the individual's intention. Fayolle & Liñán (2014), summarize and highlight the most common research areas in this stream of literature: (I) personal level variables (I) the interrelationship between entrepreneurship education and the entrepreneurial intention (III) the role that context and institutions play and (4) the intention-behavior link.

Lee et al. (2011), for example, argue that there is a connection between entrepreneurial intention and both individual and organizational level factors like innovation orientation, innovative climate and culture or incentives for technical excellence. This research introduces a multi-level perspective in studying the factors contributing to the intention to start a business. It is the interaction between individual and organizational factors, in fact, that can provide better insights to the firm creation process. The authors show that there is evidence of a strong correlation between intention and behavior of about 0.90 to 0.96 and that an important factor linking intention to behavior is the capability to practically carry out the intention. In particular, they demonstrate that the individuals' Self-Efficacy (i.e. a person's judgment of his/her abilities in executing an objective) is an important factor in transforming intentions into action. Another article shows also the importance of motivation on individuals' entrepreneurship which is often explained through drive theories and incentive theories (Fayolle et al., 2014). *Drive theories* suggest that there is an internal need (e.g., achievement or autonomy) that motivates the individual to start a new venture or another entrepreneurial act in order to reduce the resulting tension. On the other hand, *incentive theories* suggest that people are motivated to do things because of external rewards (e.g., monetary or other types of incentives). The authors also show that according to the literature, drive theories tend to have an impact on intention itself, while incentive theories may be important in explaining the transformation from intention to actual behavior.

Following the line of thinking that links individuals to the practical behavior of pursuing opportunities, it's proper to define what are the triggers for the change, which factors are relevant throughout the whole development process, and which are potential risks related to the development. Stopford & Baden-Fuller (1994) showed that changes can be stimulated both by opportunities and by threats, and in particular by the way both of those factors are perceived by individuals. Nonetheless, awareness can mainly be considered as a trigger, while the implementation relies on the ability to create momentum generated by success,

overcoming obstacles and barriers and increasing confidence due to concrete results. The outcomes realized from entrepreneurial actions are compared to previous expectations. Satisfaction with performance outcomes serves as a feedback mechanism for either sustaining or discouraging entrepreneurial behavior (Stopford & Baden-Fuller, 1994). Moreover, Urban & Wood (2015) show quantitative evidence that opportunity recognition behaviors and motivators play a significant role in identifying CE initiatives and that the higher the frequency of opportunities recognized and motivators, the greater the perceived importance of CE initiatives. Then, like in a dynamic mechanism, the perceived success self-moderates the frequency of opportunity recognized and the importance given to motivators. Going a step further, Mai et al. (2010) provide results showing how a company's human and social capital are key factors for opportunity recognition among employees. Their findings are based on an application of the job embeddedness model (Mitchell & Lee, 2001) to underline that the capability of an organization to nurture job satisfaction, inspiration, knowledge transfer and commitment, alongside with a working environment that encourages networking among individuals, create all together a more entrepreneurial workspace.

Considering individuals, many recent studies are also extending the construct of Entrepreneurial Orientation to the individual-level (Bolton & Lane, 2012), creating a connection between different level of analysis. The fact that the construct of EO can transcend from individuals to teams to the entire organization is more and more shared (Covin et al. 2020). However, while the importance of Individual Entrepreneurial Orientation in association to Corporate Entrepreneurship is starting to be acknowledged by more and more scholars (e.g. Covin et al., 2020, Kraus et al., 2019, Bolton & Lane, 2012, Covin & Wales, 2019), little evidence is provided on the antecedents of IEO, the mechanisms that lead to it and which tools companies can use to foster it.

MEASURING ENTREPRENEURSHIP

From the review of the concepts and articles related to Corporate Entrepreneurship, it is evident that researches tend to be much more abstract and qualitative. Therefore, it is critical to understand how other authors have tried to

measure entrepreneurship both at the individual level and at an organizational one in a more structured way. In this sense, scholars take multiple approaches.

One of the most used and recognized measurement system at firm level, is the so-called CEAI (Corporate Entrepreneurship Assessment Instrument) (Hornsby et al., 2002), that is based on a 84 items Likert scale questionnaire that fundamentally assesses the company's internal characteristics that enable Entrepreneurship Orientation through five main factors: the appropriate use of rewards, resources availability, management support, organizational boundaries and work discretion.

Moreover, there are articles that aim at creating a scale for entrepreneurial orientation, using the same drivers identified by Miller (1983) for the definition of a structure, making variation in the questions based on whether the goal is to get an individual or an organizational measurement (Covin & Slevin, 1989). Such measurement system is composed of a 9 items Likert scale to assess entrepreneurial orientation from the perspective of the organization, using as variables the levels of innovation, proactiveness and risk-taking of an organization.

Using these same drivers, Bolton & Lane (2012) are the first to propose an alternative 10 items Likert scale to measure the individual entrepreneurial orientation (IEO). In general, in the literature the concept of entrepreneurial orientation is strictly related to the organization and to the optimal internal and external conditions to foster entrepreneurship. In this case, however, the scale is aimed at measuring the same items from an individual perspective, testing it on a sample of students and validating it through factor analysis. Moreover, a correlation was shown among entrepreneurial intention and orientation, underlining the necessity for further empirical proof.

Another different approach is the one taken by Liñán & Chen (2009) who provides a 6 item Likert scale to measure the individual entrepreneurial intention, proposing a questionnaire that holds its validity for multiple geographical and cultural contexts. Hence, in terms of scales related to entrepreneurship, the literature offers different alternatives depending on what is under investigation. In fact, different approaches are taken if considering entrepreneurial orientation, both individual and organization, entrepreneurial attitude or entrepreneurial intention.

CHAPTER 2

DIGITAL ENTREPRENEURSHIP

In an era of digital innovation, digital technologies and digital skills, the concept of entrepreneurship is evolving at a fast pace. Entrepreneurial outcomes, in the way they were defined by Covin & Miles (1999), can still be considered a reliable construct, however, the phenomenon of digital transformation has created a disruption to the structural boundaries of the product or service in terms of features to be included, scope and market reach. Considering the scope, for example, the value offering related to a product or service, can continue to evolve also beyond the first "market launch". Also, in terms of entrepreneurial processes, digital technologies have enlarged the spatial and temporal boundaries of entrepreneurial activities.

The process of digitization of organizations, in fact, allows to get a greater flexibility on both products and services, by creating a separation between function and form and between content and medium. In this context, there is less clarity about where innovation and entrepreneurship can happen and who would be the agents carrying it out. There is, in fact, a much wider range of actors capable of entrepreneurial behaviors, each with different characteristics, capabilities and goals. Finding the agents of change is becoming more and more challenging, however, while the phenomenon of digitalization is creating new issues and is adding new complexity to the field, it is also giving the tools and the enablers to solve them.

Davidson and Vaast (2010) refer to digital entrepreneurship as the pursuit of opportunities based on the use of digital media and other information and communication technologies. Digital entrepreneurs rely upon the characteristics of digital media and IT to pursue opportunities. In doing so, they exacerbate

changes in the competitive landscape, as they attempt to seize the opportunities and thereby potentially further the creative destruction process of the digital economy (p. 2).

In this light, it's very important to better define the elements of the entrepreneurial process that create a difference between traditional entrepreneurship and digital entrepreneurship in a corporate context. In particular, the main elements to better define the concept of digital entrepreneurship are: (I) digital technologies and (II) digital skills. The first refers to the tools that enable the new digital paradigm, while the second refers to the way in which people use and take advantage of those tools to create value.

DIGITAL TECHNOLOGIES

When considering digital technologies in a context of entrepreneurship, there are three distinct components to be considered: digital artifacts, digital platforms, and digital infrastructures (Nambisan, 2017).

Digital artifacts can be either stand-alone software/hardware component on a physical device or part of a broader ecosystem that operate on a digital platform. An example of the first group can be a digital thermostat which is able to regulate the temperature of a room automatically. On the other hand, the second group can be exemplified by an app running on a smartphone or smartwatch device.

A *digital platform* is defined as a "shared, common set of services and architecture that serves to host complementary offerings, including digital artifacts" (Nambisan, 2017). Taking the previous example, this definition includes operating systems like Apple's iOS and Google's Android that offer the environment on which is possible to build new and innovative solutions.

A *digital infrastructure*, instead, can be defined as the set of tools and systems (e.g., cloud computing, data analytics, online communities, social media, digital makerspaces, etc.) that offer communication, collaboration, and/or computing capabilities to support innovation and entrepreneurship.

The combination of these 3 elements have progressively led to the democratization of entrepreneurship in the sense that change and innovation in a digital environment can be accomplished by anyone, making it harder to predict. In this sense, there is much more weight to be put on skills rather than material resources at an individual's disposal. The evolution and adoption of digital technologies and infrastructures has, in fact, created new "affordances" (Autio et. al, 2017):

- Decoupling

- Disintermediation

- Generativity

First, digitalization promotes de-coupling between form and function, consequently reducing the importance of asset specificity and dependency relationships within value chains. Digital technologies are flexible by nature, since they work through bits which represent the most elementary form of information, and all other forms of information are ultimately reducible to them. This greatly increases the flexibility of digital devices in terms of the range of functions they can be programmed to perform, but also in terms of the digital infrastructures that can be called upon to perform a given function or service. In physical technologies, on the other hand, form and function are closely related, since a specific physical form is typically required to perform a given function. Being made of non-reversible matter, physical assets are very hard to be re-programmed to satisfy different functions. Hence, digitalization induces a reduction in asset specificity called de-coupling.

Second, digitalization promotes disintermediation, reducing the power and importance of any form of intermediation in value chains. Disintermediation both reduces dependency on location and resources and opens new opportunities for interactions with end users that create value. Through the Internet, in fact, there is a direct interaction between service providers and end-users. This allows to directly and seamlessly communicate with consumers using web-based applications and to dissociate the flow of goods and services from the flow of

associated information, allowing producers to have greater control over activities within the value-chain reducing dependencies.

Finally, digitalization drives generativity, enabling the coordination of geographically dispersed audiences opening up new ways to harness the platform momentum created. In particular, the ability to rapidly scale up starting from a contained input, the ease with which a system can be modified or expanded and the wide accessibility make it easy for a variety of audiences to engage with offerings and resources made available over the Internet.

In short, the phenomenon of digitalization creates strong digital affordances that have a transformative effect upon by supporting radical business model innovation and entrepreneurship. In fact, they enable new ventures to re-invent how they create, deliver, and capture value, enabling disruption through with radically new business models.

DIGITAL SKILLS

Having clear from the literature what are the benefits of digital technologies, it is necessary to better understand how the individuals can interact with technology to create value in a digital context.

Since 90% of new jobs will require excellent digital skills, those without sufficient ICT skills will be at a disadvantage in the labor market and have less access to information (Ferrari, 2013). Already in 2006, the European Union included digital skills as one of the eight key competences to adapt flexibly in a rapidly changing and continuously interconnected society. The discussion on this topic often concentrates on internet skills, which constitutes the most common and important case of use. Digital skills, however, can be applied to different media types such as print, audio-visual and computers.

Arriaga-Azkarate and Croasdell (2013) examined how digital networks of practice supported partly by a social media platform (Twitter) fostered entrepreneurship among a group of Navarrese businessmen and women. The study highlighted the potential for group mechanisms enabled by social media and related digital

infrastructure to serve as the conduit for entrepreneurial idea generation and development.

Skills allow people to effectively use knowledge by applying it to a real case or situation. Skills can be described as cognitive (involving the use of logical, intuitive or creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments (European Parliament and Council of the European Union, 2008).

In this research stream, Van Laar et al. (2017) focus on the 21st century digital skills, recognizing that in a global knowledge economy, those skills determine organizations' competitiveness and their ability to drive innovation. Given the rapid rate of change and the constant evolution of technology, employees need to develop a set of digital skills that allows them to thrive in a changing world. Since employees' skills drive organizations' competitiveness and innovation capacity, the frequent integration of new information communication technologies (ICTs) requires continuously evolving digital skills necessary for employment and participation in society. Due to the changing environment, organizations require more and more employees who can find, process and structure information, solve problems, be creative innovators and exhibit effective communication and cooperation abilities. Their research created a comprehensive framework for digital skills based on seven core aspects: technical, information management, communication, collaboration, creativity, critical thinking, and problem solving. All these skills are considered by the authors as fundamental for performing the necessary tasks in a wide range of occupations.

Starting from this premises, the same authors elaborated further this framework and offered a scale to measure 21st century digital skills (Van Laar et al., 2018).

Such researches are particularly relevant because digital and IT capabilities have been proved to be fundamental to organizations. García-Sánchez et al. (2018), for example, show that absorptive capacity and technological skills encourage the development of internal process aimed at obtaining tacit knowledge from both internal and external sources. Such knowledge, being extremely difficult to imitate, enables sustainable performance. Therefore, educational and training plans within organizations are required to increase and develop technological skills and knowledge of both managers and employees. Such plans help to improve the

evaluation of opportunities, make the right decisions, and respond to new expectations for business and improvement.

DIGITAL CORPORATE ENTREPRENEURSHIP

Besides defining the characteristics of the digital environment, it is also important to analyze previous studies in the literature that put together the digital dimension with corporate entrepreneurship.

Existing literature on digital entrepreneurship is mainly developing in six categories (Kraus et al., 2019): digital business models, digital entrepreneurship process, platform strategies, digital ecosystem, entrepreneurship education and social digital entrepreneurship. However, research on digital entrepreneurship is still in its infancy. The authors, in fact, found only 35 articles so far. Most of them (49 per cent) followed a qualitative approach (including case studies). Challenges related to digital entrepreneurship are multiple. Technological infrastructures are constantly evolving. Challenges, such as low diffusion rates of specific technologies, might be overcome soon, but new challenges will form by advanced technological opportunities.

Traditionally, changes in external environments require firms to adapt in order to survive and thrive. In particular, it is necessary to understand how firms adapt to a digital environment. It has been shown, in fact, that high-tech firms behave differently from low-tech firms in their approach to exploiting opportunities afforded by digitalization (Joshi et al., 2019). If changes in the environment requires different competencies low-tech firms might favor an external venture. However, since high-tech firms may have the necessary human skills and flexibility to manage the new business domain, they might be more comfortable with internal ventures.

An important effect of digitization can be seen regarding the time frame of entrepreneurial processes (Ojala, 2016), which is becoming shorter and shorter. Digital technologies made it possible to create, modify and repeat product development phases much quicker than before, therefore experimentation and implementation processes are accelerated in today's digital economies and restart

within much shorter periods. Moreover, starting points and endpoints of each period are not that distinct any more on digital platforms (Nambisan, 2017).

Taken together, today's digital entrepreneurs, in comparison to traditional entrepreneurs, do not follow a predefined blueprint or highly defined business plan. Rather, the behavior and decisions of a digital entrepreneur is shaped throughout the whole entrepreneurial process. Thus, the digital entrepreneur faces increasingly dynamic paths, determined by diverse activities with uncertain time frames (Nambisan, 2017).

In particular, there are many ways in which ICTs and digital technologies can be part of an entrepreneurial process or outcome. Steininger (2019) for example shows that information technology can be associated to entrepreneurship in many ways and forms.

Digital technology, in fact, can be considered as:

1. **Ubiquity**: digital startups with digital business models.

2. **Outcome**: new ventures with a digital product or service.

3. **Mediator**: use of digital channels for the sale of traditional products and services (e-commerce).

4. **Facilitator**: use of IT to simplify processes and operations.

Therefore, no matter the intensity of use, digital tools can be used in a variety of forms and ways to create value to new businesses. However, it's critical for entrepreneurs to be able to dominate and control digital technologies to be able to create value in one way or another.

The role of digital competencies, intended as both knowledge and skills, with respect to digital entrepreneurship has also been analyzed by Ngoasong (2018). In this paper, the author groups together digital and entrepreneurial skills into what he calls entrepreneurial digital competencies (EDCs) and finds evidence that this construct affects digital entrepreneurship particularly in resource-scarce contexts.

A study conducted by Chen et al. (2015) on manufacturing firms, showed a further relationship between IT capabilities at operational levels and new product development, therefore concluding that "IT capabilities enables Corporate Entrepreneurship", in particular in firms exposed to intensive competitive environments. In fact, as Corporate Entrepreneurship operationally speaking relies on timely and relevant information, effective communication and integration, IT capabilities become critically important. The key role that is given to IT systems is more in an optic translating infrastructure flexibility, collecting information, sharing capacities, improve communication and integrate abilities. IT capabilities, therefore, do not have a direct connection to outcomes per se. From a managerial perspective, companies that are able to combine Corporate Entrepreneurship and to leverage on mobile and web-based applications to "collect data and information about customer demands and preferences and use business intelligence or analytics technologies to interpret these data to improve product innovation" (Chen et al., 2015), are more likely to be successful in innovating.

CHAPTER 3

AGILE SOFTWARE DEVELOPMENT

The term 'Agile Development' was first used in a paper published in early 2001 called 'Agile Manifesto' (Beck et al., 2001), which can be considered as the first statement containing the guidelines and principles behind the agile approach. Throughout the years, many definitions of agility have been proposed. Lyytinen & Rose (2006) define agility as "the ability to sense and respond swiftly to technical changes and new business opportunities, enacted by exploration-based learning and exploitation-based learning". Qumer & Henderson-Sellers (2006) instead define that "agility is a persistent behavior or ability of an entity that exhibits flexibility to accommodate expected or unexpected changes rapidly, follows the shortest time span, and uses economical, simple, and quality instruments in a dynamic environment; agility can be evaluated by flexibility, speed, leanness, learning, and responsiveness". Starting from these definitions and considering that the initial purpose of agile development was its use in software programming, finding a cohesive and complete translation to a business environment can be challenging. In particular, it's important to collocate agile methodologies in its own framework of reference and separate it from related disciplines. Even though agility also implies leanness and flexibility, it's critical to make a distinction among the three different aspects. Conboy (2009) was among the first to make this sort of distinction, saying that, agility encompasses the features of flexibility and leanness and it goes beyond them. If flexibility is defined as the ability of a system to "create change, or proactively, reactively or inherently embrace change, in a timely manner, through its internal components and relationships with its environment.", and leanness is defined as a managerial approach aimed at eliminating wastes and inefficiencies to achieve better operative results, then agility can be defined as the

ability "to rapidly or inherently create change, proactively or reactively embrace change, and learn from change while contributing to perceived customer value (economy, quality, and simplicity), through its collective components and relationships with its environment."

PRINCIPLES

There are 12 pillars of agile development stated in its manifesto (Beck et al., 2001):

1. Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.

2. Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.

3. Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.

4. Business people and developers must work together daily throughout the project.

5. Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.

6. The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.

7. Working software is the primary measure of progress.

8. Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.

9. Continuous attention to technical excellence and good design enhances agility.

10. Simplicity--the art of maximizing the amount of work not done--is essential.

11. The best architectures, requirements, and designs emerge from self-organizing teams.

12. At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.

From these 12 pillars there are few principles that can be extrapolated. These principles are not to be considered as a formal definition of agile methodologies, but rather as a guideline for delivering value to customers in an agile way. In another perspective, the principles stated by the Manifesto are not something new 'per se', but the way in which they were presented together as a 'unique framework' of reference is quite innovative (Williams & Cockburn, 2003).

1. **Individuals and interactions over processes and tools**: in the business world, a process can be considered either defined or empirical. A defined process is an activity or a set of activities that are structured in a way that they produce the same output at each iteration through a set of predefined tools. In a context like manufacturing and process plants, this approach can allow companies to reach efficiency and use resources in the best possible way, but in a context like the one of software development, the team is subjected to a high number of variations during the course of the project. For that reason, in a dynamic context with high uncertainties, or more in general every time we consider empirical processes rather than structured ones, it's necessary to take a new perspective which is more centered on individuals and their interaction. (Williams & Cockburn, 2003). In this perspective, agile methods are people centric and recognize the value of competent people and their interaction in delivering outputs and customer

satisfaction. The formation of self-organizing teams with a culture of interchangeable roles, autonomy of decision-making and adaptive planning are critical ingredients for agile development success. In fact, it has been shown from a more psychological perspective, that individuals working in agile methodologies tend to follow and develop a certain culture and context which pushes the relevance of team identity as opposed to individual role identity (Whitworth & Biddle, 2007). However, from this perspective, it's important to balance the level of personal autonomy with the presence of self-organizing teams working and collaborating towards a common goal (Barney et al., 2009). The risk that needs to be addressed with this principle, is suppressing individual freedom and ideas to make space for the interests and commitments of the team. It's critical that the practices in use to foster collaboration and self-organizing teams are in some ways balanced by practices fostering the individual autonomy and creativity. Regarding interactions, Ryan & O'Connor (2013) show that tacit knowledge exchanges and transactive memory systems (TMSs) (Wegner, 1987) are positive factors in influencing the team's performance when bringing new products to the market. They find that tacit knowledge sharing is significantly positively correlated to social interactions, and in particular to the quality of interactions rather than the quantity. On the other hand, both quality and quantity of interactions are proved to be positively correlated to TMSs and therefore to the ability of a group of sharing and processing information through communication. Hence, shifting the attention from tools to interactions, can at the same time improve tacit knowledge sharing and strengthen TMSs among team members.

2. **Incremental delivery of working software over comprehensive documentation:** "agile software development takes the view that production teams should start with simple, knowable approximations to the final requirement and then continue to increment the detail of these requirements throughout the life of the development." (Rees M, 2002). This will allow to add more value at each delivery, have better control on resources and output and reduce the time to market. On the other hand, having an early delivery of software with a set of limited functionalities

and subsequent releases adding new functionalities, adjusting existing faults and adapting to new technologies might have some downsides (Rawat et al., 2017). Since every release adds new code to the system, at each delivery there is a non-negligible possibility to introduce new faults, which in general increases the overall failure rate of the system. For that reason, in agile methodologies, incremental deliveries are coupled with continuous testing and more and more companies are using data to test and learn at each iteration how to maximize value and increase the reliability of the system. Moreover, if the objective of incremental deliveries is about creating value, it's fundamental to understand how different stakeholders consider the concept of value examining different perspective and different industries (Alahyari et al., 2017). For this purpose, new trends show a tendency towards "continuous experimentation" as in companies' ability to quickly gather and process data of customer behavior to understand the value of what has been delivered to customers. This belief is based on the assumption that delivering value to the customer also implies increasing the value for the organization both in terms of tangible and intangible benefits.

3. **Customer collaboration over contract negotiation:** in any transaction between a company and its customer, contracts have always had the role of assuring the requirements and standards of the value delivered. In traditional software development the relationship between the customer and the developer team is limited to the definition of requirements in the initial phase and the exchange of feedbacks towards the final phases of development. This usually limits the amount of time available to make changes, and as a result teams are forced to cope with huge amounts of work in short periods and deliver products with many errors (Hanssen & Faegri, 2006). On the other hand, agile approaches shift the attentions from a focus on factors like requirements, costs, quality and design to an attention on customer satisfaction and being able to fill and exceed the gap between expectations and value delivered. In this perspective, what is proposed by agile methodologies, it's much more complex than simply training or changing the customer's perception. The real challenge of customer collaboration becomes being able to adapt processes to the

customers and not the other way around. Besides, in a context like the one of software development expectations and requirements usually change with time and in such cases, it can be appropriate that the customer communicates with the developer team throughout the whole duration of the project providing insights and directions. This frequent communication can help achieving greater levels of satisfaction and indirectly also improve efficiency and waste reduction by focusing only on activities that represent an added value for the customer (Conboy, 2009). A further attention should be made in separating the concepts of User-Centered Design (UCD) and agile development's customer collaboration. As stated by Da Silva et al. (2011) there are some similarities in the two concepts, but there is also a critical difference in terms of resource allocation. While UCD approaches spend many resources in developing detailed documentations and research analysis before starting the project, agile methods "strive to deliver small sets of software features to customers as quickly as possible in short iterations" with continuous inputs from the customer at every stage. Furthermore, there is an important difference in an UCD approach aimed at improving software's usability and an agile approach aimed at understanding what is the value for the customer in order to deliver what they want. Therefore, it can be beneficial to integrate the two approaches to deliver a valuable product with better usability and design. In general, an inadequate customer involvement can lead to adverse consequences in the implementation of an agile project, which can range from increasing pressure to over-commit, problems in understanding the project's requirements, absence of feedbacks or decreasing productivity to business losses in extreme circumstances (Hoda et al., 2010). In some cases, the lack of customer collaboration can be attributed to internal factors like skepticism and hype or lack of time commitment, but in other cases the source of this problem could be attributed to external conditions like ineffective customer representatives, dealing with large customers, physical distance or the request for fixed-bid contracts. Hence, it's important to understand the root causes of this problem and leverage on agile practices to level out unbalances.

4. **Responding to change over following a plan:** the traditional approach in which complex projects are carried out are through a Stage-Gate approach (Cooper, 2008), which consists in finding models and methods to perform a fixed set of activities**.** Following this approach, a lot of time and resources are allocated in the initial stages in order to lay out the most probable scenarios and define a plan of actions with the goal of minimizing wastes of resources in more advanced stages. In general, a project can be broken down into different phases like requirements definition, product design, coding or development and testing. The Waterfall approach suggests to identify tasks belonging to each phase and to carry them out in a linear way following precedence relationships. In contexts with low uncertainties and high quantities of information available, using this approach can allow to concentrate eventual mistakes in the initial phases where the cost of making error is less that the cost at final stages of the project. In other contexts, to cope with the high risks related to planning far ahead, the spiral model was introduced (Boehm, 1985) in order to include a risk assessment and prototyping activity at the end of each phase in the Waterfall approach. This approach would allow to reduce the risks with respect to the previous one but considers too much linearity in the process. For this reason, new approaches are based on the iterative methodologies, which divide projects into iterations and takes all the standard phases of the waterfall model into each iteration. This allows to reduce drastically the risks and also the time and costs related to the implementation of the project, but still requires thinking in terms of predefined processes. Agile methodologies, instead, take the concept of iteration but exploits it in terms of feature and increments instead of defined processes. In fact, only the planning and closing phases of each iteration are minimally pre-defined, while the all the other factors are always re-defined during the implementation (Schwaber, 1997). The fact that many of the aspects of the project are decided during its course allows the team to be more flexible and creative, reducing the overall risk and increasing the probabilities of success. In a more dynamic context with growing uncertainties, or for new products development, the literature shows that agile approaches usually lead to better performances in a software domain. However, the case carried out by Sommer et al. (2015) shows that also in industrial and manufacturing contexts, a hybrid agile approach can be beneficial in terms

of performances. In fact, the introduction of agile methodologies that create a break from the Stage Gate approach, transforms fixed planning into iterative problem solving and strict controls into productive disorder. From the literature, it's clear that change is a central aspect in agility, but in general, agility is associated with responding to changes. Conboy (2009) provides a wider taxonomy of agility adopting a broader interpretation of change. He states that agility not only implies responding to change but also creating change, being proactive in the direction of innovation and learning at each iteration from changes.

Adopting agile software development, from a purely managerial perspective, requires addressing many challenges and changes, especially in more traditional organizations. In particular, the key factors of change that are necessary for a successful implementation of agile approaches, are mostly related to the organizational culture, the management style, the knowledge management strategies and the development process (Misra et al., 2006). Analyzing the organizational culture through the lens of the Competing Values Model (CVM), it's possible to distinguish organizations based on their tendency towards stability or change and their tendency towards internal factors or external factors.
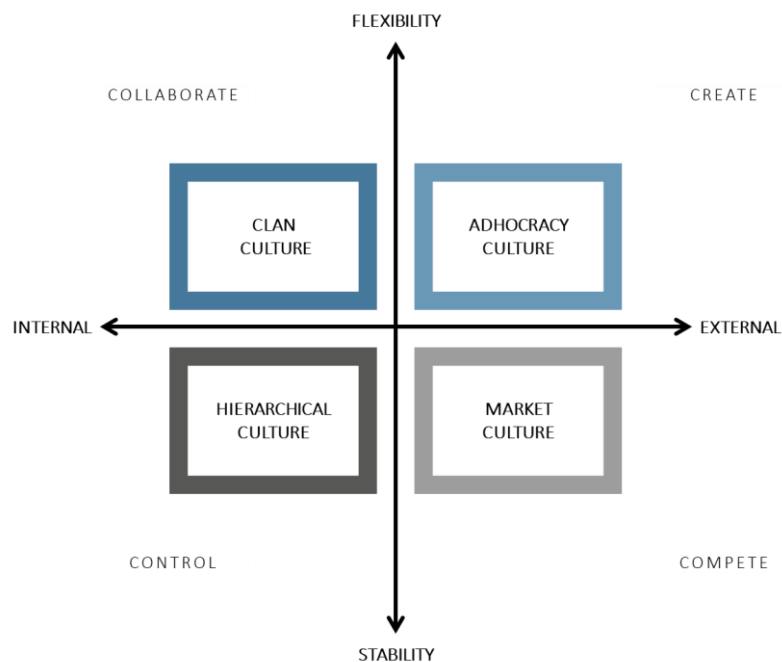

FIGURE 3: TYPES OF ORGANIZATIONAL CULTURE, ADAPTED FROM MISRA ET AL. (2006)

In general, change emphasizes flexibility and spontaneity, while stability emphasizes control and continuity. On the other hand, internal focus underlines integration and maintenance of socio-technical systems and external focus underlines competition and interaction with external environment. Considering these four factors, organizations that are more prone to hierarchical cultures (i.e. high stability and high internal focus) are most incompatible with agile principles and methodologies, while the other forms of culture orientation can each favor the implementation of agility (Iivari & Iivari, 2011). Moreover, following the study of cultural levels presented by Schein (1999), it's possible to define three layers of organizational culture in which the first level is represented by formal and visible aspects, the second is composed by more informal and hidden aspects and the third one is made of all the underlying assumptions which are invisible, affective, emotional and linked to social and psychological factors.

FIRST LEVEL: Visible artifacts: pair programming, agile team, test driven development, refactoring, continuous integration, coding standards, collective ownership, daily meeting, small releases, on-site customer, horizontal hierarchy, participation, sustainable pace, democratic work environment, management facilitator that emphasize flexibility and spontaneity.

ICEBERG OF AGILE CULTURE

SECOND LEVEL: Espoused Values: focus, self-organization, commitment, consultation, participation, learning and continuous improvement, discussion, equity, respect and consensus, trust, honesty, transparency, openness, communication, simplicity, feedback, courage, responsibility, coherence, balance between technical excellence, personal achievement, deliver value to the customer and organizational success.

THIRD LEVEL: Basic Underlying Assumptions: belief in the competence and responsibility of individuals, mental models that enhance adaptation, cooperation, and continuous learning and improvement, stimulus and creativity, to foster innovation and take moderate risks, systematic view of sustainability and pro-activity, awareness that agile philosophy must be in line with the mission of the organization and the satisfaction of different stakeholders.
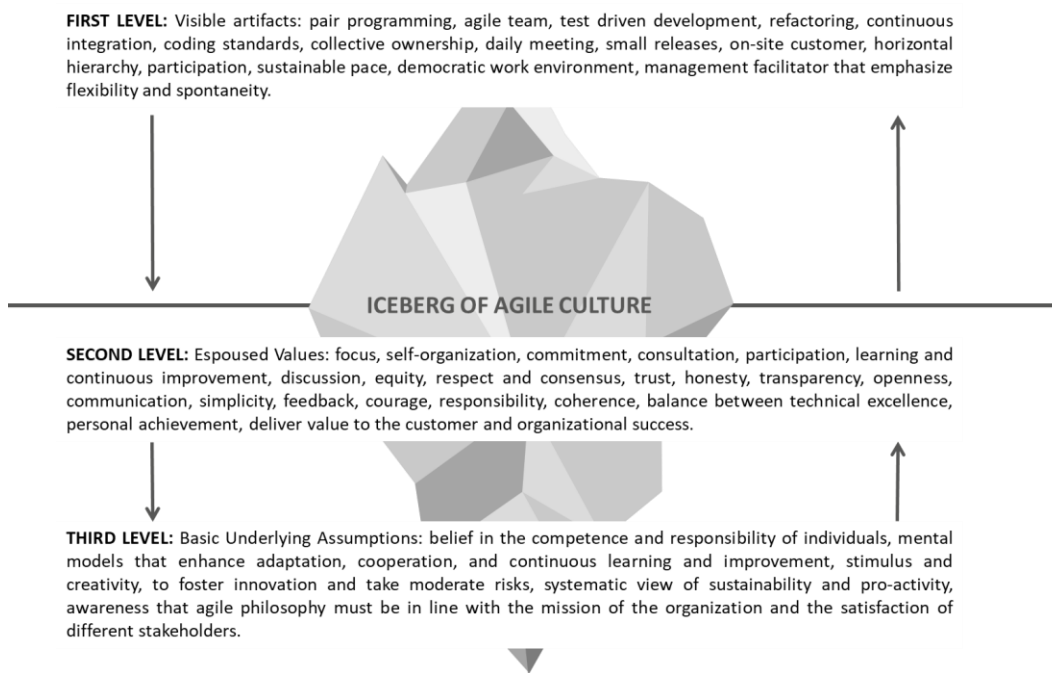
FIGURE 4: LAYERS OF AGILE CULTURE FROM TOLFO ET AL. (2011)

Starting from this taxonomy, Tolfo et al. (2011) apply it to agile software development to better define how it manifests into the hidden layers of culture. They conclude that "an agile culture cannot be reduced to a software development process, or to a specific agile method, and it is neither related only to a set of

technological artifacts used by a company, […] an agile culture is founded on a set of basic presuppositions similar to the agile principles". Focusing on factors at all the different layers, companies can leverage agile values to achieve a competitive advantage that is hard to imitate. It's necessary to shift the focus on short, iterative, test-driven, people centric processes that boosts individual autonomy and freedom in decision making leveraging leadership and collaboration rather than command and control.

AGILE METHODOLOGIES

The principle and values of agile software development have given birth to many methodologies and practices that are widely discussed among scholars and used in several practical applications. A recent research carried out by Campanelli & Parreiras (2015) shows that the most used agile methodologies are: Extreme Programming (XP), Scrum, Kanban, Feature-Driven Development (FDD), Dynamic Systems Development Method (DSDM), Adaptive Software Development (ASD), Crystal and Rational Unified Process (RUP). As previously stated, since the concept of agility includes leanness it's not surprising that practices like Kanban, that is considered as a lean tool, are also considered agile practices by the literature.

Among the listed methodologies, the Annual State of Agile Report (2018) shows that the most used one is Scrum with a 54% of usage. For completeness' sake, it's appropriate to discuss what is the context of application of agile methodologies, what are the benefits and what are the factors of success both from a generic point of view and from a more detailed level of analysis looking at each single agile practice and their effects in practical applications. This overview it's particularly relevant when we try to move from the applications of agile practices from software development to applications that are more business oriented. From a universal perspective, the study proposed by Chow & Cao (2008) shows that in order to successfully implement agile methodologies and practices, it's critical to take care of the strategic and organizational enablers. In fact, factors like a strong commitment from management, the existence of a strong culture that is responsive to managing change and finally the presence of a high caliber agile-friendly team

environment are all fundamental aspects to consider before addressing agility in an operational perspective. However, looking at adoption, some methodologies are more used than others. For the purpose of this research, in fact, only the methodologies of Scrum and Extreme Programming were considered, since their adoption rate combined represents the vast majority of the used agile methodologies and almost the totality of the used agile practices as reported by the Annual Report.
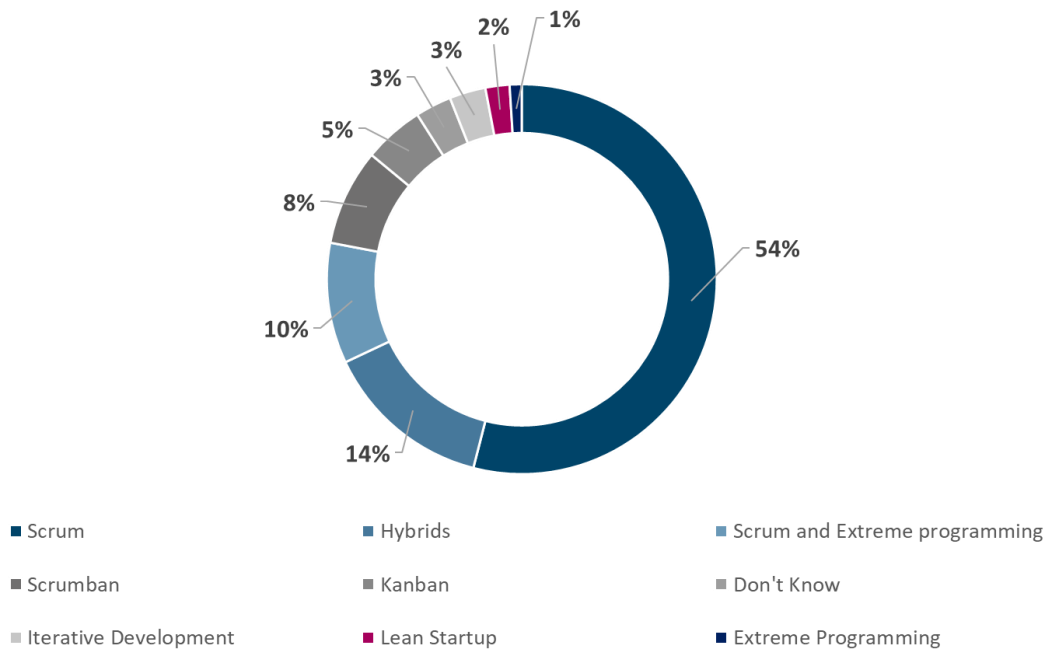

FIGURE 5: USE OF AGILE METHODOLOGIES FROM ANNUAL STATE OF AGILE REPORT (2018)

SCRUM

In each project there are many factors of risk, among which he identifies quality deficiencies, cost and time overruns and business interruptions. Given that these risks will likely affect the output of the entire project and its outcomes, it's important to be able to anticipate them or, if possible, structure the project to avoid

them. Moreover, Oyegoke et al. (2008) discuss that risks and uncertainties in a project can be traced back to two important factors: the project's environment and the development process. Factors like communication, coordination and cooperation are usually critical in a project's implementation. The agile methodology of Scrum proposes to offer guidelines and practices to address these specific issues in a way that enhances timeliness information exchanges, transparency and trust among stakeholders and a moderation of the level of uncertainty related to a project's implementation. Scrum can be described as a people-centric agile methodology that is commonly adopted in project management, often applied to product development and specifically to software development. It can be considered as one of the first agile methods together with Extreme Programming, since it was presented for the first time at the OOPSLA Conference by Ken Schwaber and Jeff Sutherland in 1995. This practice takes its name after the SCRUM in rugby, which implies a tight formation moving forward towards a specific position. Scrum projects typically consist of different components that can be classified as team & roles, artefacts and events.

Artefacts are documents that are produced and used in a scrum project, and they mainly consist in a product backlog and a sprint backlog. The <u>Product Backlog</u> is an ordered list of everything that might be needed in the project development. This document is always revised throughout the whole project implementation, therefore it's not complete until the project is ended. The product backlog is always under review and it's the effect of constant collaboration between the Product Owner and the entire Development Team. From the product backlog the team defines a <u>Sprint Backlog</u>, which is a list of elements that has to be accomplished in an iteration. With this document, all the characteristics of each increment are defined as well as a definition of "done", which describes when and how an increment can be considered as done.

In terms of events, Scrum is organized in sprints, sprint planning, daily sprints, sprint review and sprint retrospective. Scrum can be defined as an empirical process, in which all phases are characterized by unpredictability and, as a consequence, it uses control mechanisms to increase the overall flexibility and responsiveness to change (Schwaber, 1997).

<u>Sprints</u> are considered as the heart of Scrum and consists in a "time box" of one month or less with a specific Sprint Goal, at the end of which a product increment is potentially releasable. Once a sprint is completed another one starts until the

project is realized. Sprints are, by definition, empirical phases in which its components can't be predefined because of their non-linear nature. At the beginning and end of each sprint there are planning activities and closure activities, where inputs and outputs are defined.
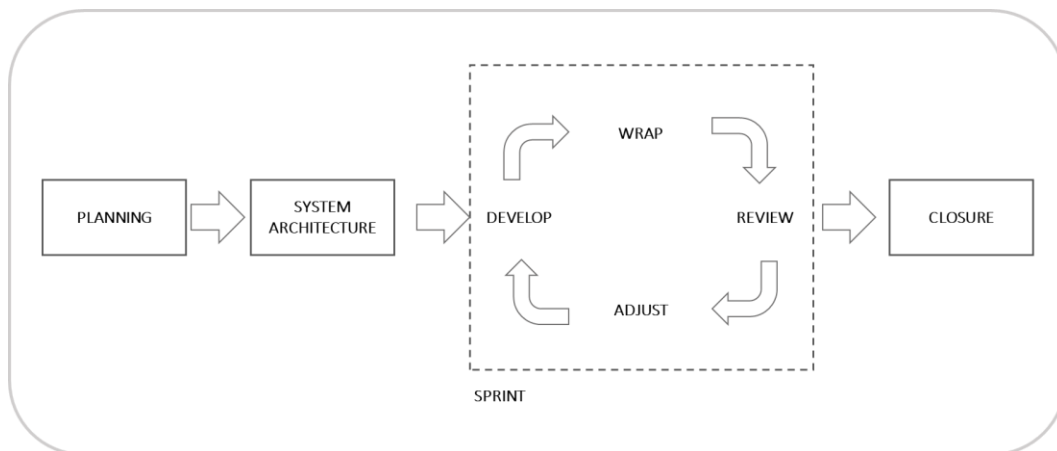

FIGURE 6: SCRUM PROCESS (ADAPTATION FROM SCHWABER (1997))

During each sprint, the team is supported by a burndown chart, which is a visual tool representing the remaining work on the Y axis and the time remaining until the end of the sprint on the X axis. Such tool provides a quick visual information to the team about how many tasks have been completed and the velocity of the project to date.

Before each sprint starts, the work to be performed and the goals are decided in the Sprint Planning, which is a short meeting of about 8 hours in which all the team members have to participate and in which the work is organized considering the Product Backlog.

During the project, the team attends Daily Sprints or Daily Scrums, which are short stand-up meetings of about 15 minutes, in which each team member describes all the activities concluded from the past meeting highlighting the main problems. It's very important that these daily meetings respect the 15 minutes time box, since during this time the team is not able to work on tasks, therefore an excessive prolongation of the meeting would imply less time to work on problems **(Fowler, 2018)**. These meetings, in fact, have only the goal of exposing the entire team to

eventual problems to make them visible, without focusing on their solution. Plans to solve them should be made after the meeting is over by the actors involved and by any member of the team who has ideas. Among the different agile practices, the daily stand up meeting is recognized as the most adopted one (VersionOne 13th Annual State of Agile Report), therefore it's important to understand its benefits and issues. The literature provides many cases, both related to distributed and non-distributed team, indicating how daily meetings are vital for a project (Pries-Heje L., Pries-Heje J., 2011). These cases are focused on linking the adoption of daily meetings to improvements in communication, coordination, collaboration and control of the overall project. Throughout the years both the literature and practical applications show a general level of acceptance related to the benefits of daily meetings. Stray et al. (2013), however, provide a case study investigating why this practice should be adopted and focusing more on how it should be implemented. They provide 13 factors that are important to observe in order to make the meetings more effective and classify them into 4 main categories: temporal, physical, procedural, and attendee. With respect to time, it's important that the meetings respect the time box in terms of starting, ending and length. From the physical point of view, it has been noticed that tools and equipment of spaces should be suitable to encourage communication and make it easy. Moreover, it's fundamental that individuals joining the meeting are limited in terms of number and come prepared in terms of attitude and approach. Lastly, it's critical to manage the information flows, therefore the presence of a role whose task is distributing the information that is created becomes crucial.

In cases with many teams working together, the daily sprint can be integrated with the so-called "scrum of scrums", which is a meeting attended only by designated ambassadors representing each team with the goal of aligning stakeholders from different teams. Once each sprint is concluded the team attends a Sprint Review meeting to discuss about what was accomplished, understand if constraints were met or not and define whether the Product Backlog needs to be revised and adjourned based on new constraints and opportunities.

After the review and before each new planning there is also a Sprint Retrospective meeting, in which the team discusses about eventual lessons learned and how to optimize the way they approach their work. In general, retrospective meetings are organized in a structured series of phases: setting the stage, gathering data, generating insights, deciding what to do and closing the retrospective meeting. In

the first phase, it' necessary to specify the duration, the goals and the approach of the meeting in order to create an environment where people feel stimulated to talk about any potential issue without constraints. Subsequently, in the data gathering phase, each team member is encouraged to share its own reviews or feedback regarding the previous sprint. In this stage, having a visual representation of the feedbacks or a storyline of the facts can increase the effectiveness of the communication and reduce eventual emotional biases. In the third phase, the team is required to further discuss the critical points that emerge in the previous stage and decide which ones are more pressing. Once the discussions are prioritized, in the "deciding what to do" phase, the team works to find a solution deciding which areas need to be improved. Finally, the meeting is closed by summarizing the main points of the discussion and the main solutions that emerged. To better understand the content of a retrospective meeting, Andriyani et al. (2017) proposed a case study to define which are the main themes and topics under discussion. The results highlight six important themes. The first one is the identification and discussion of obstacles and issues concerning blockages like unfinished tasks and dependencies. The second one is related to discussing feelings and subjective responses to facts and events of the previous sprint. The third theme is linked to discussions about eventual improvements with respect to those issues identified in the previous retrospective meeting. The fourth topic is related to the identification of possible background reasons related to specific issues. In fact, if the team notices that there are some issues that are not progressing, it proceeds it analyzes the background to explore possible structural blockers. The fifth matter is individuating future action points. This means that the team analyzes success and failure stories to evaluate what are the issues that need to be focused. The last topic is about creating future action points by planning the objectives of improvement that the team should be able to meet before the following retrospective meeting.

Among the roles, Scrum recognizes the presence of a development team, a scrum master and a product owner. A scrum team is usually made by people with cross-functional expertise, fluid roles, ability of self-organization and shared accountability over individual one.

Since roles are not strictly defined, the team relies on the presence of a <u>Scrum Master</u>, who is responsible to ensure the adherence to Scrum theory, practices and rules in order to maximize the productivity of the team and the value generated at

each iteration. Given the complexity of this figure, many papers have been published with the goal of understanding which are the main activities and responsibilities of the scrum master. Bass (2014) defined the six main activities of this figure considering big corporations and international projects. First, there is the role of "Process Anchor", which implies the responsibility of disseminating the scrum processes among the team and ensuring the adoption of its principles and practices. It's important that the scrum master is able to facilitate springs executions, contribute to policy-related decisions and select the more fitting scrum practices in order to lead and mentor self-organized teams. Second, there is the role of "Stand-up Facilitator", who facilitates the coordination at each daily meeting, ensuring that all the most valuable information are shared during the time span dedicated. The third important role is the "Impediment Remover", which means that the scrum master has to be able to remove eventual impediments to make activities run smoother. In large organizations, this role leads to being responsible of ensuring that all team members have all the right information to progress in their tasks. Fourth, there is the role of "Sprint Planner", which means providing technical skills to transform the inputs of the product owner into tasks during each sprint planning phase. After tasks have been defined and prioritized, the scrum master assigns them to the team. The fifth role is the "Scrum of Scrum Facilitator", which is relevant in large projects with many teams involved. In these cases, the scrum master has to ensure the best outcome of scrum of scrums meetings in terms of composition, participation and frequency. Finally, the last role is the "Integration Anchor", which requires the scrum master to be responsible for the integration of different tasks to the final output. This activity is particularly important in the case of projects carried by many teams, since coordinating the integration of different tasks may lead to a reduction of internal conflicts.

In order to ensure communication and dynamism both internally and externally, instead, the team relies on a <u>Product Owner</u>, who is responsible for the product backlog and represents the interests of the various stakeholders (users, customers…) throughout the whole project. Bass et al. (2018) further analyzed the different roles of the product owner and defined a set of fundamental activities related. The main roles of a product owner are "The Groom", who clarifies the details of the product backlog and the acceptance criteria, "The Prioritiser", who selects the elements bringing more value to the project, "The Release Master", who manages, releases and approves plans, "The Communicator", who transfer

knowledge, "The Traveller", who understand the customer's needs, "The Intermediary", who interfaces among the team and senior roles of the company, "The Customer Relationship Manager", who actively provides support to customers and finally "The Gate-Keeper", who determines features for a release. Given the importance of the Product Owner and the variety of activities that this figure needs to cover, Kristinsdottir et al. (2016) present a case study based on the role of the product owner in Spotify. The company's choice was motivated by the fact that Spotify, since it was first founded in 2006 has been using many agile approaches, among which the one of Scrum. One of the major problems for Spotify when approaching a new project, is the so-called "product risk", which means developing something that the customer doesn't want. For this reason, it's very important that the Product Owner represents the interests of the customer, which in this case is also the user, and involves them in the planning phase and throughout the project. By representing the customer, the Product Owner can also set up and communicate a specific vision for the project to the entire team. It's important, in fact, that the team understands the needs of the final customer in order to produce something that is valuable. Having a clear vision in these projects is fundamental, since it would be too hard and risky to make decisions and plan activities based on some financial indicators like the ROI. The reason is simply that there are no tools that can allow to make predictions of the value of each activity, therefore in this optic, value becomes everything that is important to the customer. The findings of the case show how complex is the figure of the Product Owner and how it is much more a leadership role than a management role. Recognizing people's autonomy, improving communication and creating a vision for the project are critical for the success of this role and by extend for the success of the project.

In general, there are many mechanisms that are important to understand when using Scrum as a holistic methodology. For example, Pries-Heje L. & Pries-Heje J. (2011), used a case study based on an IT project with a distributed team to understand the advantages of adopting Scrum in terms of communication, collaboration and control in a distributed environment. The case reports what are the advantages and the challenges that can be encountered when adopting Scrum practices in a distributed environment. First of all, the team is located in Europe for the 80%, while for the other 20% is located in India, hence the potential problems of and agile implementation throughout the project are vast. The results show that the main important factors related to coordination are the product

backlog, the sprint backlog, the scrum board and the daily scrum meetings. Having a backlog that is compliant with Scrum characteristics means that it is provided a series of characteristics and functionalities of the project or the sprint. The backlog, therefore, explains what has to be done without constraints about who, when and how. This characteristic push team members to coordinate activities with other people and tasks at every phase of the project, therefore the collaboration is significantly higher. Moreover, the daily meetings can allow team members to give their inputs on specific problems promoting a sense of mutual and common addressability. Regarding communication, it was noted that the roles of the product owner and the scrum master are essential for the team. Moreover, the case underlines the importance of daily meetings even in a context of distributed teams. E-meetings held daily, in fact, proved to be relevant for the entire team in order to get feedbacks, present issues and to clarify expectations about each delivery. Finally, in terms of Control the case shows the importance of Sprint Reviews and Sprint Retrospective in providing feedbacks, testing individual performances in a wide and inclusive way, provide some learning suggestions and create common milestones for the team. More importantly, the presence of short daily meetings allowed to have frequent feedbacks to sustain the idea of frequent deliveries and inform individuals about the status of each sprint.
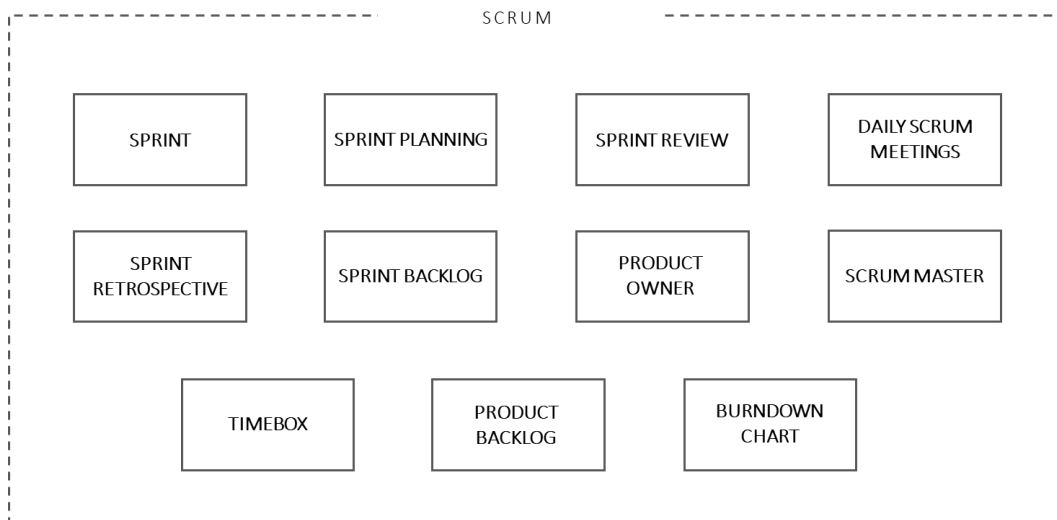

FIGURE 7: LIST OF AGILE PRACTICES BELONGING TO SCRUM

EXTREME PROGRAMMING

Extreme Programming (XP) can be considered as one of the first agile methods to give a comprehensive framework for software development founded on four underlying values: communication, simplicity, feedback and courage (Beck, 2000). Instead of seeing the project as a series of pre-determined phases (analysis, design, implementation and test), the team focuses only on an initial analysis to understand the project requirements and divide it in terms of <u>user stories</u>. A story is a business-oriented, testable and estimable feature that creates value to the final output and to the customer. In this way all the traditional activities are done all at once but little at a time. In general, there are some core practices that are associated to the adoption of Extreme Programming (Beck, 1999; Beck, 2000).

Planning game: customers decide the scope and the timing of the project based on the initial analysis made by the programming team. Priorities, in terms of which stories should be realized first, are decided by the customer. In practice there are two fundamental steps in the planning: release planning and iteration planning (Beck & Fowler, 2001). In the <u>release planning</u>, the customer presents the desired features to the developers, and the team subsequently makes an estimation of their difficulty considering a time span of 2-3 moths worth of stories. In this stage, usually programmers estimate how long will it take to build a story, understand eventual technical risks and provide an overall budget. In general, initial estimations are not precise nor solid, therefore the team revises the release planning continuously throughout the project. Every couple of weeks, the team is given directions through the <u>iteration planning</u>, in which the customer decides what features must be prioritized and the programmers break down stories into tasks in order to make estimations in terms of cost and time and assign responsibilities for each task considering past experiences and lessons learned. "Each iteration is planned by breaking down the stories for that iteration into tasks. Tasks are scheduled by asking programmers to sign up for the tasks they want, then asking them to estimate their tasks, then rebalancing as necessary" **(**Beck & Fowler, 2001). In general, the estimation process, which is the most important aspect about planning, is made in form of unstructured group estimation, which exposes the validity to factors like company politics, group pressure, anchoring or prevalence of dominant personalities (Haugen, 2006). For those reasons, the planning process is sometimes associated to the practice of "<u>Planning Poker</u>". With this practice, instead of proposing and discussing estimations in a group meeting,

the customer explains what is expected from each user story and then each developer makes an individual estimation independently. Then, all estimations are revealed simultaneously and the lowest and highest are discussed among team members in order to decide a collective estimation. In this sense, Haugen (2006) propose a case study to compare the use of planning poker with respect to group estimation for the planning phase. The results show that planning poker enhances the two extremes in terms of outcomes. On the one hand, both estimations and performances are better in the case of teams with previous experiences, while on the other hand, for teams with no previous experience, the outcome is worse considering the sample.

Small releases: new releases are made often, with a time span of days or months depending on the project.

Metaphor: common vision about how the final output should work. Metaphors are exchanged between programmers to make sure everyone understands how the system should work in terms of functionalities, but also between programmers and customers to better define the project's scope and increase the clarity of the communication.

Simple Design: on-going activities and communications should be simple, clear and essential. Eventual complexities are managed after they are discovered.

Tests: programmers write their own unit tests before starting to code. Tests should be run successfully at each iteration. Also, customers write their own acceptance tests based on what they would like to see to be convinced that one story is finished. Every time new code is added to the system, each function has to be successful both in the unit test and in the integrated test. This approach is also known in software development as "Test Driven Development" (TDD). A set of experiments made by George & Williams (2004) provide practical evidence that upfront testing results in a better quality of the code, a higher perceived productivity from developers and a push for programmers to adopt simple designs, but on the other hand it shows to require slightly more time for the development. Specifically, TTD programmers show to produce code that passes 18% more functional tests cases but employ about 16% more time. On this topic, the literature recognizes that the most important benefits of agile testing are related to quality, clarity, productivity and defects localization, while the most pressing problems are related to the adoption and the difficulty of understanding properly this practice, as well as

maintenance, repeatability and distributed environments (Hellmann et al., 2013). Moreover, the literature is mostly focused on the application of TDD, automated testing, acceptance testing and unit testing, hence more empirical and experimental research is needed in the field.

Refactoring: it's the process of changing the code in terms of structure and architecture to make easy its maintenance and integration. Fowler (2018) defines this practice as "the process of changing a software system in such a way that it does not alter the external behavior of the code yet improves its internal structure. It is a disciplined way to clean up code that minimizes the chances of introducing bugs. In essence when you refactor you are improving the design of the code after it has been written". Thus, it's important to understand that refactoring is a different practice than integration. In fact, although the two practices can be very close to each other from a practical point of view, conceptually speaking refactoring it's about changing a system to improve it without adding new features or functionalities. From the literature, there is much evidence about the effects of refactoring in terms of software quality and therefore performance. A case study by Moser et al. (2006), provides empirical evidence about the relationship among refactoring and software concerning quality and team performance in an agile context. In terms of quality, the results are in accordance with the existing literature, showing that refactoring reduces the project's complexity driving developers to the adoption of simple system designs that are easier to maintain. Also, the case provides evidence that refactoring, and in particular "explicit refactoring" (i.e. when developers explicitly write a user story for refactoring tasks), increases the productivity of the team in subsequent developments in terms of how much code is produced per unit of time.

Pair Programming: the code is written by two programmers at one single screen. The first programmer, called "driver" writes down code or designs, while the other, who is called "navigator", observes and supports the work. The role taken by each programmer rotates at certain time spans. Since this practice is one of the most discussed by the literature and one of the most applied by companies and practitioners, it's important to understand its implications. From this perspective, the literature offers many studies aimed at describing the main effects of adopting such practice. Cockburn & Williams (2000), for example, provide an analysis of the most important benefits of pair programming from different points of view. They consider effects in terms of economic, individual satisfaction, design quality,

reviews, problem solving, learning, team building & communication and finally the overall team effects. From a purely economic standpoint, pair programming is expected to induce a maximum of 15% increase in the overall cost, since the expenditure in human resources is paid back by an increasing productivity and a reduction of defects. In terms of satisfaction, the article shows statistical results proving a significant increase in terms of enjoyment and confidence in the output among teams working in pairs. Moreover, besides producing superior quality, paired teams also show a better capability in designing the structure of the system by developing same functionalities in less lines of code. Besides, with the continuous check made by the navigator, reviews are carried out in a way that mistakes are identified and treated early, avoiding later complications. Regarding interactions, working on pair programming shows more easy and frequent communication enhancing problem solving approaches with brainstorming and fostering knowledge sharing through learning. In particular, the combination of all these aspects brings value to the overall team improving individual skills and reducing the risks of project implementation. Regarding this practice, a lot of focus is posed in the literature in the context of learning. A research carried out by Kavitha & Ahmed (2015) shows the results of adopting pair programming among students developing a software project and highlights the results in terms of knowledge sharing. In particular, the results show how the projects' output had higher performances than previous cases conducted without pair programming. Furthermore, throughout the duration of the project, there was empirical evidence about enhancement of both collaborative and programming skills from the majority of the sample. Approaching the project with a collaborative learning mentality proved to be effective in knowledge sharing and helped students to learn quicker the software in use. While many of the papers about pair programming are made from a software project perspective or from the point of view of academic environments and are focused on explaining its benefits, there are also cases in which this practice does not necessarily provide a better quality or superior productivity. Hulkko & Abrahamsson (2005), for example, provide results from multiple case studies, and, given the significant variance from one case to the other, conclude that there is not clear evidence about quality improvements and productivity enhancement related to pair programming. Therefore, it is always necessary to understand the environment in which the practice is used before deciding to invest in it.

Continuous Integration: every couple of hours the system is integrated with new code. Once that happens, the system is considered as new and all tests must be successful, both previous ones and new ones. If they are not successful, the change is discarded. Fowler & Foemmel (2006) highlight the main benefits related to the adoption of this practice. In particular, with respect to the more traditional approach of deferred integration, in which programmers would integrate big portions of the code all at one, this practice has two main advantages. First, it allows to reduce the risk related to the project. In fact, with deferred integration, the significant amount of code to produce can generate a sort of "blind spot" for which the developers are not able to quantify the remaining work in terms of time and effort. Adopting continuous integration, instead, it is possible to make precise estimation of each task since it's not far ahead in the future. Second, continuous integration benefits the debugging process. Indeed, it's easier to recognize and solve bugs when they occur in a small portion of code rather than when they are spread through a vaster section. Nonetheless, adopting this practice comes with certain issues that need to be addressed. For instance, Debbiche et al. (2014) presented a case study to analyze the main challenges of continuous integration. The results show the presence of 23 potential issues that can be collocated in 7 main categories (mindset, tools & infrastructures, testing, domain applicability, understanding, code dependencies and software requirements). In particular, the case underlines that some factors may be more pressing than others. First, developing the right mindset and avoiding skepticism it's critical for the success of such practice, since the role of individuals in its implementation is non negligible. Second, having testing methodologies and tools that present a certain degree of automation it's fundamental in terms of success. In fact, the presence of continuous codes and subsequent tests, has to be facilitated by mature and functioning infrastructures. Third, it's important to take into consideration the software requirements and the dependencies among different tasks. In this perspective, it can be challenging to correctly break down and prioritize different tasks from the initial requirement.

Collective Ownership: there are no boundaries in terms of responsibilities. Every programmer is able to implement any change in any part of the system as soon as an opportunity is recognized. Everyone is responsible for all the aspects related to the project. In this sense, it is argued that collective ownership substitutes expertise coordination, since knowing where to find the right competencies for specific

problems becomes less relevant in an environment where each individual is naturally contributing to the final output (Maruping et al., 2009).

On-site Customer: a customer, or a representative, stays with the team full time. According to this practice, the customer should be available 100% for the development team in order to provide feedbacks and answers to specific problems that may arise during iterations. In Extreme programming, a customer is someone who sits with the team to provide and prioritize stories, suggest and validate acceptance tests for each release and makes the final business decision (Beck & Fowler, 2001). Implementing such practice can be both dangerous and positive for the success of a project. Narang & Webber (2002) notice that there are some risks of having an on-site-customer, in particular if the team is not able to leverage its opportunities. Hence, if the customer is not integrated with the team, or he doesn't have experience in managing user stories and acceptance tests, or there are problems in communication, the results of such practice may be undesirable. On the other hand, being able to exploit the on-site customer can lead to improved performances in terms of value created. A case study made by Koskela & Abrahamsson (2004) analyzes in an empirical manner the effects of this practice in an agile team. Results show that, even though the customer was available for the 83% of the time, it was only needed by the team for the 21%. Moreover, it shows that the phases in which interactions with the customers are required the most are for the planning stages and for the validation of tests. As a consequence, although the evidence reports an overall positive experience, the data reveals that this practice may be dangerous in creating a false sense of confidence among developers. Furthermore, it is noted that the role of the customer is very demanding, since developers expect to get quick and precise answers to specific questions.

40 hours week: too frequent overtimes are considered as a sign that something is not working properly, therefore, instead of encouraging it, the team should understand its causes.

Open Workspace: the team works in a large room with small cubicles. In particular, the idea of open workspace is strictly linked to the concept of "Informative Workspace", which means a place where information flows are encouraged using open-plan working areas, feedback devices, big visible charts and information radiators. In practice, Keeling et al. (2015) make an important differentiation among agile open plan, traditional open plan and traditional

cellular offices. Agile workspaces are like open plans when considering the point of view of interactions, but at the same time are similar to cellular offices when considering information control. This study, in fact, suggests that agile workspaces break the trade-off among interaction and privacy, by offering spaces and feature that can be used for either individual or group work. Moreover, Mishra et al. (2012), analyze the effect of agile workspaces on communication, collaboration and coordination through a case study. They consider a workspace with half-height cubicles, status boards, whiteboards, communal/discussion spaces and an open space layout. Considering communication, the results show a significant increase in the frequency, while less significant in the quality. Cubicles make individuals more visible and reachable in terms of communication, status boards help in non-verbal communication and information sharing about the status of the project, whiteboards are proved to be helpful in clarifying complex issues and illustrating thoughts and discussion rooms are used daily for stand-up meetings or more informal communication. Regarding collaboration, half-height cubicles are very effective enhancing problem solving in team activities, open environments help to create a sense of community and both whiteboards and discussion spaces are proved to support brainstorming as well as formal or informal communication among individuals. Furthermore, open cubicles are observed to improve the collaboration among developers or the practice of pair programming. Finally, concerning coordination, cubicles and status boards are very effective since they both increase awareness about what everyone is doing and what are the different roles and responsibilities in the project.

Coding Standards: developers in the team should adhere to some coding standards so that there is a common base to comprehend each other's code. Coding standards, also called coding conventions by the literature, are set of rules that guide programmers in the development phase and that have been in use way before agile methodologies began to spread. In fact, it has been observed that using standards can impact some non-functional aspects of the software quality like reliability, security, robustness or maintainability (Popic et al., 2019). In an agile framework, coding standards allow developers to be faster in integrating new code into the system, but also understand the code every time it has to be changed following, for example, the practice of collective ownership. A research made by Maruping et al. (2009), also shows that the adoption of standards has positive effects on team collaboration. In fact, understanding clearly what the problem in

the code is, makes it easier to locate the individual with the particular expertise and knowledge to solve it.

Just Rules: it's important to understand the rules and practices of Extreme Programming, but the team can be able to change the rules at any moment if they agree on the fact that changing will improve their performances.
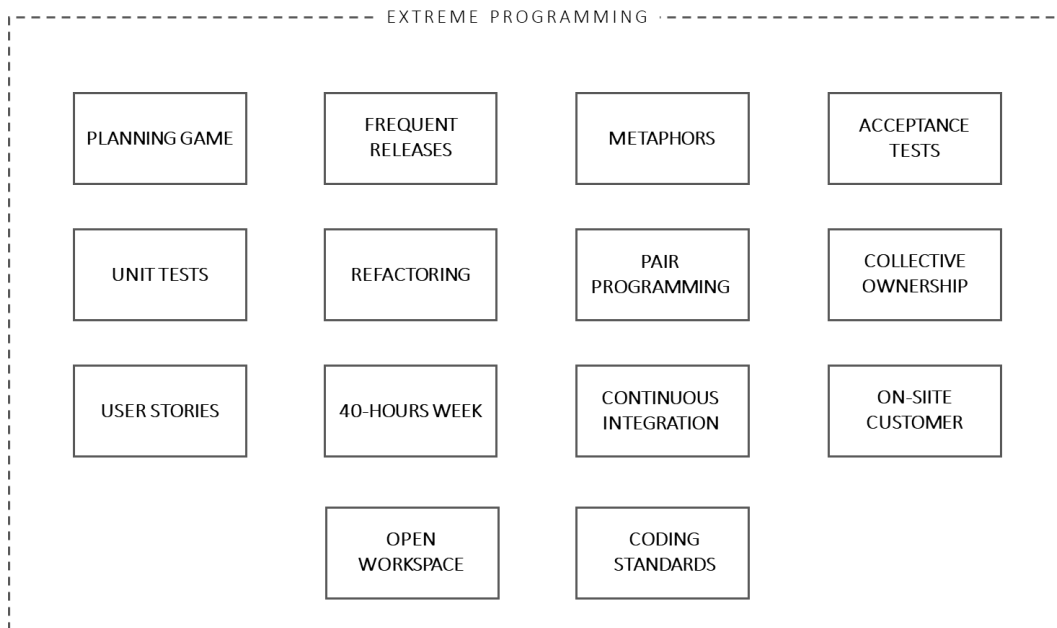
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FIGURE 8: AGILE PRACTICES BELONGING TO EXTREME PROGRAMMING

AGILE ADOPTION MEASUREMENT

The implementation of agile software development, as highlighted by the literature, is not always something easy, since it needs to take care of many organizational factors concerning individuals, the organization and the corporate culture. In this sense, the literature flourishes in providing measurement systems

of a company's or an individual's agility, going in details into the different components to analyze.

The definition of a scale for agility may be challenging, due to the multidimensionality and vagueness of the concept itself as well as the strict relationship with the context. Many of the agility scales, in fact, are related in one way or another to specific industries. In this sense, the studies address multiple goals: creating a measurement system to assess agility performances in manufacturing environments (Yauch, 2011), defining a scale to measure the supply chain agility (Gligor et al., 2013) or finding a fitting way to assess workforce agility at the individual level. Regarding the latter, researches are based on the fact that individual agility implies many sub-attributes and that assessing them is both a way to measure one's agility tendency and a way to get more meaningful insights on operational and daily matters. Braun (2017) defines a 14-items scale including 2 subscales related to monitoring the environment and anticipating the need for change and proactively acting and initiating change. Some other paper in this field, instead relate workforce agility to sub-components like adaptive behavior, ability to learn and involvement (Muduli, 2016). More recent researches, instead, focus more on evaluating which out of all the scales in the literature both on agility and on methodologies and practices adoption are more fitting for practitioners' use.

Understanding what it means for an individual to be agile it's definitely very important in situations in which is necessary to assess the readiness of implementation of agile methodologies in an organization. In this context, however, while it is interesting, it is not of primary importance. On the other hand, it is rather more relevant to understand how the literature provides measurement systems for the adoption of agile practices. In this sense, when needing to measure agile practices' adoption, the majority of the articles in the literature is aligned in the same direction. In fact, the scales are composed of simple questionnaires in which the interviewee is asked the frequency of use of each practice (Neto et al., 2019; Al-Sakkaf et al., 2017). Then, depending on the objective of the article, some other questions may be added to asses eventual challenges in the adoption, the usefulness of each practice (Korhonen, 2011) or the reason why they have been implemented (Tripp & Armstrong, 2018).

In other cases, instead, the assessment was made simply through questions aimed at identifying only the adoption or not of each practice. Nurdiani et al (2019) for

example used a survey in which the respondent could choose between "Used", "Not Used" or "Don't know" for each practice in the list.

Some of the papers present differences in terms of scale range, in the sense that some may use a 5 point Likert scale while others could use a 4 or 7 items scale, but in conceptual terms the measurement is pretty much consistent throughout the literature. Overall, the literature doesn't have many papers about the development of a scale on agile practices adoption but rather on agility in different contexts.

AGILE PRACTICES TAILORING

Many of the agile practices have been developed concurrently to specific methodologies (XP, Scrum...), and are usually associated with their implementation. In fact, even though the analysis here is mostly concentrated on the most adopted methodologies and practices from practitioners, the principles and values of the agile manifesto gave birth to many other methodologies and fields of application that are less used on a large scale. Regarding the latter, the applications of agile software development goes well beyond project management and software development. In fact, there are many studies in the literature where agile practices are used in field like procurement engineering, manufacturing, marketing, data mining, supply chain management and many others. What has emerged both from practitioners and scholars, it's that practices can be adopted and combined in many ways according to the company's needs and structure, or according to the field in which they are deployed. In fact, it is discussed that in order to be successful in implementing an agile system, it's important to consider the context of use and to fit practices to the problem rather than fitting the problem to standardized practices. Thus, treating principles as guidelines rather than fixed procedure is what makes their application a value added for companies. This creates a huge amount of combination that goes beyond the most common methodologies like Scum and XP, since every context would require its own set of specific practices.

Some researchers in this field have investigated both in a quantitative and in a qualitative way what are the criteria according to which agile practices can be grouped into clusters. This creates a way to use single practices beyond the specific

methodology they were created for. Al-Sakkaf et al. (2017), in this regard, use a hierarchical cluster analysis (HCA) to find related items in a dataset that was previously created by means of survey. Cluster analysis is a convenient method for identifying homogenous groups of objects called clusters in a way that items grouped together share many characteristics internally, while they are very dissimilar to other objects that do not belong to that cluster. The results show that the 24 initial practices considered can be grouped together into 4 clusters. With a similar process, Abbas et al. (2010) apply a factor analysis to the Agile Adoption Survey 2007 and divide the 58 practices that were referenced into 12 factors each containing a different amount of practices. In other cases, instead, the clustering of practices is made in a more qualitative way. Korhonen (2011) divides practices into three groups: 1) Daily work practices, 2) Team practices and 3) Programming practices. Daily work practices are non-technical practices which set up the boundaries on how the daily work of the team should be organized: time-boxed iterations, user stories and product backlog. Team practices are similarly non-technical team level practices: retrospectives, daily Scrum and self-organized teams. Finally, the Programming practices are those more technical associated to code development: continuous integration, tests, refactoring, collective ownership and pair-programming.

In support of this line of thinking, Bass (2012) reports multiple case study underlining the importance of this phenomenon called "agile practice tailoring". The results show that in a context of software development projects promoted by international corporations, some practices may result in conflicts with enterprise' policies and processes. In such context, the integration of certain practices could lead to unexpected negative results, while the introduction of others could be more beneficial. A review in the context of global software engineering (Jalali & Wohlin, 2010), shows that in many studies, agile practices are modified from the original method in which they were created and customized to meet context needs. In many cases, the adjustments were made to balance the geographical distribution, the overlapping working hours or simply the specific requirements of a project. One of the main challenges in this sense is to determine whether the new set of practices and the way they are adapted can still be recognized as agile as intended in the Manifesto or if they are only operational variances of a traditional approach made for convenience.

A systematic literature review on agile tailoring by Campanelli & Parreiras (2015), shows that the research in this field can be considered mature, since 2/3 of the almost 800 papers considered by their study use empirical research methods to provide results. Therefore, the focus in this field should be to provide a model useful for practitioners to specify some criteria to select which agile practices should be adopted by an organization. In fact, in a more recent research, Campanelli et al. (2018) show that adoption of agile practices was influenced by criteria such as external environment, previous knowledge and internal environment. Hence concluding that these variables are the drivers that should considered when making the decision of which practice to adopt. Similarly, Tripp & Armstrong (2018) suggest that there are four guidelines that may be used to help organizations to develop a strategy for agile method tailoring. Three of them are focused on organization-level actions and one is focused on the team-level. The guidelines identified are encouraging organizations to focus first on what is more challenging and then expand adoption, identify the important metrics to measure results, have clear the reason why each practice is employed and what are its benefit and always use multiple practices at once.

Given the state of the literature, most of the practitioners use agile tailoring to adapt a methodology to a specific project. However, it is still in discussion how to select the right bundle of practices given some context variables to get better results.

IMAPACT ON ORGANIZATIONS

After understanding how the agile literature analyzes every single practice in terms of impact that each one has individually on teams and people, it's important to review the studies made on bundles of practices and how their adoption helps organizations.

From this perspective, Jalali & Wohlin (2010), study which agile practices lead to more successfully implemented project (i.e. lead to better results), finding out that continuous integration and daily standup scrum meetings are the most efficiently applied in practical cases. Nurdiani et al (2019), instead analyze the adoption of

agile practices and their abandonment by practitioners, showing the which practices are most likely to be dropped and the various reasons in different contexts. Results show that the main reasons for abandoning practices range from team discomfort to lack of engagement to lack of perceived value to the presence of strong dependencies among practices. This implies that there needs to be an active involvement from the organizations to train individuals and share with them the benefits of adopting agile.

When considering agile practices in bundles, the research focuses a lot on making a connection with organizational constructs, defining how agile practices help organization in developing different skills. Neto et al. (2019), for example, show that Agile practices, together with knowledge management strategies, have positive and meaningful influence on Organizational Learning in software management. Moreover, they find that only a small portion of the available practices are used practically in the daily work of teams, hence the adoption of "Unit Testing", "Continuous Integration", "Collective Code Ownership" and "Coding Standards" in a software context is much more pressing.

Among the different papers discussing the consequences of the adoption of agile practices, only one focuses on defining a relationship with entrepreneurial skills (Tolfo et al., 2018). The authors take entrepreneurial skills following the taxonomy given by Lezana & Tonelli (1998) as a reference and try to understand if there is a link with the concept of agility. The study discusses that "entrepreneurial skills can be regarded as visible artifacts of agile culture" and that an agile culture fosters some entrepreneurial skills. However, little quantitative or empirical proof is given to the statement, since the results are the elaboration of a survey conducted on practitioners or experts with the goal of gathering their professional opinion on the matter. Therefore, even considering the validity of what is stated by agile experts, in terms of research no mathematical proof or empirical evidence can be concluded.

CHAPTER 4

AMBIDEXTERITY

Organizational ambidexterity originally referred to a firm's capacity to exploit existing competencies and explore new opportunities with equal dexterity (Duncan, 1976). Ambidexterity is critical for organizational survival due to the complexity of these two extreme activities, since one requires the ability to strategically use current resources and the other is more associated to opportunity recognition and novelty (Birkinshaw & Gibson, 2004).

At a firm level, organizations need to make explicit and implicit choices between the two (March, 1991). Explicit choices are mostly calculated decisions about alternative investments and competitive strategies. Implicit choices are, instead, hidden in features of organizational forms, like organizational procedures for accumulating and reducing slack, searching rules and practices, the ways in which targets are set and changed and the way incentive systems work. Understanding the choices and improving the balance between exploration and exploitation is, therefore, something challenging for organizations.

There are two ways to implement ambidexterity into organizations, according to Birkinshaw & Gibson (2004). One way is a top-down approach in which management decides on one extreme ambidextrous activity of complementary skills or another for each business unit in a strict ambidextrous structure and system (Duncan, 1976). The other is a bottom-up approach, where individuals based demonstrate behaviors of alignment and exploitation and/or behaviors of adaptation and exploration.

Individually, people require skills and behaviors to maintain their current performance and adapt to their environment to create long-term success.

Employees with the capacity for ambidextrous behaviors may pay attention to maximizing their current tasks and connections, and proactively seek opportunities beyond their own jobs.

On the individual level, however, ambidexterity is a much more recent construct that needs to be conceptualized in a slightly different way. Unlike organizational ambidexterity, individual ambidexterity consists of combining the exploration of new opportunities and the exploitation of existing capabilities over a period of time. The main difference is, in fact, that firms are able to distribute and allocate their resources to balance the two approaches at once. In contrast, individuals cannot simultaneously explore and exploit in a single unit of time. Hence, the challenge of individual ambidexterity is not only integrating or coordinating exploration and exploitation activities but smoothly switching between these two modes of operation. However, the way exploration of new opportunities and exploitation of existing capabilities are triggered at an individual level and on their subsequent effects on overall performance is still lacking (Schnellbächer et al., 2019).

At the individual level, exploration might be conceptualized as the search for novel ideas, technologies, paradigms and general knowledge to shake up existing processes and find superior ways to conduct business (March,1991). On the other hand, individual-level exploitation consists of improving, standardizing and elaborating established processes by collecting best practices from other departments and applying those to one's own departments (Birkinshaw & Gibson, 2004). From a research perspective, the growing interest on individual level ambidexterity is due to the fact that it has been shown a positive link between individual ambidexterity and team performance (Schnellbächer et al., 2019). Moreover, it has been confirmed by the same authors that the positive effects of ambidextrous behavior are not only manifested at the team level but also carry over vertically to the organizational level. In fact, superior team performances and the identification of new best practices or superior processes creates benefits for the entire organization. For these reasons, researches related to individual ambidexterity proliferates in different directions.

In changing environments, organizations and their employees should have a certain degree of ambidexterity to sustain their competitive advantage, no matter the business function or hierarchical position of individuals (Zhang et al.,2019). The challenge, however, is how to simultaneously balance different types of the two extreme ambidextrous activities. In this sense, the authors focus on two antecedents of individual ambidexterity: handling work stress for performance

management and trust building for social support. The ability of organizations to use policies and practices that help to build trustful and resilient working environments becomes fundamental to develop competent and ambidextrous employees that outperform those engaging in only one of these activities in a low-performance context of ambidexterity (Zhang et al.,2019). In another attempt to define what impacts individuals' ambidexterity, a research carried by Tempelaar & Rosenkranz (2019) shows the importance of role integrators at the individual level. In particular, it is necessary to expose targeted individuals to a variety of different work roles. Such exposure allows individuals to create divergent role identities which result as the combination and integration of different knowledge and skills.

On the other hand, few researchers are exploring the link between ambidexterity and agile. Vinekar et al. (2006), for example, tried to understand whether it is beneficial for organization to adopt both traditional and agile approaches and what is the role played by ambidexterity. In fact, although agile methods are gaining acceptance among traditional systems development organizations, the majority of these organizations seem to indicate a preference to sustain both forms of development. There is consensus among academics and practitioners that an agile methodology needs a specific organizational culture to sustain it, one that is very different from the organizational culture needed for traditional systems development (Misra et al. 2006; Tolfo et al. 2011).
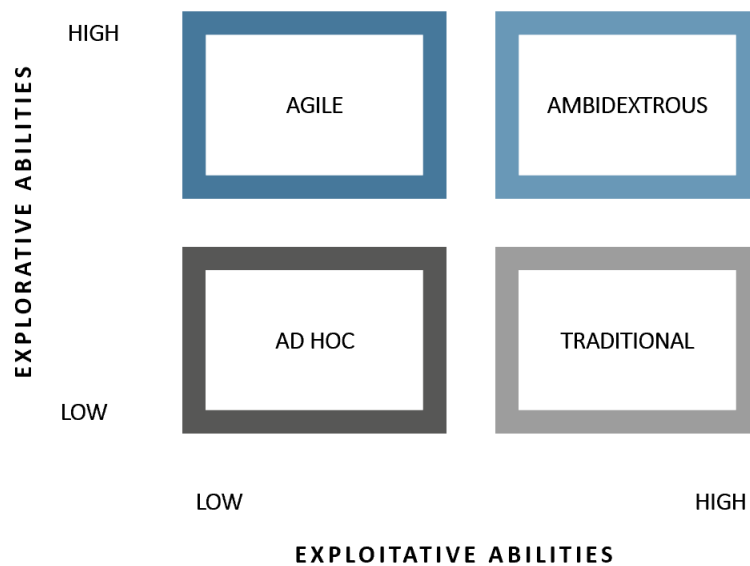

FIGURE 9: ORGANIZATIONAL MODELS, FROM VINKAR ET AL. (2006)

Therefore, new organizational structures are needed to sustain these opposing cultures so that systems development organizations can reap the full benefits of both agile and traditional systems development. In such scenario, ambidextrous organizations are able to create a balance among the two perspectives, integrating them in the best possible way (Vinekar et al., 2006).

Another research carried by Leonhardt et al. (2017) deepens the relationship between agility and ambidexterity in a context of digitalization. The authors show that, while agility facilitates seeking and pursuing market opportunities, there is need for competencies and capability that go beyond those strictly required by agile practices. In a digital context, agility may create tensions between IT exploration and IT exploitation activities. Accordingly, the authors prove that IT ambidexterity moderates the relationship between IT agility and the IT function's digitization support, intended as the ability to manage today's business demands while simultaneously being adaptive to changes in the digital environment. In contrast, an excessive focus on exploiting existing IT resources and capabilities tends to foster structural inertia (He & Wong, 2004), weakening the effect of IT agility because it hinders IT sensing and IT responding capabilities to be effectively used by being fixated on IT exploitation.

In a context of digitalization, the concept of ambidexterity often takes the acceptation of IT ambidexterity, which is defined as a firm's ability to simultaneously pursue exploration and exploitation in their management of IT resources and practices (Lee et al., 2015). In particular, IT ambidexterity can be conceptualized through the presence of IT exploration and IT exploitation. IT exploitation permits to develop information systems more rapidly due to the benefits of reusing developed digital artifacts, while IT exploration refers to acquiring or experimenting new digital technologies and processes.

Given the importance of digitalization, many scholars are recently tackling the theme of IT ambidexterity. For example, Tai et al. (2017) shows empirically that the combination of IT exploration and IT exploitation fosters an organization's digital innovation capability. This finding is particularly important because it implicitly creates a link between the concept of ambidexterity and different forms of corporate entrepreneurship. In fact, digital innovation capability can manifest in different entrepreneurial forms, from venture creation to process renewal.

This perspective finds further confirmation in the literature. In fact, it has been shown that developing the capability of process ambidexterity creates an IT function able to implement entrepreneurial practices that better align the IT

function to business functions (Bot & Renaud, 2012). Moreover, improving an IT organization's entrepreneurial ability results in improved productivity, shorter time to market, and lower operational costs. By becoming ambidextrous, IT functions can more effectively and predictably enable transformational change while simultaneously improving efficiency. In fact, IT skills can develop an entrepreneurial capability that balances both demand and supply management, and the process ambidexterity enables this mechanism in a practical way.

An effort to combine the concepts of entrepreneurship, agility, IT skills and ambidexterity at an organizational level was made by Röder et al. (2014). To explain the connection the propose a framework (Figure 10) that ties together the different elements and explains the mechanisms among them. Regarding organizational ambidexterity, in line with extant research, two dimensions are reported: (I) Exploration and (II) Exploitation. Regarding IT agility (i.e. agility enabled by digital technologies and digital skills), similarly, the authors define two further dimensions: (I) Entrepreneurial Agility and (II) Adaptive Agility. In particular, the first is referred to approach of adapting to environmental change in order to maintain competitive parity or competitive advantage, while the second refers to anticipating environmental changes and conducting strategic experiments with new business approaches and models.
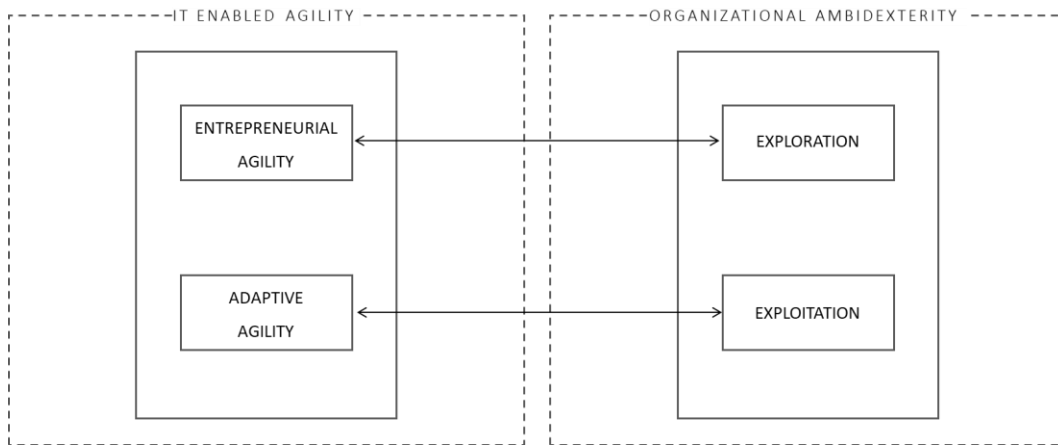

FIGURE 10: CONCEPTUAL FRAMEWORK ADAPTED FROM RÖDER ET AL. (2014)

Starting from the proposed framework, the authors sustain that there is a natural link between exploration and entrepreneurial agility and between exploitation and adaptive agility. However, at the same time entrepreneurial agility impedes

exploitative behaviors and adaptive agility impedes exploratory behaviors. In such context, organizational ambidexterity creates a structure such that firms are allowed to transfer results from exploratory to exploitative by means of IT agility mechanisms.

CHAPTER 5

LITERATURE REVIEW

"A review of prior, relevant literature is an essential feature of any academic project. An effective review creates a firm foundation for advancing knowledge. It facilitates theory development, closes areas where a plethora of research exists, and uncovers areas where research is needed" (Webster & Watson, 2002). The aim of the following review is not only to give credit to the authors who have already shed a light on certain areas of the research, but also a way to understand how any other subsequent work, including this one, can bring value to the research filed. Hart (1999) explains the necessity of the literature review in academic theses, presenting four purposes for its presence: it synthesizes the understanding on a particular subject matter, it stands as a testament to the rigorous research dedication and it justifies future research (including the thesis itself).

For the scope of this thesis, the literature review serves for multiple reasons. It was a way to understand the research on the topics of agile software development, corporate entrepreneurship, ambidexterity digitalization. The procedure followed was a multi-step process consisting in different phases: researching articles from specific sources, classifying the articles into pre-defined categories and finally selecting the most relevant ones according to different criteria.

ARTICLES RESEARCH

The first move of this multi-step process was to define the main sources of literature. It was decided, given the nature of the topics being researched, to

include mainly scientific papers available in international journals. The main sources for these kinds of articles were all the most popular online library databases: Scopus (from which the majority of papers come from), ISI Web of Knowledge, Springer, Emerald, Wiley and Google Scholar. The research was carried out using specific keywords, which in some cases were also cross-combined. This allowed to reduce and filter the huge amount of content available on the mentioned libraries.

The agile literature review started by analyzing the contributions given by the authors of the agile manifesto. This approach was very effective to define the main features and boundaries of the topic so that the following article research could me more targeted. The majority of these sources includes mostly books or guides (Beck, 2000; Beck & Fowler, 2001; Schwaber & Sutherland, 2013) that are not included in this analysis because they are not considered as scientific papers. However, given that the authors are the same ones that elaborated the manifesto, their work can be considered reliable, especially when the goal is understanding the foundations of agile software development.

This kind of first level analysis, allowed to define a set of initial keywords to filter scientific papers. At this point, the second step of the agile research was to use very general keywords like "Agile", "Agile Software Development", "Agile Methodologies", "Agile Scrum", "Agile Practices" and "Agile Principles". This process was very dynamic, in the sense that whenever new keywords were identified in the articles, some of the above searches were filtered again by means of additional terms. For example, the use of "Agile Practices AND adoption" or "Agile Practices AND impact" or "Agile Practices AND clusters" or "Agile AND tailoring" helped the research process to be more focused and targeted towards the objective of this research, avoiding a huge number of papers out of scope. Then, once the theoretical foundations were laid, in order to increase the level of detail of the analysis in accordance to the scope of this thesis, it was necessary to use keywords related to each single agile methodology and practice like "Agile Project Management", "Extreme Programming Practices", "Scrum Practices", "Scrum Sprint", "Pair Programming", "Agile Continuous Integration" and similar others.

On the other hand, the corporate entrepreneurship literature was started directly by using keywords like "Corporate Entrepreneurship", "Entrepreneurial Orientation", "Individual Entrepreneurship", "Corporate Entrepreneurship Taxonomy". In this case, in fact, there is not an "official list" of authors to which is

possible to attribute the foundations of corporate entrepreneurship, therefore the research had to begin directly on scientific papers. Once the main concepts were identified, then the research was again filtered by means of more specific keywords like "Corporate Entrepreneurship AND leadership", "Corporate Entrepreneurship AND strategy", "Corporate Entrepreneurship AND environment" or "Entrepreneurial Orientation AND individual".

In some cases, it was also necessary to combine agile keywords with entrepreneurship ones to see if there were already some articles merging the boundaries between agile and corporate entrepreneurship.

Regarding the literature about digitalization, the research was conducted in a similar way. The main keywords used in this sense were "Digitalization", "Digital Technologies", "Digital Skills", "Digital Entrepreneurship" or "IT skills". Similarly, articles' research on ambidexterity followed some keywords like "Ambidexterity", "Individual Ambidexterity", "Exploration" or "Exploitation".

Giving the empirical nature of this research, among the articles searched, it was made an effort to isolate those offering measurement systems and scales. This approach allowed to gather as much information as possible to guide the step of data collection.

For completeness' sake, the research wasn't only limited to what has been mentioned until now. In fact, the use of keywords can be considered just as an immediate source of research strategy aimed at getting the most popular articles in the libraries. Other strategies were used to make the literature review more comprehensive like the "successive fractions" strategy (Rowley & Slack, 2004) which consists in searching within an already retrieved set of documents to eliminate the less relevant ones. Moreover, many articles were also retrieved by investigating the references of other documents, with the goal of ensuring a better and deeper coverage of the research field.

In terms of year of publication, no limits were set because of the nature of the concepts studied. Some of the most important contributions in this field, in fact, have been given by articles dated around the 1990s for corporate entrepreneurship and 2000s for agile. In particular, much of the theoretical foundation that is still used by recent papers comes from such time span. Researches on digitalization are, instead, much more recent in comparison. Therefore, it was very important to include both recent articles, to understand where the research is focusing and

which are the new directions, and more dated ones, to understand better the foundation of what is being discussed.

ARTICLES SELECTION

From the entire variety of articles that came out of the research phase, it was necessary to select only those that could bring value to the scope of the thesis which is to assess the relationship between agile practices, digitalization and corporate entrepreneurship. Hence, among the wide variety of articles there were 4 main drivers common to the research areas to make the selection: researches about the use of agile practices, papers discussing important issues related to corporate entrepreneurship, papers studying the effects of digitalization and papers aimed at gathering an understanding on the topic of ambidexterity.

Regarding the first, it was important to highlight papers with results in specific areas. For the agile review, in fact, it was important to gather papers describing both the different methodologies (Scrum, XP, Kanban etc.) and the different practices, since the latter represent an important foundation for the development of this thesis. On each single practice, then, it was critical to highlight how they relate to organizations and individuals to uncover the impact of their adoption both when considered one by one and when taken as bundles.

Regarding the corporate entrepreneurship review, instead, the main focus was first on finding the key elements that define it and then analyzing more deeply the different connotations given to it like entrepreneurial orientation or intrapreneurship. Then it was important to select papers linking the abstract concept to more practical implications to understand in which fields the literature makes the connection between operational and entrepreneurial variables and how.

Towards digitalization and ambidexterity, the approach was slightly different. Concerning the first, in fact, the goal was both to analyze researches on digitalization, digital technologies and digital skills but also to understand the relationship with entrepreneurship. Regarding ambidexterity, instead, the goal was to define its main features to judge whether or not this variable could play a role in this research.
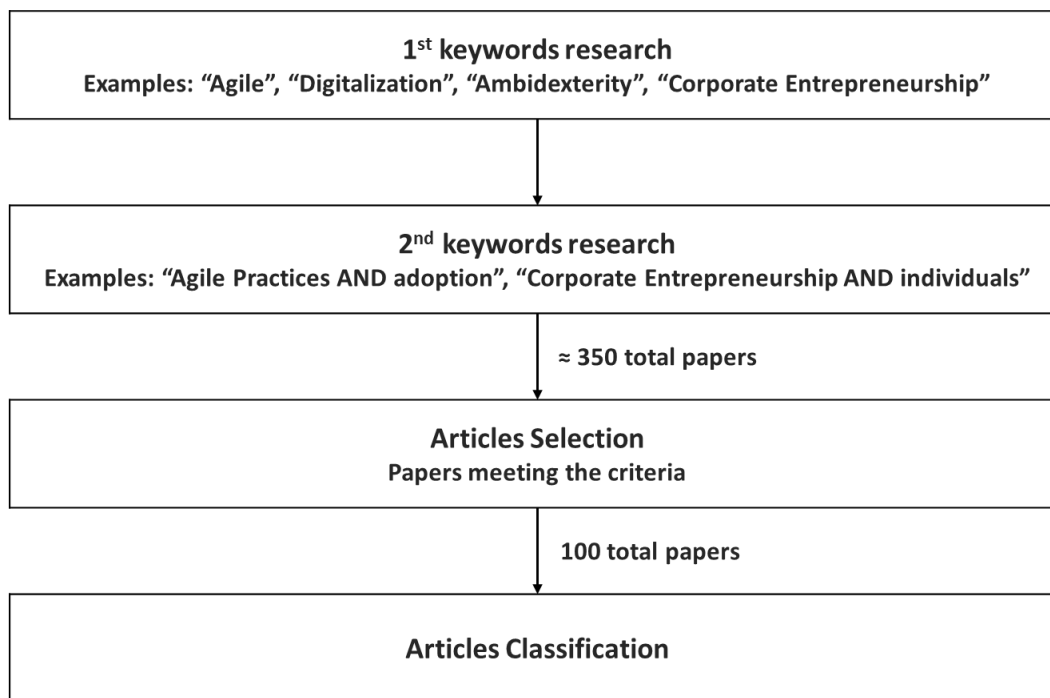
Content of the figure:

1st keywords research
Examples: "Agile", "Digitalization", "Ambidexterity", "Corporate Entrepreneurship"

2nd keywords research
Examples: "Agile Practices AND adoption", "Corporate Entrepreneurship AND individuals"

≈ 350 total papers

Articles Selection
Papers meeting the criteria

100 total papers

Articles Classification

FIGURE 11: ARTICLES SELECTION PROCESS

After the keywords researches and the selection process illustrated, 100 papers were classified and deeply analyzed. Among those, 49 were about agile software development, 30 were about entrepreneurship, 10 about digitalization and 11 about ambidexterity. The number of articles were considered to be enough to cover the main aspects and research line of each topic. In particular, the difference in the number of agile papers compared to the rest is justified by the fact that the review of agile papers had to cover not only conceptual and theoretical aspects but also practical cases and implications of use about all the practices identifies.

ARTICLES CLASSIFICATION

The subsequent step to the review process was to classify the most relevant articles selected. All the researched papers, once they were selected according to the criteria mentioned, were registered into an excel file and divided considering the

macro topic (i.e. agile, corporate entrepreneurship, digitalization and ambidexterity). Then each one was recorded and described considering multiple attributes: title, authors, year of publication, DOI, link, abstract, keywords, type of publication, methodology, method of data gathering and a summary containing the research objectives and the key findings. Without mentioning the most obvious ones, it's important to clarify why each one is an important variable and what they mean. The mentioned variables have been defined by interpreting the paper of Stuart et al. (2002) in which a research process model is given. The main categories identified, hence, are 4: (I) the aim of the research, (II) the method of data gathering, (III) the method of data analysis and (IV) quality measures. All the other variables have been included only for the purpose of identifying and retrieving the articles in a more efficient way. To keep the focus on what is valuable to this thesis, only the first and the third categories have been included. The reason is that quality measures aim at assessing the reliability, replicability and validity of a paper and this assessment was already conducted in the selection phase, while methods of data gathering could be overlapped with methods of data analysis, therefore their inclusion would not bring any value added.

The aim of the research was classified for each article with the attribute "summary", where each paper was described in terms of its scope and objectives and its most useful results according to the purpose of this thesis. This task allowed to identify the main recurring themes in the literature and spot eventual gaps in the research that could identify paths for future studies.

Similarly, the method of data analysis was classified with the attribute "methodology" and it addresses how each paper answers to its research question. The rationale of classification followed the one of a study conducted by Meixell & Norbis (2008), where the following values were identified:

- *case study:* empirical analysis that investigates a phenomenon in a real context, especially when the boundaries between theory and application are not evident.

- *literature review:* the paper collects and analyses a series of previous articles related to a specific topic. It usually organizes the existing research and discusses future directions in the field.

- *conceptual model:* it allows to represent ideas through frameworks, maps, diagrams, matrixes etc. The result is usually immediate and easy to understand.

- *survey:* it takes a sample of individuals from a targeted population to ask specific questions that may unveil insights related to the scope of the paper.

- *interviews:* similarly to a survey, it takes a sample of individuals to ask specific questions. In this case, however, the questions are verbally expressed and then transcribed. In many cases it tends to be a less structured form of questioning, but it gives the possibility to gather deeper qualitative insights.

- *mathematical model:* it expresses an idea through a quantitative scientific analysis that uses established mathematical or statistical calculations.

- *multi-methods:* it is the combination of two or more of the methods described. It allows to compensate the weaknesses of one with the presence of another.

The authors also define other methodologies like the one of "simulation" and "action research", but they were excluded because less relevant in this field of study. To make the analysis even deeper, the more quantitative methodologies that have been defined (i.e. survey or mathematical model) were classified also in terms of the type of data analysis performed, accordingly to Sachan & Datta (2005). Among the most common variables, some examples are "regression", "factor analysis", "cluster analysis" and "correlation analysis".

ARTICLES ANALYSIS

The definition of a structure that allows to easily classify the selected papers, was a critical step to make an analysis on what has been gather. The aim of the analysis was both to highlight eventual distributions of the articles from a statistical

perspective and to identify some recurring themes in a way to understand where a contribution is more needed. For the sake of simplicity and clarity, the analysis considers the 100 papers that have been classified only in an aggregated manner, without making the separation between agile, entrepreneurship, digitalization and ambidexterity.

Considering the distribution of paper throughout the years (Figure 12), the classified articles cover a period of about 30 years. Practically speaking, however the majority of them is concentrated in the last decade of research, from 2009 to 2019. The reason for this wide distribution is due to the specific nature of the topics covered. In particular, the entrepreneurship literature has a lot of history, and some of the researches carried out in the 1990s still stand today. A clear example would be the definition of a corporate entrepreneurship taxonomy (Covin & Miles, 1999) or the definition of the main variables to describe entrepreneurial orientation (Miller, 1983) which are still used and cited today in many recent researches. In fact, about 40% of all the papers related to corporate entrepreneurship were published among the year 1983 and 2006. The main reason are two: first, as mentioned, the intrinsic nature of the topic and second, the fact that to fulfill the objective of this thesis, analyzing the conceptual variables in terms of characteristics, taxonomy and framework was as much important as understanding how the literature is evolving in more recent years.

The agile literature, on the other hand, lays its foundation around the year 2000, when many books and unofficial works were starting to spread the agile ideas. Then, it was only after 2001, when the Agile Manifesto was published, that the majority of the articles started to appear to discuss the first implications of this new approach both from a practical and from a theoretical point of view. In fact, only about 28% of the articles related to agile are dated between the years 1999 and 2006, while the remaining 72% are all between 2007 and 2019. This is in line with the trend of articles related to agile according to the yearly distribution of papers found through Scopus. The main reasons are two: (I) agile software development is a more recent concept than entrepreneurship and (II) the theoretical foundations of agile are mostly found in books written by the authors of the agile manifesto and, since this review considers only scientific papers available in international journals, those sources were used but not included in this kind of analysis.

The literature regarding digitalization, instead, includes mostly recent papers. In fact, all the articles in this stream of literature are dated between 2015 and 2019.
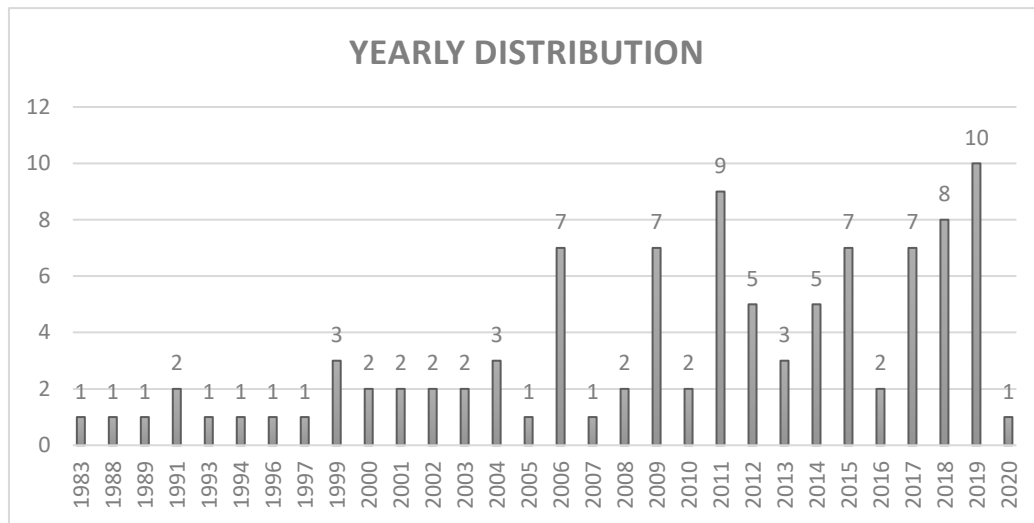
YEARLY DISTRIBUTION

FIGURE 12: DISTRIBUTION OF PAPERS PER YEAR

Finally, papers related to ambidexterity cover a time period from 2004 to 2019. However, more than 70% of those are actually dated between 2012 and 2019.

Following the rationale of classification previously mentioned, it was important to analyze also the different methodologies used in each paper to discover patterns in the literature. Most of the papers classified usually adopt two or more methods at once. When evident, only the prevailing method was used to analyze the papers; however, the importance of some researches lay in the combination of multiple methods. For example, in most of the cases surveys were combined with analytical or mathematical models like regression, correlation or factor analysis, or case studies with surveys and interviews. Therefore, some of the articles were classified with two or more methods at once.

The first useful insight of this kind of analysis was to highlight eventual correlations among the methodology used and the objectives of the papers. The results show an evident correlation regarding the papers whose objective is to define a scale. In those articles, in fact, the majority of the authors use a combination of literature reviews, surveys and mathematical models. The reason is that the literature review allows the authors to understand how to build the measurement system, the survey allows them to gather some data according to their scale and tools like factor analysis or correlation with the Cronbach's

coefficient are then helpful to assess the reliability and to measure the internal consistency of the items identified.

Regarding other themes, correlations between the objectives of a paper and its methodologies were less evident. The strongest correlations, however, were among the methodologies itself. In fact, almost all the articles analyzed use multiple methods at once. Generally speaking, there is a correlation between: (I) the use of literature reviews combined with conceptual model, (II) the use of mathematical models combined to surveys and (III) the use of interviews combined with case studies. Regarding the first, it's reasonable that authors creating new conceptual frameworks first analyze what is the state-of-the-art in the literature to present results that create added value to the field. The second correlation, instead, can be explained by the fact that surveys are usually methods to gather data, but in order to present empirical evidence, that data needs to be analyzed mathematically. As for the latter relation, case studies alone tend to be more qualitative, therefore including interviews to the different individuals involved can be a way to gather information to complement the case under analysis and gather even more insights.
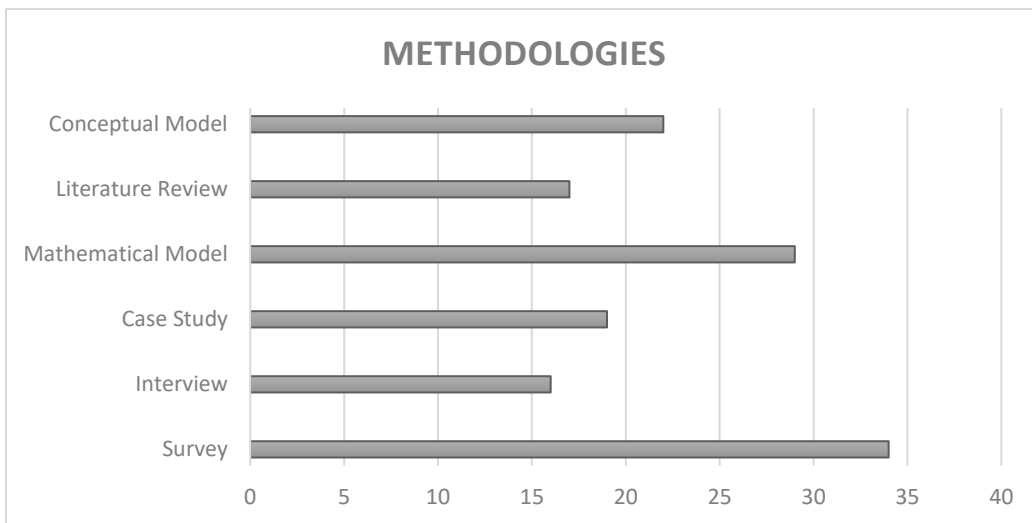

FIGURE 13: METHODOLOGIES USED IN PAPERS

The majority of the articles classified use the above methodologies. However, there are also isolated cases in which authors use different ones that have not been listed. For example, few use *structured experiments* on a selected number of employees to

prove very specific hypothesis that need to be confirmed or denied (George & Williams, 2004). Others, instead, use *observation* as a mean to gather information, particularly in the case study methodology (Narang & Webber, 2002). Finally, some use *Grounded Theory* to define sets of procedures for the collection and analysis of qualitative data, but in most of the cases they aim at building a conceptual model to guide authors (Whitworth & Biddle, 2007). In general, however almost all of the paper use one of the listed methodologies as a primary approach.

Given that a significant portion (more than 30%) of the papers analyzed use quantitative methods (mathematical models and surveys) to fulfill their research scope, it was necessary to clearly specify the most common approaches through which data is analyzed. The main techniques used are: (I) factor analysis, (II) correlation analysis, (III) regression and (IV) clustering. In the sample isolated for this thesis, there are different ways in which these methods are used. The reason is the multidimensionality of the topics that are treated. In fact, the concepts analyzed are usually split into sub-attributes that may simplify a quantitative analysis. Hence, tools like clustering can help identify which items can be grouped together, a factor analysis can be used with the goal of evaluating the internal consistency of the attributes and a correlation analysis can be helpful to highlight internal relationship in a clear and analytical way.

Regression analysis are instead used more often when it comes to creating a relationship among two or more concepts, where one can be used as the dependent variable and the others as the independent variables. A clear example of the latter is the article by Anderson et al. (2019), which uses a regression model to create a mathematical link between two different conceptual items: the entrepreneurial orientation of an organization and its learning capabilities.

THEMES

Throughout the literature review, in terms of content analysis, different interesting themes were discovered. In this case, it was necessary to make a distinction between agile software development and entrepreneurship to highlight the main

themes of both. This kind of analysis was made not including the articles regarding digitalization and ambidexterity, since the review in that case was much more target from the beginning. In this section, themes are identified at a macro level, meaning that they represent mostly streams of research. In each stream, however, there are many more micro-themes that can be analyzed, but for the purpose of this thesis, this kind of micro-analysis has been discarded or at least reduced to a level of detail that was considered appropriate.

Regarding corporate entrepreneurship, mainly 5 macro-themes emerged from the review: (I) defining entrepreneurship in its forms and giving it a taxonomy, (II) organizational and environmental variables, (III) the role of middle management, (IV) entrepreneurship at the individual level and (V) link to operational practices.

Each of these macro-themes was elaborated by the authors to define the main elements related to corporate entrepreneurship. Within those macro-areas, many more sub-themes were discussed in the literature.

In defining concepts and taxonomies, the most recurring themes are related to the different forms of corporate entrepreneurship and the different connotations related to it, like intrapreneurship or entrepreneurial orientation (EO). The latter, in particular, creates a link with the field of study about context and organizations, where many study are provided from the characteristics of the market environment (dynamism, hostility and heterogeneity), to the way organization can perceive external factors (environmental scanning and individual perception), to the ways in which organizations can promote entrepreneurial behaviors (culture, leadership style, strategy and internal factors), to the different expected entrepreneurial outcomes (new revenue streams, internationalization, survival, competitive advantage or preventing disruption). Each of these themes is strictly related with the other, for this reason many of the more recent articles are also focused on studying the relationship among them rather than treating them as individual elements.

Regarding the research line of individuals, instead, the literature contains different fields of study that are either aimed at defining a set of individual characteristics and traits that can predict and correlate with entrepreneurship, or at defining the entrepreneurial behavior as the result of an intention. In the second case the most recurring themes are related to understanding which factors create the intention (education, family background, desire for autonomy, job satisfaction etc.) and how

intentions are transformed into actual behaviors (practical capabilities, incentives, commitment etc.).

When such themes are combines those related to digitalization, the literature moves towards Digital Corporate Entrepreneurship, a construct that includes both Corporate Entrepreneurship and digital themes.
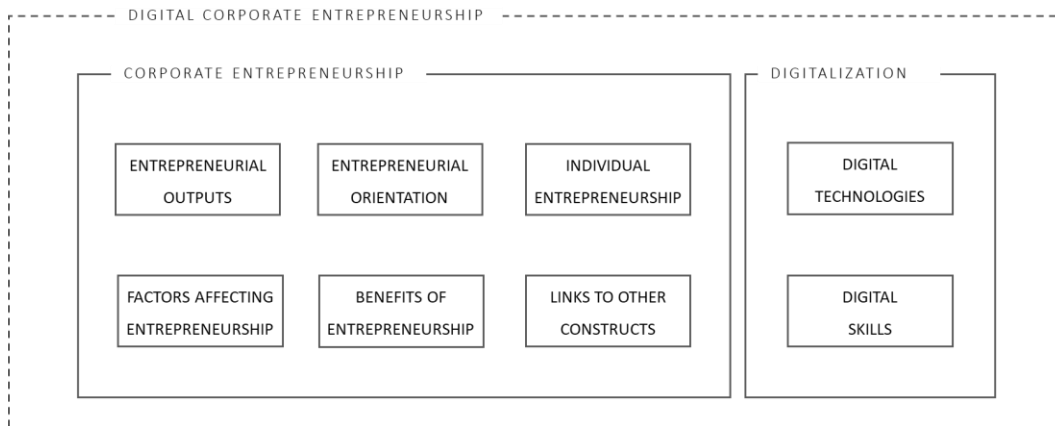

FIGURE 14: MAIN THEMES OF DIGITAL CORPORATE ENTREPRENEURSHIP

Concerning the agile literature, the macro-themes identified were 7: (I) conceptualizing agile, (II) agile principles, (III) culture and change management related to the implementation of agile, (IV) agile practices related to Scrum, (V) agile practices related to Extreme Programming, (VI) bundles of agile practices and (VII) agile tailoring.

Conceptualizing agile is the first step to understand its characteristics and its impact in the business world. The concept of agile is a complex one, and as such it implies many components like leanness, flexibility, change and reactiveness, therefore, starting from a clear definition of what agile is and is not is critical to lay the foundations for practical applications.

What is call agile software development is much more than an idea; it is the result of practical inefficiencies that were rooted in the way value was delivered to the customer in a software environment. This led to a real movement of scholars and practitioners that led to an 'agile manifesto' (Beck et al., 2001), and to a series of basic principles that were created to set guidelines and values for agile.

Understanding the principles is fundamental not only to better define how to deliver value to the customer but also to fully acknowledge in what way agile methodologies and practices create a disruption with respect to traditional methodologies and what does this imply in terms of adoption.

Moreover, having its own set of values, agile methodologies need to be addressed first at a strategic level. For this reason, the literature gives much importance in understanding how the organizational culture plays a critical role in the adoption of agile methodologies, what impact may have the agile values on the existing culture, and what are the possible strategical benefits related to its implementation.

Once all the fundamental elements have been laid out, it is possible to go into further details in studying the practical aspects of agile, including the best practices of the most important methodologies (Scrum and Extreme Programming). In this sense, the literature uses different approaches with different objectives. In fact, about 70% of the articles related to agile practices classified approached each one individually, understanding what are the benefits, issues and challenges related to their implementation. The remaining 30%, instead takes a more aggregated perspective and analyzed bundles of practices and their adoption in a more "high level" perspective, considering also the theme of agile tailoring, which means taking some methodologies and implementing only specific practices instead of all of them. Generally, in the first case, where agile practices are analyzed individually, authors tend to focus more on shining a light into how a practice influences things like communication, coordination, conflicts, knowledge sharing, mutual accountability, problem solving, feedbacks, responsiveness to changes, trust & cooperation, satisfaction, problem identification, time availability and risk edging. In the second case, in which practices are considered in bundles, authors tend more to define cluster of practices that serve to specific goals. For example, Neto et al. (2019), show that practices like "Unit Testing", "Continuous Integration", "Collective Code Ownership" and "Coding Standards" should be considered when the goal is nurturing Organizational Learning. Similarly, Korhonen (2011) creates clusters of practices according to their use on daily work, team activities or programming activities.

Therefore, starting from single practices and why they create value for the organizations, the literature uses bundles of them to analyze more operational and practical aspects of the agile software development paradigm. This then creates a

link with more "high level" and organizational themes like the impact of agile tailoring, the presence of distributed teams, the necessity to scale up or the application of the agile principles in relationship to the organization and its cultural values.
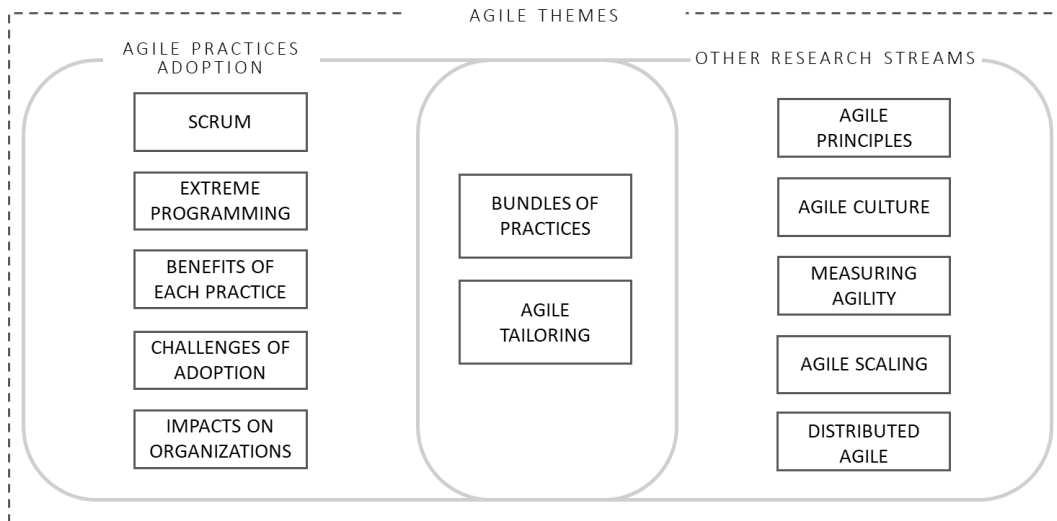

AGILE THEMES

AGILE PRACTICES ADOPTION

OTHER RESEARCH STREAMS

| AGILE PRACTICES ADOPTION | BUNDLES OF PRACTICES | OTHER RESEARCH STREAMS |

SCRUM

EXTREME PROGRAMMING

BENEFITS OF EACH PRACTICE

CHALLENGES OF ADOPTION

IMPACTS ON ORGANIZATIONS

BUNDLES OF PRACTICES

AGILE TAILORING

AGILE PRINCIPLES

AGILE CULTURE

MEASURING AGILITY

AGILE SCALING

DISTRIBUTED AGILE

FIGURE 15: MAIN THEMES OF AGILE LITERATURE

Given the state of the agile literature, the majority of the gaps were identified in this last theme. In fact, there is still much need for research in understanding how bundles of practices create practical value when they are applied.

LITERATURE ANALYSIS

The main purpose of a literature review is laying a theoretical foundation about the different constructs analyzed in this research. To define the research questions, it is, in fact, necessary to first understand the roots of a certain stream of research and understand the most relevant discussions and emerging topics. First, definitions are analyzed to understand the main elements that constitutes the constructs. Second, Corporate Entrepreneurship is deepened from an organizational and individual perspective. Third, Agile Software development is

analyzed through its principles and values. Finally, the roles of digitalization and ambidexterity are explored in relation to both the previous constructs.

In terms of definitions, many different forms emerge from the literature. However, some common characteristics can be extrapolated.

Agility:

> "ability to rapidly or inherently *create change, proactively or reactively embrace change, and learn from change* while contributing to perceived customer value (economy, quality, and simplicity), through its *collective components* and relationships with its environment" (Conboy, 2009)

> "ability to sense and *respond* swiftly to technical *changes* and *new business opportunities*, enacted by exploration-based learning and exploitation-based learning" (Lyytinen & Rose, 2006)

Corporate Entrepreneurship:

> "a dynamic process of *vision, change, and creation*. […] Essential ingredients include the willingness to take calculated risks, formulate an *effective venture team*, marshal the needed resources, build a solid business plan, and, finally, the vision to *recognize opportunity* where others see chaos, contradiction, and confusion" (Kuratko, 2009)

From the definition of the two concepts, it is possible to highlight that there are some common features that emerge from both fields of study: (I) the relationship to creating and embracing *change,* (II) the collective dimension of analysis and (III) the recognition and exploration of *new opportunities*. A key point that can be extrapolated by the definition is the importance of the context. Agile Software Development was first introduced to deal with the presence of a *dynamic and hostile context*, with many uncertainties, hence the fact that concepts like proactiveness, change and opportunities emerge can be considered as normal. Similarly, for companies, the concept of Entrepreneurship become more and more relevant with

the presence of an environment characterized by high hostility, heterogeneity and dynamism (Covin & Slevin, 1989; Zahra, 1991).

Corporate Entrepreneurship has always been associated to a company's performance. Specifically, in this context, performance is associated to many outcomes like firm's profitability (Zahra, 1991 & 1993), Strategic Renewal (Guth & Ginsberg, 1990), firm's innovativeness (Baden-Fuller, 1995), new revenue streams (McGrath et al., 1994), internationalization (Dess et al., 2003) or, in general, achieving a competitive advantage (Covin & Miles – 1999).

From an organizational perspective, the concept of Corporate Entrepreneurship is often linked to the one of Entrepreneurial Orientation, which is considered as the main driver for performance (Rauch et al., 2009). Entrepreneurial Orientation can be defined as:

> "the extent to which top managers are inclined to take business-related risks, to favor change and innovation in order to obtain a competitive advantage for their firm" (Covin & Slevin, 1989, p.77).

However, researchers have proposed different variations over the years (George & Marino, 2011). Starting from the initial components defined by Miller (1983), which defined Entrepreneurial Orientation through proactiveness, innovativeness and risk-taking, some studies added more factors like autonomy and competitive aggressiveness (Lumpkin & Dess, 1996).

In order for companies to be entrepreneurial and increase their Entrepreneurial Orientation, it is necessary to deal with the external environment (Lumpkin & Dess, 2001), while creating an internal culture that fosters the generation of new ideas and supports teams throughout the development (Ireland et al., 2009) and dealing with internal factors like internal communication, control systems, rewards and managerial support (Zahra,1991 & 1993).

On the other hand, Agile Software Development, with its methodologies and practices, is an example of approach based on the scientific method, which substitutes the traditional Stage-Gate approach with an iterative one based on the continuous delivery of value. Agile methodologies were first introduced to respond to dynamic contexts with high uncertainties, where empirical processes perform better than structured ones. Therefore, an important aspect is that of

change as highlighted by the definitions. In this sense, agile methodologies offer a light structure that allows to deliver value while exploring new opportunities and minimizing risks. The agile approach was first developed in relation to the software development process (Beck, 2000), but it was quickly spread to many other application domains. The SCRUM methodology, which is the most used by practitioners (Annual State of Agile Report, 2018), for example, creates a new paradigm of project management. The way agile methodologies and practices reach these objectives is through a series of principles and values.

The shifting paradigm on collectivity and interactions promoted by agile practices (1st principle), for example, has been seen by the literature to have positive effects on *communication* and *collaboration* among the members of a team. The main reason is that this principle substitutes the use of strict and defined processes with a team that works in a dynamic way. Instead of following a set of instructions it's more important to define competencies and understand how each individual can bring value to the team or to the output. This means that is necessary to increase the level of communication and collaboration internally and therefore enhancements in *knowledge sharing*, *participation*, *feedbacks* and *coordination* are required.

Analyzing the 3rd agile principle, the idea of customer collaboration means cultivating relationships with all the stakeholders throughout the entire duration of the project. This allows to promptly perceive changes and new requirements in a way that is reduces wastes of time. This idea is also behind the 2nd agile principle, according to which it is fundamental for companies to quickly gather and process data about their customer, so that they can be able to deliver something that is valuable. Hence, the agile decision-making process is characterized by speed and the ability to quickly acquire knowledge and use it to deliver value.

Looking at the 4th principle, agile software development focuses on being able to respond to changes instead of following strict procedures changing the way value is delivered from linear to iterative. This means that the process of problem solving changes similarly, because instead of having an initial phase of planning where all decisions are made at the beginning of a project, in an iterative approach individuals have to face continuous experimentation to define what works and what doesn't. In this scenario, people are required to make decisions on a daily basis in a much shorter time span, therefore learning and flexibility become essential capabilities that are directly foster by the use of agile practices.

On a different note, the recent trend of digitalization has shifted market dynamics, creating new affordances (Autio et. al, 2017): (I) Decoupling, which is the possibility to use the same resource to achieve multiple outputs, (II) Disintermediation, which leads to the reduction of intermediaries and the possibility of reaching directly the end user and (III) Generativity, which allows to scale solutions at a fast paste and low cost. In this context, the digital entrepreneur faces increasingly dynamic paths, determined by diverse activities with uncertain time frames (Nambisan, 2017). Hence, there is a necessity to consider the concept of Digital Corporate Entrepreneurship and to understand how companies can be entrepreneurial in a digital world and what is the role played by Agile Software Development.

In a digital environment, also the concept of ambidexterity needs to be adapted. In this sense, the literature considers IT ambidexterity which is defined as a firm's ability to simultaneously pursue exploration and exploitation in their management of IT resources and practices (Lee et al., 2015). IT ambidexterity is conceptualized through the presence of IT exploration and IT exploitation, where IT exploitation permits to develop information systems more rapidly due to the benefits of reusing developed digital artifacts, while IT exploration refers to acquiring or experimenting new digital technologies and processes. Starting from these concepts, some authors make efforts to link the different constructs together. For example, from an organizational perspective, Röder et al. (2014), show that organizational ambidexterity is a mechanism that allows interaction between "IT enabled Agility", entrepreneurial activities and adaptive or exploitative activities.

Digitalization creates a wider range of actors capable of entrepreneurial behaviors, each with different characteristics, capabilities and goals. Finding the agents of change is becoming more and more challenging (Nambisan, 2017; Autio et al., 2018). Therefore, also the level of analysis related to Corporate Entrepreneurship needs to be adapted. In this sense, many researchers are moving from an organizational perspective to an individual one. Organizations need to understand what are the factors that affect individuals' propension to act in an entrepreneurial way and how to enhance them. At an individual level, the literature defines Corporate Entrepreneurship mainly through the constructs of Entrepreneurial Orientation and Entrepreneurial Intention (Bolton & Lane, 2012; Liñán & Chen, 2009). Most of the research, however, is focused on defining the factors that impact individuals' intention (Fayolle & Liñán, 2014). Very few

researches, in fact, focus on individuals' Entrepreneurial Orientation and even fewer analyze these constructs in relation to digitalization or Agile practices.

ARTICLE'S TITLE	AUTHOR (YEAR)	SOURCE	METHOD	THEMES
Corporate entrepreneurship and the pursuit of competitive advantage	Covin, J. G., & Miles, M. P. (1999)	Entrepreneurship Theory and Practice	Conceptual Model, Literature Review	Corporate Entrepreneurship Taxonomy
The correlates of entrepreneurship in three types of firms	Miller, D. (1983)	Management science	Conceptual Model, Regression	Entrepreneurial Orientation (EO)
Strategic management of small firms in hostile and benign environments	Covin, J. G., & Slevin, D. P. (1989)	Strategic management journal	Survey	Entrepreneurial Orientation (EO)
Clarifying the entrepreneurial orientation construct and linking it to performance	Lumpkin G.T., Dess G.G. (1996)	Academy of Management Review	Conceptual Model, Literature Review	Entrepreneurial Orientation (EO)
Linking two dimensions of entrepreneurial orientation to firm performance: The moderating role of environment and industry life cycle	Lumpkin, G. T., & Dess, G. G. (2001)	Journal of business venturing	Survey, Regression	Entrepreneurial Orientation (EO)
Understanding the relationship between entrepreneurial orientation and strategic learning capability: an empirical investigation	Anderson, B. S., Covin, J. G., & Slevin, D. P. (2009).	Strategic Entrepreneurship Journal	Survey, Regression	Entrepreneurial Orientation (EO)
Entrepreneurial orientation and business performance: An assessment of past research and suggestions for the future	Rauch, A., Wiklund, J., Lumpkin, G. T., & Frese, M. (2009)	Entrepreneurship theory and practice	Meta Analysis, Mathematical Model	Entrepreneurial Orientation (EO)
Entrepreneurial orientation theory and research: Reflections on a needed construct	Covin, J. G., & Lumpkin, G. T. (2011)	Entrepreneurship theory and practice	Literature Review	Entrepreneurial Orientation (EO)
The epistemology of entrepreneurial orientation: Conceptual formation, modeling, and operationalization	George, B. A., & Marino, L. (2011)	Entrepreneurship Theory and Practice	Literature Review	Entrepreneurial Orientation (EO)
Where to from here? EO-as-experimentation, failure, and distribution of outcomes	Wiklund, J., & Shepherd, D. A. (2011)	Entrepreneurship Theory and Practice	Survey, Mathematical Model	Entrepreneurial Orientation (EO)

TABLE 7: SUMMARY OF THE REVIEWED PAPERS (1)

ARTICLE'S TITLE	AUTHOR (YEAR)	SOURCE	METHOD	THEMES
Crafting high-impact entrepreneurial orientation research: Some suggested guidelines	Covin, J. G., & Wales, W. J. (2019)	Entrepreneurship Theory and Practice	Literature Review	Entrepreneurial Orientation (EO)
Fostering intrapreneurship: The new competitive edge	Rule, E. G., & Irwin, D. W. (1988)	Journal of Business Strategy	Survey	Corporate Entrepreneurship (CE) Organizational Factors
Predictors and financial outcomes of corporate entrepreneurship: An exploratory study	Zahra, S. A. (1991)	Journal of Business Venturing	Survey, Mathematical Model	Corporate Entrepreneurship (CE) Organizational Factors
Environment, corporate entrepreneurship, and financial performance: A taxonomic approach	Zahra, S. A. (1993)	Journal of Business Venturing	Survey, Mathematical Model	Corporate Entrepreneurship (CE) Organizational Factors
Creating corporate entrepreneurship	Stopford, J. M.; Baden-Fuller, C. W. (1994)	Strategic Management Journal	Case Study, Survey, Interviews	Corporate Entrepreneurship (CE) Organizational Factors
The relationship between corporate entrepreneurship and strategic management	Barringer, B. R., & Bluedorn, A. C. (1999)	Strategic management journal	Survey	Corporate Entrepreneurship (CE) Organizational Factors
Emerging issues in corporate entrepreneurship	Dess, G. G., Ireland, R. D., Zahra, S. A., Floyd, S. W., Janney, J. J., & Lane, P. J. (2003)	Journal of Management	Literature Review	Corporate Entrepreneurship (CE) Organizational Factors
Balanced management control systems as a mechanism for achieving corporate entrepreneurship	Morris, M. H., Allen, J., Schindehutte, M., & Avila, R. (2006)	Journal of Managerial Issues	Mathematical Model	Corporate Entrepreneurship (CE) Organizational Factors
Conceptualizing corporate entrepreneurship strategy	Ireland, R. D.; Covin, J. G.; Kuratko, D. F. (2009)	Entrepreneurship Theory and Practice	Conceptual Model, Literature Review	Corporate Entrepreneurship (CE) Organizational Factors
Why implementing corporate innovation is so difficult	Kuratko, D. F., Covin, J. G., Hornsby, J. S. (2014)	Business Horizons	Conceptual Model, Literature Review	Corporate Entrepreneurship (CE) Organizational Factors

TABLE 8: SUMMARY OF THE REVIEWED PAPERS (2)

ARTICLE'S TITLE	AUTHOR (YEAR)	SOURCE	METHOD	THEMES
Middle managers' perception of the internal environment for corporate entrepreneurship: Assessing a measurement scale	Hornsby, J. S., Kuratko, D. F., & Zahra, S. A. (2002)	Journal of Business Venturing	Survey, Mathematical Method	Individual Entrepreneurship
A competency-based framework for promoting corporate entrepreneurship	Hayton, J. C., & Kelley, D. J. (2006)	Resource Management: Published in Cooperation with the School of Business Administration	Conceptual Model	Individual Entrepreneurship
The impacts of job embeddedness on high-tech employees entrepreneurship	Mai Y., Gan Z., Yao F. (2010)	International Conference on Information Management and Engineering	Conceptual Model	Individual Entrepreneurship
Entrepreneurial intentions: The influence of organizational and individual factors	Lee, L., Wong, P. K., Der Foo, M., & Leung, A. (2011)	Journal of business venturing	Survey, Regression	Individual Entrepreneurship
The future of research on entrepreneurial intentions	Fayolle, A., & Liñán, F. (2014)	Journal of Business Research	Literature Review	Individual Entrepreneurship
Individual and team entrepreneurial orientation: Scale development and configurations for success	Covin, J. G., Rigtering, J. C., Hughes, M., Kraus, S., Cheng, C. F., & Bouncken, R. B. (2020)	Journal of Business Research	Survey, Regression	Individual Entrepreneurship
The importance of opportunity recognition behaviour and motivators of employees when engaged in corporate entrepreneurship	Urban, B., & Wood, E. (2015)	Journal of Business Economics and Management	Survey, Mathematical Model	Individual Entrepreneurship
Intrapreneurial behavior: an empirical investigation of personality traits	Farrukh, M., Ying, C. W., & Mansori, S. (2016)	Management & Marketing	Survey, Mathematical Method	Individual Entrepreneurship
Development and cross-cultural application of a specific instrument to measure entrepreneurial intentions	Liñán F. & Chen Y.-W. (2009)	Entrepreneurship theory and practice	Survey, Mathematical Model	Entrepreneurial Intention (Scale)
Individual entrepreneurial orientation: Development of a measurement instrument	Bolton D.L., Lane M.D. (2012)	Education+ Training	Survey, Mathematical Model	Individual Entrepreneurial Orientation (IEO) (Scale)

TABLE 9: SUMMARY OF THE REVIEWED PAPERS (3)

LITERATURE REVIEW

ARTICLE'S TITLE	AUTHOR (YEAR)	SOURCE	METHOD	THEMES
The relation between 21st-century skills and digital skills: A systematic literature review	Van Laar, E., Van Deursen, A. J., Van Dijk, J. A., & De Haan, J. (2017)	Computers in human behavior	Literature Review	Digital Skills
21st-century digital skills instrument aimed at working professionals: Conceptual development and empirical validation	van Laar, E., van Deursen, A. J., van Dijk, J. A., & de Haan, J. (2018)	Telematics and informatics	Survey	Digital Skills
IT capabilities and product innovation performance: The roles of corporate entrepreneurship and competitive intensity	Chen, Y., Wang, Y., Nevo, S., Benitez-Amado, J., & Kou, G. (2015)	Information & Management	Survey, Regression	Digital Entrepreneurship
Digital entrepreneurship: Toward a digital technology perspective of entrepreneurship	Nambisan, S. (2017)	Entrepreneurship Theory and Practice	Conceptual Model	Digital Entrepreneurship
Digital affordances, spatial affordances, and the genesis of entrepreneurial ecosystems	Autio, E., Nambisan, S., Thomas, L. D., & Wright, M. (2018)	Strategic Entrepreneurship Journal	Conceptual Model	Digital Entrepreneurship
Analysis of the influence of the environment, stakeholder integration capability, absorptive capacity, and technological skills on organizational performance through corporate entrepreneurship	García-Sánchez, E., García-Morales, V. J., & Martín-Rojas, R. (2018)	International Entrepreneurship and Management Journal	Survey, Regression	Digital Entrepreneurship
Digital entrepreneurship in a resource-scarce context	Ngoasong, M. Z. (2018)	Journal of Small Business and Enterprise Development	Interviews	Digital Entrepreneurship
Corporate entrepreneurship in the digital era: The cascading effect through operations	Joshi, M. P., Kathuria, R., & Das, S. (2019)	The Journal of Entrepreneurship	Survey, Regression	Digital Entrepreneurship
Digital entrepreneurship	Kraus, S., Palmer, C., Kailer, N., Kallinger, F. L., & Spitzer, J. (2019)	International Journal of Entrepreneurial Behavior & Research	Literature Review	Digital Entrepreneurship
Linking information systems and entrepreneurship: A review and agenda for IT-associated and digital entrepreneurship research	Steininger, D. M. (2019)	Information Systems Journal	Literature Review	Digital Entrepreneurship

TABLE 10: SUMMARY OF THE REVIEWED PAPERS (4)

ARTICLE'S TITLE	AUTHOR (YEAR)	SOURCE	METHOD	THEMES
Manifesto for agile software development	Beck, K., Beedle, M., Van Bennekum, A., Cockburn, A., Cunningham, W., Fowler, M., ... & Kern, J. (2001)		Manifesto	Agile Manifesto
Information system development agility as organizational learning	Lyytinen, K., & Rose, G. M. (2006)	*European Journal of Information Systems*	Conceptual Taxonomy, Literature Review	Agile Concept
Measuring agility and adaptibility of agile methods: A 4 dimensional analytical tool	Qumer A. & Henderson-Sellers, B. (2006)	International Conference on Applied Computing	Conceptual Taxonomy	Agile Concept
Agility from first principles: Reconstructing the concept of agility in information systems development	Conboy K. (2009)	Information Systems Research	Conceptual Taxonomy, Literature Review	Agile Concept
Agile software development: It's about feedback and change	Williams L., Cockburn A. (2003)	Computer, IEEE	Conceptual Model	Agile Principles
The social nature of agile teams	Whitworth E., Biddle R. (2007)	AGILE 2007	Semi-structured Interviews	Agile Principles
Balancing individual and collaborative work in agile teams	Barney H.T., Moe N.B., Dybå T., Aurum A., Winata M. (2009)	International Conference on Agile Processes and Extreme Programming in Software Engineering	Semi-structured Interviews, Observation & Case Study	Agile Principles
User-centered design and agile methods: a systematic review	Da Silva, T. S., Martin, A., Maurer, F., & Silveira, M. (2011).	AGILE conference		Agile Principles
Acquiring and Sharing tacit knowledge in software development teams: An empirical study	Ryan, S., & O'Connor, R. V. (2013)	Information and Software Technology	Conceptual Model, Survey, Mathematical Model	Agile Principles
Improved product development performance through agile/stage-gate hybrids: The next-generation stage-gate process?	Sommer, A. F., Hedegaard, C., Dukovska-Popovska, I., & Steger-Jensen, K. (2015)	Research-Technology Management	Case Study, Interviews, Observation	Agile Principles

TABLE 11: SUMMARY OF THE REVIEWED PAPERS (5)

LITERATURE REVIEW

ARTICLE'S TITLE	AUTHOR (YEAR)	SOURCE	METHOD	THEMES
The Development, Validation, and Practical Application of an Employee Agility and Resilience Measure to Facilitate Organizational Change	Braun T.J., Hayes B.C., DeMuth R.L.F., Taran O.A. (2017)	Industrial and Organizational Psychology	Survey, Mathematical Model	Agile (Scale)
The organizational changes required and the challenges involved in adopting agile methodologies in traditional software development organizations	Misra, S. C., Kumar, U., Kumar, V., & Grant, G. (2006)	International Conference on Digital Information Management	Literature Review	Agile Culture
The relationship between organizational culture and the deployment of agile methods	Iivari, J., & Iivari, N. (2011)	Information and Software Technology	Literature Review	Agile Culture
Agile methods and organizational culture: Reflections about cultural levels	Tolfo, C., Wazlawick, R. S., Ferreira, M. G. G., & Forcellini, F. A. (2011)	Journal of Software Maintenance and Evolution: Research and Practice	Survey, Mathematical Model	Agile Culture
Agile practices in global software engineering - A systematic map	Jalali S., Wohlin C. (2010)	2010 5th IEEE International Conference on Global Software Engineering	Literature Review	Agile Practices Tailoring
Influences on agile practice tailoring in enterprise software development	Bass, J. M. (2012)	2012 Agile India	Case Study, Interviews	Agile Practices Tailoring
Agile methods tailoring–A systematic literature review	Campanelli, A. S., & Parreiras, F. S. (2015)	Journal of Systems and Software	Literature Review	Agile Practices Tailoring
The impact of tailoring criteria on agile practices adoption: A survey with novice agile practitioners in Brazil	Campanelli, A. S., Camilo, R. D., & Parreiras, F. S. (2018)	Journal of Systems and Software	Conceptual Model, Survey	Agile Practices Tailoring
Agile methodologies: organizational adoption motives, tailoring, and performance	Tripp F. J., & Armstrong, D. J. (2018)	Journal of Computer Information Systems	Conceptual Model, Survey	Agile Practices Tailoring
Using factor analysis to generate clusters of agile practices (a guide for agile process improvement)	Abbas, N., Gravell, A. M., & Wills, G. B. (2010)	2010 Agile Conference	Survey, Factor Analysis	Bundles of Agile Practices

TABLE 12: SUMMARY OF THE REVIEWED PAPERS (6)

ARTICLE'S TITLE	AUTHOR (YEAR)	SOURCE	METHOD	THEMES
Adopting agile practices in teams with no direct programming responsibility–A case study	Korhonen, K. (2011)	International Conference on Product Focused Software Process Improvement	Case Study	Bundles of Agile Practices
Using Hierarchical Cluster Analysis to Generate Clusters of Agile Practices	Al-Sakkaf, A. M., Hashim, N. L., & Omar, M. (2017)	Journal of Telecommunication, Electronic and Computer Engineering (JTEC)	Survey, Clustering	Bundles of Agile Practices
A survey study of critical success factors in agile software projects	Chow, T., & Cao, D. B. (2008)	Journal of systems and software	Survey	Impact of Agile Practices on Organizations
Agile practices and the promotion of entrepreneurial skills in software development	Tolfo C., Wazlawick R.S., Ferreira M.G.G., Forcellini F.A. (2018)	Journal of Software: Evolution and Process	Conceptual Taxonomy & Literature Review	Impact of Agile Practices on Organizations
Impact of Agile Practices Adoption on Organizational Learning: a Survey in Brazil	Neto, F. S., Rafael, B., de Souza França, R., Ziviani, F., & Parreiras, F. S. (2019)	International Conference on Software Engineering and Knowledge Engineering, SEKE	Survey	Impact of Agile Practices on Organizations
Understanding the Order of Agile Practice Introduction: Comparing Agile Maturity Models and Practitioners' Experience	Nurdiani, I., Börstler, J., Fricker, S., Petersen, K., & Chatzipetrou, P. (2019)	Journal of Systems and Software	Survey	Impact of Agile Practices on Organizations
SCRUM Development Process	Schwaber K. (1997)	Springer, London	Conceptual Model	Agile SCRUM
Why Scrum works: A case study from an agile distributed project in Denmark and India	Pries-Heje L., Pries-Heje J. (2011)	Agile Conference	Case Study	Agile SCRUM
Reflection in agile retrospectives	Andriyani Y., Hoda R., Amor R. (2017)	International Conference on Agile Software Development	Case Study, Interviews, Observation	Agile Practices: Sprint Retrospective
Scrum master activities: Process tailoring in large enterprise projects	Bass J.M. (2014)	IEEE 9th International Conference on Global Software Engineering	Case Study, Interviews	Agile Practices: Scrum Master

TABLE 13: SUMMARY OF THE REVIEWED PAPERS (7)

LITERATURE REVIEW

ARTICLE'S TITLE	AUTHOR (YEAR)	SOURCE	METHOD	THEMES
Obstacles to efficient daily meetings in agile development projects: A case study	Stray V.G., Lindsjorn Y., Sjoberg D.I.K. (2013)	ACM/IEEE International Symposium on Empirical Software Engineering and Measurement	Case Study, Interviews, Observation	Agile Practices: Daily Scrum Meetings
Responsibilities and challenges of product owners at Spotify - an exploratory case study	Kristinsdottir S., Larusdottir M., Cajander Å. (2016)	Human-Centered and Error-Resilient Systems Development	Case Study, Interviews	Agile Practices: Product Owner
Poster: An empirical study of the product owner role in scrum	Bass J.M., Beecham S., Razzak M.A., Canna C.N., Noll J. (2018)	IEEE/ACM 40th International Conference on Software Engineering: Companion	Case Study, Interviews	Agile Practices: Product Owner
Embracing change with extreme programming	Beck K. (1999)	Computer, IEEE	Conceptual Model	Agile Extreme Programming
Extreme programming explained: embrace change	Beck K. (2000)	Book (Addison-Wesley Professional)	Conceptual Model	Agile Extreme Programming
The Costs and Benefits of Pair Programming	Cockburn A., Williams L. (2000)		Interviews, Controlled Experiments, Survey	Agile Practices: Pair Programming
A multiple case study on the impact of pair programming on product quality	Hulkko H., Abrahamsson P. (2005)	Proceedings of the 27th international conference on Software engineering	Multiple case Study	Agile Practices: Pair Programming
Knowledge sharing through pair programming in learning environments: An empirical study	Kavitha R.K., Ahmed M.S.I. (2015)	Education and Information Technologies	Survey, Experiments	Agile Practices: Pair Programming
A structured experiment of test-driven development	George B., Williams L. (2004)	Information and software Technology	Experiments	Agile Practices: Testing
Agile testing: A systematic mapping across three conferences - Understanding agile testing in the XP/agile universe, agile, and XP conferences	Hellmann T.D., Chokshi A., Abad Z.S.H., Pratte S., Maurer F. (2013)	2013 Agile Conference	Literature Review	Agile Practices: Testing

TABLE 14: SUMMARY OF THE REVIEWED PAPERS (8)

ARTICLE'S TITLE	AUTHOR (YEAR)	SOURCE	METHOD	THEMES
Impact of physical ambiance on communication, collaboration and coordination in agile software development: An empirical evaluation	Mishra D., Mishra A., Ostrovska S. (2012)	Information and software Technology	Case Study	Agile Practices: Open Workspace
The effect of agile workspace and remote working on experiences of privacy, crowding and satisfaction	Keeling T., Clements-Croome D., Roesch E. (2015)	Buildings	Case Study	Agile Practices: Open Workspace
Challenges when adopting continuous integration: A case study	Debbiche A., Dienér M., Svensson R.B. (2014)	International Conference on Product-Focused Software Process Improvement	Case Study	Agile Practices: Continuous Integration
Role of collective ownership and coding standards in coordinating expertise in software project teams	Maruping L.M., Zhang X., Venkatesh V. (2009)	European Journal of Information Systems	Case Study	Agile Practices: Coding Standards
The Benefits of the Coding Standards Enforcement and it's Influence on the Developers' Coding Behaviour: A Case Study on Two Small Projects	Popic S., Velikic G., Jaroslav H., Spasic Z., Vulic M. (2019)	26th Telecommunications Forum	Case Study	Agile Practices: Coding Standards
Towards an Effective Onsite Customer Practice	Narang, C. F. R., & Webber, S. K. H. (2002)	Third International Conference on eXtreme Programming and Agile Process in Software Engineering	Literature Review	Agile Practices: On-site Customer
On-Site customer in an XP Project: Empirical results from a case study	Koskela J., Abrahamsson P. (2004)	European Conference on Software Process Improvement	Case Study	Agile Practices: On-site Customer
An empirical study of using planning poker for user story estimation	Haugen N.C. (2006)	AGILE 2006 (IEEE)	Case Study	Agile Practices: Planning Game
A case study on the impact of refactoring on quality and productivity in an agile team	Moser R., Abrahamsson P., Pedrycz W., Sillitti A., Succi G. (2008)	IFIP Central and East European Conference on Software Engineering Techniques	Case Study	Agile Practices: Refactoring
Exploration and exploitation in organizational learning	March, J. G. (1991)	*Organization science*	Conceptual Model	Organizational Ambidexterity

TABLE 15: SUMMARY OF THE REVIEWED PAPERS (9)

LITERATURE REVIEW

ARTICLE'S TITLE	AUTHOR (YEAR)	SOURCE	METHOD	THEMES
Building an ambidextrous organisation	Birkinshaw, J., & Gibson, C. B. (2004)	Advanced Institute of Management Research Paper	Conceptual Model	Organizational Ambidexterity
Can agile and traditional systems development approaches coexist? An ambidextrous view	Vinekar, V., Slinkman, C. W., & Nerur, S. (2006)	*Information systems management*	Conceptual Model	Organizational Ambidexterity
Process ambidexterity for IT entrepreneurship	Bot, S. D., & Renaud, P. E. (2012)	Technology Innovation Management Review	Regression	Organizational Ambidexterity
IT enabled agility in organizational ambidexterity	Röder, N., Schermann, M., & Krcmar, H. (2014)	Conference on Information Systems	Conceptual Model	Organizational Ambidexterity
How does IT ambidexterity impact organizational agility?	Lee, O. K., Sambamurthy, V., Lim, K. H., & Wei, K. K. (2015)	Information Systems Research	Survey, Regression	Organizational Ambidexterity
Reinventing the IT function: the role of IT agility and IT ambidexterity in supporting digital business transformation	Leonhardt, D., Haffke, I., Kranz, J., & Benlian, A. (2017)	European Conference on Information Systems	Survey, Regression	Organizational Ambidexterity
Investigating the Impact of IT Ambidexterity on Digital Innovation Capability	Tai, J. C., Wang, E. T., & Wang, K. (2017)	Pacific Asia Conference on Information Systems	Regression	Organizational Ambidexterity
Individual Ambidexterity and Antecedents in a Changing Context	Zhang, Y. I., Wei, F., & Van Horne, C. (2019)	International Journal of Innovation Management	Survey, Regression	Individual Ambidexterity
Antecedents and effects of individual ambidexterity–A cross-level investigation of exploration and exploitation activities at the employee level	Schnellbächer, B., Heidenreich, S., & Wald, A. (2019)	European Management Journal	Regression	Individual Ambidexterity
Switching hats: The effect of role transition on individual ambidexterity	Tempelaar, M. P.; Rosenkranz, N. A. (2019)	Journal of Management	Survey, Regression	Individual Ambidexterity

TABLE 16: SUMMARY OF THE REVIEWED PAPERS (10)

CHAPTER 6

METHODOLOGY AND RESEARCH QUESTIONS

This chapter presents the underlying research questions and the different methodologies implied in order to answer them and develop the different phases of this research. To answer to the research questions identified, this thesis uses multiple methodologies with the goal of providing answers and insights through different approaches. The methodologies used are the following:

1. <u>Literature Review</u>: it is the first step to better understand the context of the field of study and define gaps in the literature that can be exploited to create more evidence where needed. The review is useful to understand the current state-of-the-art in the research field, to gain introductory knowledge about agile software development and corporate entrepreneurship and to highlight deeper knowledge that is related to the fundamental elements of the research questions.

2. <u>Survey</u>: once the theoretical foundations of this work were acquired, this method allowed to gather quantitative data from the field. The main objective of the survey was the one of quantitively measuring the different attributes from the sample: (I) the level of digital skills, (II) the level of Entrepreneurship, (III), the level of ambidexterity and (IV) the level of adoption of the agile practices that were found to be the most common ones.

3. <u>Mathematical Model</u>: after gathering significant data, the creation of a mathematical model through regression and correlation analysis allowed to answer the research questions that emerged from the literature and quantify the relationship between each component analyzed. The model, however, allowed to find only connections and correlations in the data but not causality.

4. <u>Conceptual Model</u>: this method allowed to make meaningful conclusions to this research by summarizing the findings and creating a tool that could be used both by practitioners in their activities and by researchers to deepen specific aspects. Connections were taken from the mathematical model and causality was attributed considering the research done through the literature.

RESEARCH FRAMEWORK

Among all the methodologies used, some were more fitting to answers than others. It is important, at this point, to understand how each methodology used created an impact to each step of the research process.

	LITERATURE REVIEW	SURVEY	MATHEMATICAL MODEL	CONCEPTUAL MODEL
DEFINING CONSTRUCTS	X			
DEFINING RESEARCH QUESTIONS	X			
DATA GATHERING		X		
ANSWERING RESEARCH QUESTIONS	X		X	X

TABLE 17: RESEARCH METHODOLOGIES USED IN EACH PHASE

First, the literature review was particularly helpful in defining the different concepts used in research as well as identifying gaps in the literature to be filled. Once these constructs were defined, the literature review led to a series of research gaps that guided the definition of some research questions that were explicated in the survey design. Then, data was gathered through a questionnaire and analyzed by means of regression and correlation to identify eventual links and interactions among the measured constructs. Once connections were highlighted, the analysis of the literature was used to complement the analysis of the data to create a unique model of reference that combines data and correlations coming from a empirical evidence and causality coming from a series of studies tested by researchers.

RESEARCH QUESTIONS

From the literature review, there are many themes that emerge. Moving from the concept of entrepreneurship to the concept of digital entrepreneurship, there is a shift of paradigm. Digital technologies, which are the enabling factors of this change, create an increasing complexity but also offer a solution. In a digital environment, in fact, the entrepreneurial process is shorter, more unstructured and uncertain. In this context, digital entrepreneurs are forced to be market oriented and adapt an experimenting approach leveraging on digital technologies. Similarly, agile practices and methodologies, which are based on the scientific method, offer a way to make organizations lighter and more responsive to change, shifting the focus to the customer and to value creation and continuous experimentation. Moreover, organizations need to be ambidextrous by balancing the exploration of new opportunities with the exploitation of current capabilities and strengths. Hence, the research questions of this research are designed to investigate the practical existence of a relationship among four important concepts:

1. **Corporate Entrepreneurship**: measured at the individual level in the forms of Entrepreneurial Intention (willingness to participate in a company's project that could lead to the creation of a new business) and

Entrepreneurial Orientation (presence of entrepreneurial behavioral traits: (1) innovativeness, (2) proactiveness and (3) risk-taking).

2. **Digital Skills**: presence of a set of skills that define the ability of individuals to create value from interactions with digital technologies (internet, social media, ICTs etc.).

3. **Use of agile practices**: number of practices used (Agile Breadth) and the number of practices used in a frequent way (Agile Depth).

4. **Ambidexterity**: focused at an individual level, it measures the capability of employees to combine explorative and exploitative activities.

It is the author's priority to analyze the relationship between the use of agile practices as an example of experimental method and the entrepreneurial level of individuals. It is investigated whether the adoption of agile can help firms to respond to the challenges of digitalization and affect the individuals' orientation towards entrepreneurship. Moreover, the role of individuals' ambidexterity in such context is investigated. The research questions can be expressed though the following hypotheses:

H1: The use of Agile practices is positively associated to individuals' Digital Skills

H2: Individuals' Digital Skills are positively associated to Entrepreneurial Orientation

H3: Individuals' Digital Skills mediate the relationship between the use of Agile practices and Entrepreneurial Orientation

H4: Individual Ambidexterity moderates the relationship between Digital Skills and Entrepreneurial Orientation

CHAPTER 7

SURVEY AND DATA ANALYSIS

This chapter has the goal of presenting the research phase of data gathering and preliminary analysis. First, is illustrated the process of creating a survey, starting from the software, the definition of the different scales used and the description of the resulting dataset. Then, are presented preliminary results about the sample and the control variables together with preliminary tests about the validity, reliability and significance of the data gathered. Finally, are presented the results of factor analysis, preliminary data analysis and the approach of mathematical model is illustrated.

SURVEY

The survey was prepared and delivered by means of the software "Opinio" which allows to create more professional and structured questionnaires than other options like "Google Forms". Regarding the analysis of the data, the software used were primarily Python and SPSS, since they allow to have access to both data visualization tools and statistical/quantitative libraries to perform regression analysis and other statistical techniques.

The software allowed to identify each of the respondents with a "Respondent Id". This allows to uniquely identify individuals, but at the same time keep the survey anonymous and avoid the *desirability bias*, which means the tendency to answer questions in a manner that will be viewed favorably by others.

Regarding the survey's timing, it was initially set to 1 month, but after suggestions from the company's HR, it was reduced to a period of 3 weeks. Respondents were notified of the starting date of the survey and then received two more reminders. The distribution of responses followed 3 main picks: one in the moment the survey was sent, another after the first reminder and the third after the last reminder.

FIGURE 16: DISTRIBUTION OF RESPONSES

SCALES DEFINITION

In the process of creating the survey, one of the first step was to define a way to measure the different attributes included. In this sense, the literature was very important to analyze which are the most used and reliable scales for the purpose.

Control variables consist in a set of 12 items about age, gender, education, tenure, position and background of the respondents (Zhang et al., 2019; Schnellbacher et al., 2019). By definition, they are not particularly interesting to the scope of the survey, but it's important to check if they are related to the dependent variable and if there are evident correlations. In this case, for example, one of the control variables is whether the individual has a parent who is an entrepreneur. Shirokova G. et al. (2016), in fact, show that there is a positive correlation between entrepreneurial intentions and individuals who have families with an entrepreneurial background. Hence, keeping this variable constant, allows to measure the relationship of the other attributes in a more reliable way.

The scale for digital skills consists of a 59 items 5 points Likert scale (where '1' = never and '5' = (almost) always) in which the goal was to measure a series of sub-attributes analyzing the frequency of different behaviors according to van Laar et

al (2018): information management (2 items), information evaluation (3 items), communication expressiveness (3 items), communication sharing (3 items), communication building (3 items), communication networking (8 items), collaboration (11 items), critical thinking (12 items), creativity (6 items) and problem solving (8 items). The scale was taken in its integrity with the exception of the collaboration items that were modified to measure the collaboration through the company's information systems instead of the internet, under suggestion from the company's executives. Moreover, the items about information management were reduced from 3 to 2 because of the nature of the sample. Having selected a company working in the IT sector, in fact, it was necessary to exclude the most basic questions from the survey. Each of the sub-attributes of the scale can be further analyzed to better define what they represent to the research:

- *Information items*: they measure the ability of the individual to manage, access, define and evaluate content through the internet.

- *Communication items*: they assess how digital tools help individuals to transmit information and create networking.

- *Collaboration items*: they are useful to assess how digital technologies are used to promote feedbacks, coordination, participation and sharing within a team or a group of people working together.

- *Critical Thinking items*: they assess the way in which digital technologies foster new ideas or help to justify, clarify and link different arguments.

- *Creativity items*: they assess the level of content creation of each individual and how the internet helps in the generation of new ideas.

- *Problem Solving items*: they assess the processes of knowledge acquisition and knowledge application in the decision-making process to address specific problems.

The scale for individual entrepreneurial intention was an adaptation from Linan & Chen (2009). The 7 items of the original questionnaire, in fact, were directly

asking the intention of individuals to become entrepreneur and to start their own firm. To make the scale more generalizable and the questions less explicit, a scenario was introduced (Monsen et al., 2010). In the scenario it is described a situation in which a company is starting a new innovative project that might become a new independent business and is asking the employee to participate. With the aid of this, the questions were transformed from an explicit version like "I am ready to do anything to be an entrepreneur" to a more implicit one like "I am ready to do whatever it takes to participate to the project." without changing the meaning.

The measurement system for individual entrepreneurial orientation (IEO) was taken from Bolton & Lane (2012), since they were among the first authors in the literature to create a 10 items scale for entrepreneurial orientation at the individual level rather than the organizational one. The scale consists in the measurement of the 3 important sub-attributes defined in the EO literature measured using a 5-point Likert scale (1=strongly disagree to 5=strongly agree):

- *Risk Taking* (3 items): measured as tendency to act "boldly" in specific business situations.

- *Innovativeness* (4 items): measured as tendency to define new approaches when tackling new unexplored problems.

- *Proactiveness* (3 items): measured as tendency to plan ahead and anticipate future problems when solving unknown problems.

Regarding ambidexterity, the scale was taken from Zhang et al. (2019), without adjustments and it consists in a 4 items Likert scale. The reason why such variable has been included in the survey is that the concept of individual ambidexterity suggests that people should work both individually and collaboratively. It's a way to measure whether people are able to work on current tasks efficiently and at the same time explore opportunities effectively. In effective agile teams, in fact, it's critical to maintain a balance between team collaboration and individual autonomy. Therefore, measuring this factor in terms of individual ambidexterity

can be a way to ensure the validity of the survey and ensure that agile principles and values are in place in the sample considered.

Finally, the agility scale is aimed at measuring the adoption of the 25 agile practices selected. As seen from the literature, the majority of the measurement systems are very straight forward and are either assessing the use (yes or no) or the frequency. For this reason, the scale was build starting from the concept of breadth and depth (Laursen & Salter, 2006) that was first used for open innovation. In this context, *breadth* can be identified as weather the individual uses the practice, or not, while *depth* is the usage degree of each in a scale from 1 to 5. The combination of both measures gives the scale more credibility and more practical use also with respect to what emerged in the literature. For the sake of completeness, it was also included the option "I use no specific practice but I follow the agile principles". In this case the depth and breadth of single practices wasn't considered.

AGILE

AGILE BREADTH

AGILE DEPTH

DIGITAL SKILLS

COMMUNICATION

COLLABORATION

CREATIVITY

PROBLEM SOLVING

CRITICAL THINKING

INFORMATION MANAGEMENT & EVALUATION

ENTREPRENEURIAL ORIENTATION

PROACTIVENESS

INNOVATIVENESS

RISK-TAKING
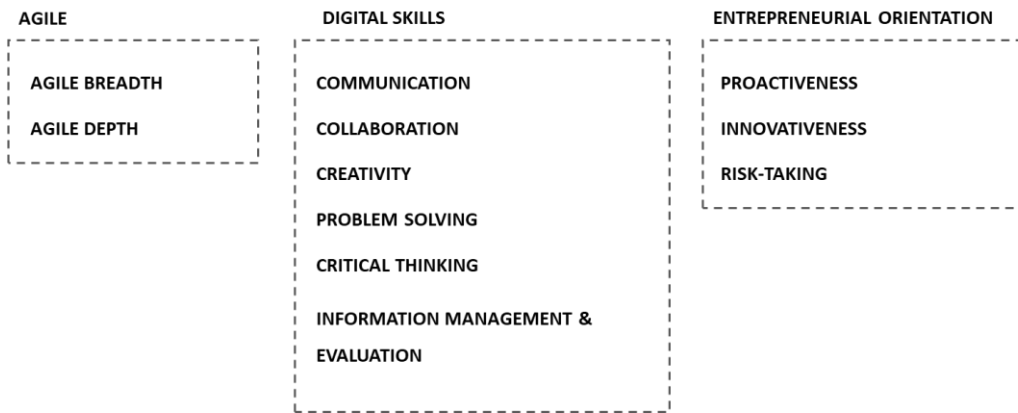
FIGURE 17: SUMMARY OF SUB-SCALES

DATASET DESCRIPTION

Given the format of the survey, overall, the total number of items consists in 12 control variables, 59 digital skills attributes, 10 entrepreneurial orientation attributes, 6 university collaboration attributes, 4 individual ambidexterity attributes, 53 agility attributes (25 of which about agility breadth and 25 about

agility depth) and 7 attributes about entrepreneurship. However, the initial dataset was composed by 150 attributes, because other than the 145 valuable ones, there were also some variables to account for alternative answers (selection of "other" among the choices). Besides, the initial dataset included some attributes that were hidden by survey branching. For example, if someone would respond "Bachelor's degree" to the education question, next they would have to answer the question with a list of specific fields of study instead of a list of diploma types. However, the dataset had to include all the variables. For this reason, it was necessary to clean the dataset afterwards to account for the high presence of missing values created by design of the survey.

In terms of number of observations, the survey was issued in collaboration with a medium-large size company working in information technology whose mission is to provide innovative IT solutions to private and public actors in the Italian landscape. To make the research relevant also in terms of statistical significance, it was possible to target the entire organization which was estimated to be about 1500 people. After 18 days, the response rate was about 20% with a total amount of completed responses of 299.

The resulting initial datasets consists in a matrix with dimensions (299x146) containing both categorical and numerical variables. In particular, the numerical variables could be classified into both continuous (variables like age or tenure) and ordinal (variables related to the measured scales), while the categorical were mainly those related to control variables (i.e. gender, study title, company position and family background).

DATA CLEANING & PREPARATORY TESTS

The first important step in the process of analyzing the data from the survey and finding quantitative insights through multiple regression models, correlation and visualization is cleaning the data gathered in a way that makes them easier to process. This has a significance both from a conceptual and from a technical point of view.

Technically speaking, in fact, it wasn't possible to just process the data AS IS and get to a meaningful result. The first big issue was in the fact that the target variable of the regression (or the dependent variable in the equation) was made up more than one attribute. However, in order to properly work, the regressor needs to have as input only 1 numerical attribute. For this reason, it was necessary to combine different variables into one by making the mathematical average. Moreover, some of the regressors are not able to handle categorical attributes on their own, since their algorithm is numerical based. To solve this second issue, all the categorical attributes needed to be converted into the so-called "dummy variables". These are variables that simply take all the possible different string values that an attribute can have and convert it into another column of the dataset. For each of those new columns, the observation will have a value of 1 if the old string-value corresponds to the column or 0 otherwise.

Furthermore, since the survey contains branching, some of the questions were mutually exclusive. This means that by default the dataset has a certain amount of NaN values in particular regarding the control variables. Hence, it was important to aggregate the couples of mutually exclusive variables into 1 so that every respondent would have a unique answer, eliminating the empty values.

Conceptually speaking, it is important to understand which is the best level of aggregation for the different predictors. In fact, from the way the survey was designed, each of the constructs that has been measured is composed of different items, each corresponding to one answer in the survey. From a conceptual and mathematical point of view there is a difference in treating hundreds of variables or just few. For this reason, to ensure simplicity and interpretability of the results, it was important to understand how to aggregate the various constructs trough factor analysis.

Moreover, all the attributes, except the control variables, had to be standardized to reduce the likelihood of multicollinearity (Cohen et al., 1983) and to ensure the quality of the model by giving the same weight to all the variables measured. In fact, to prepare data for the regression model, it's critical that the predictive variables are not linearly correlated to one another, otherwise the significance of the model is compromised. This is particularly relevant when testing models of linear regression. Instead, other models like the hierarchical one or the neural network regressor can handle this issue on their own, so they are not affected in

any way by the standardization. For these reasons, the data was standardized by means of the min-max operator:

$$\text{Min-max:} \quad x'_{ij} = \frac{x_{ij} - x_{min\,i,j}}{x_{max\,i,j} - x_{min\,i,j}} \left(x'_{max\,ij} - x'_{min\,ij} \right) + x'_{min\,ij}$$

In this case it was set $x'_{max\,ij} = 5$ and $x'_{min\,ij} = 1$ so that all the values were reduced to a scale from 0 to 5. This choice was driven by the fact that the majority of the scales used were already ranging from 1 to 5, while few others like entrepreneurial intention or ambidexterity were ranging from 1 to 7. At this point, it was necessary to check for reliability, validity and non-response bias in the sample gathered.

According to Churchill (1979), in fact, a research process that involves any sort of data gathering and analysis, can be identified by many phases and it is very important to follow them to ensure that any result that is presented can hold its validity and be valuable for a research field.
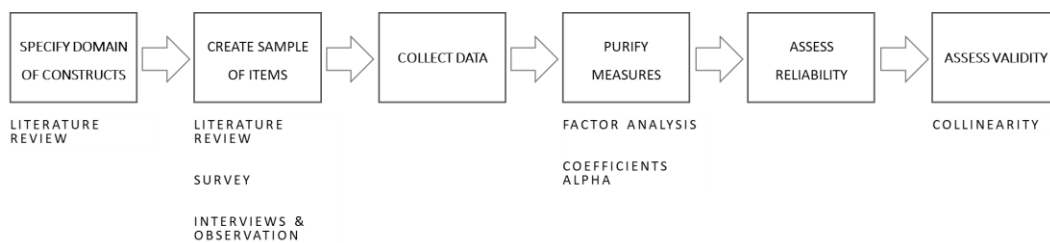
FIGURE 18: RESEARCH PROCESS. ADAPTED FROM CHURCHILL (1979)

Since the used variables are derived from survey data, several measures were taken to mitigate concerns of common method bias (Kammerlander et al., 2015). First, in designing the survey, was decreased the respondents' motivation to provide answers driven by social desirability by assuring strict confidentiality, anonymity and embedding questions related to our variables in a comprehensive survey. Second, an exploratory factor analysis was performed to ensure that no

dominant factor explained variance in our sample (which would indicate the presence of common method bias). The largest factor, in fact, explained less than 28% of the total variance. Further, a confirmatory factor analysis showed that the data structure proposed in the study fits the data significantly better (as revealed by Chisquared test) than a model with only one dominant factor. For these reasons, it is possible to conclude that the risk of common method bias is low. Moreover, it was important to check for non-response bias. The <u>non-response bias</u> refers to the possibility that people who didn't respond to the survey are very different from people who responded. This creates a problem of sample significance and generalization of the results, therefore it is something that must be tested, particularly since the survey got a 20% rate of response when compared to the entire population. In this case, the non-response bias was tested by comparing two sub-samples: early respondents and late respondents (Borg & Tuten, 2016). Early respondents were considered as those who completed the survey within the first 9 days (245 individuals), while late respondents as all the remaining (60 individuals). The division was made considering the median value between the first and last day in which responses were gathered. However, due to the non-homogeneous distribution of responses the two sub-samples are not made of the same number of observations each.

In a T-test, the null hypothesis can be expressed as:

$H_0: \mu_1 = \mu_2$ (i.e. the two samples' means are equal)

In order to perform the T-test, however, the assumption of homogeneity of variance (i.e., both groups have the same variance), needs to be tested. In this situation the assumption was tested through the Levene's Test.

In Levene's Test the null hypothesis can be expressed as:

$H_0: \sigma_1^2 - \sigma_2^2 = 0$ (i.e. the two samples' variances are equal)

To make the test, it was necessary to transform the categorical demographic variables into ordinal numerical ordinal variables so that it could be possible to compute averages and test for their similarity. In particular:

- **Gender**: Male = 1, Female = 0.

- **Education**: Diploma = 0, Bachelor's Degree = 1, Master's Degree = 2, Postgraduate Degree = 3 and Other = 4.

- **Company Role**: Operations-Delivery = 1, Software Factory = 2, Sales = 3, Solution Factory = 4, Administration, Accounting, Control = 5, Marketing & communication = 6 and Other = 0.

The remaining variables (age and years employed), instead, were already numerical, hence it was possible to compute the tests without further manipulation on the data. Results of the different tests are reported in table 18. For each variable are reported the number of observations in each sub-sample, their mean and the p-values of both the Levene's Test and the T-Test. Looking at the p-value for both tests, it is possible to conclude that the two samples do not have significantly different means nor variances in all the demographic variables tested, therefore it is possible to reject the risk of non-response bias in the population of the survey.

	N	MEAN	LEVENE TEST P-VALUE	T-TEST P-VALUE
GENDER			0.92	0.73
GROUP 1 (EARLY RESP.)	229	0.66		
GROUP 2 (LATE RESP.)	70	0.68		
AGE			0.58	0.13
GROUP 1 (EARLY RESP.)	229	45.8		
GROUP 2 (LATE RESP.)	70	47.7		
TENURE			0.28	0.57
GROUP 1 (EARLY RESP.)	229	12.1		
GROUP 2 (LATE RESP.)	70	12.8		
EDUCATION			0.34	0.48
GROUP 1 (EARLY RESP.)	229	1.8		
GROUP 2 (LATE RESP.)	70	1.9		
POSITION			0.47	0.24
GROUP 1 (EARLY RESP.)	229	0.4		
GROUP 2 (LATE RESP.)	70	0.5		

TABLE 18: NON-RESPONSE BIAS TESTS

FACTOR ANALYSIS

Once the dataset was ready to be processed, it was necessary to check some conceptual assumptions. It was important to check the internal consistency and validity of the scales used through factor analysis (Nunnally & Bernstein, 1994). In this case, in fact, even though the measurement systems were taken almost in their integrity by reliable sources from the literature, it was still important to check their reliability particularly since they have been combined in an original way that was never tested before. The scales can be considered reliable if taken one by one, but when combined reliability needs to be checked. Moreover, this kind of analysis can help to define in which way the items should be aggregated by highlighting eventual correlations within the data that would be otherwise hard to spot. Even when theory indicates a specific number of factors, it can be useful to inspect a range of factors solutions to validate the insights provided by the literature.

The sample size (299 observations) would be classified as "good" according to Comrey & Lee (1992), who defined thresholds as a guideline for sample size: 50 being considered as very poor, 100 as poor, 200 as fair, 300 as good, 500 as very good, and 1,000 as excellent. While it is not uncommon to find such rules of thumb in the factor analytic literature, it is much less common to find consistent recommendations and guidelines to follow.

Since the survey was composed of different scales taken from the literature, it was enough to check the constructs by means of confirmatory factor analysis (CFA) to understand if there is a correspondence between the conceptual scales and the data. Factors were chosen to check the correspondence between the dataset and the following conceptual items:

1. Digital Skills (59 items)
   - Information Management (2 items)
   - Information Evaluation (3 items)
   - Communication Expressiveness (3 items)
   - Communication Sharing (3 items)
   - Communication Building (3 items)
   - Communication Networking (8 items)
   - Collaboration (11 items)

- o Critical Thinking (12 items)
- o Creativity (6 items)
- o Problem Solving (8 items)

2. Ambidexterity (4 items)

3. Entrepreneurial Intention (7 items)

4. Individual Entrepreneurial Orientation (10 items)
   - o Risk-taking (3 items)
   - o Innovativeness (4 items)
   - o Proactiveness (3 items)

In this case, since the items related to agile (Breadth and Depth) consisted only in a checklist measuring the use and the eventual extension of use of agile practices, those items were not considered for the factor analysis because they were not directly measuring conceptual constructs but only practical adoption of specific practices. Factor analysis is a statistical technique for data reduction. It is used to group together items that are conceptually similar by testing the correspondence between indicators, or scores, and factors, presumed to affect those scores. In every factor analysis, there are potentially the same number of factors as there are variables, where each factor captures a certain amount of the overall variance in the observed variables, and the factors are always listed in order of how much variation they explain. The simplest solution for this kind of analysis is to create a model with a single factor that explains the conceptual construct and at the same time explains enough variance to be considered significant. However, the number of factors is usually determined in a more structured way. In particular, when considering exploratory factor analysis (EFA) factors are determined through statistical criteria, while when considering confirmatory factor analysis (CFA), the number of factors can be determined by previous researches and theories. The statistical criterion used for determining the number of retained factors is the eigenvalue rule (Kline, 2013). The eigenvalue is a measure of how much of the variance of the observed variables a factor explains. Any factor with an eigenvalue ≥ 1 explains more variance than a single observed variable. According to Kaiser criterion only such factors should be retained, so that it assured that every factor

contributes more with respect to single items. However, in this research the scales have been taken by the literature, therefore it is already well known what is the conceptual meaning behind each item. In table 19 are reported the results of the factor analysis. For each construct are reported the number of items, how many factors they were transformed into and how much variance is explained by the retained factors. In particular, the latter was greater than the cut-off value of 0.5 for all constructs besides Digital Skills.

CONSTRUCT	# ITEMS	#FACTORS	VARIANCE EXPLAINED
ENTREPRENEURIAL INTENTION	7	1	78.6 %
AMBIDEXTERITY	4	1	91.6 %
INDIVIDUAL ENTREPRENEURIAL ORIENTATION	10	1	54.8 %
DIGITAL SKILLS	59	1	37.2 %

TABLE 19: OVERVIEW OF FACTOR ANALYSIS RESULTS

However, the scale of Digital Skills is made of many sub-attributes each conceptually different from the other. For this reason, the level of variance explained was considered satisfactory. To prove the validity of the scale, table 20 reports a factor analysis performed on each sub-attribute of Digital Skills.

CONSTRUCT	# ITEMS	#FACTORS	VARIANCE EXPLAINED
DIGITAL SKILLS			
INFORMATION MANAGEMENT	5	1	65.2 %
COMMUNICATION	17	1	65.7 %
PROBLEM SOLVING	8	1	85.9 %
COLLABORATION	11	1	78.7 %
CRITICAL THINKING	12	1	79.1 %
CREATIVITY	6	1	88.1 %

TABLE 20: FACTOR ANALYSIS (COMPONENTS OF DIGITAL SKILLS)

Following the factor analysis, items in the same factor must be aggregated. In this case items within each factor had similar loading ranges, hence it was possible to aggregate items by computing their average.

SAMPLE AND PRELIMINARY ANALYSIS

Since the survey was issued to the entire population of a company, in order to better understand the sample, it is important to perform an exploratory data analysis to define the distribution of the different demographic variables measured. Most of the control variables in the dataset, were already designed as categorical variables (e.g., gender, role, business function, study title), but the remaining ones were discretized to reduce complexity. Results (table 21) show that the sample contains more males (67%) than females (33%) mostly between the ages of 31 and 60. There is also a wide distribution of tenure, ranging from 0-3 years to more than 30. The majority of the sample consists on employees, however there is a wider distribution regarding the role or business function in which individuals operate. This potentially allows to have good generativity of the results, since the sample gathered covers individuals with very different tasks and skills. Regarding the business function, low frequency entries were grouped together into the "Other" category. Therefore, it includes job positions like consulting, human resources, R&D, IT and project management. Finally, the variable "study title" shows that the majority of the respondents has a diploma (53%), but also that a good portion has a Postgraduate Degree (30%).

It was important also to check the distribution of other "concept-specific control variables", which in this case means attributes that are related to the dependent variables. This allows to judge whether the target variable of the model is influenced by the effect of the independent variables or by other factors. The entrepreneurial background of respondents, for example, has been considered by Fayolle & Liñán (2014) as determinant of an individual's entrepreneurship. Hence, including it in the analysis allows to control the effect of the other variables that are used as predictors. However, there is a small percentage of the sample previously active in entrepreneurial activities or with a family member who is an entrepreneur.

	N	%
Gender		
Male	200	67%
Female	99	33%
Age		
21-30	27	9 %
31-45	96	32 %
46-60	164	55 %
>60	12	4 %
Tenure		
0-3	75	25 %
4-9	56	19 %
10-19	91	30 %
20-29	63	21 %
≥30	14	5 %
Study Title		
Diploma	157	52.5 %
Bachelor's degree	40	13.4 %
Postgraduate degree	93	31.1 %
Higher	6	2 %
Other	3	1 %
Role		
Employee	195	65.3 %
Manager	80	26.7 %
Senior manager	16	5.3 %
Other	8	2.7 %
Entrepreneurial Background (family)		
No	254	85 %
Yes	45	15 %
Previous entrepreneurial activities		
No	266	89 %
Yes	33	11 %

TABLE 21: SAMPLE CHARACTERISTICS AND CONTROL VARIABLES (N=299)

Having defined the sample and validated the conceptual components of the dataset, it is possible to better understand the characteristics of the independent variables measured. First, it is necessary to evaluate the reliability of the scales adopted and previously tested. Reliability can be defined as the degree to which measures are free from error and yield consistent similar results under consistent conditions. The degree of reliability of measures of attitudes, emotions, opinions and personalities should be assessed to validate the robustness of the results produced by scientific research (Peter, 1979). In this research, the various constructs analyzed are all made of multiple items each. Therefore, there is the potential to check the internal consistency reliability, which is applied to groups of items that measure one construct and examines the homogeneity of the variables (Gliem & Gliem, 2003).

Besides starting from scales that have been already validated in previous researches, the reliability has been checked for each construct using Cronbach's (1951) coefficient alpha, which is widely recommended for measuring internal consistency (Gliem & Gliem, 2003). Cronbach's alpha ranges between 0 and 1 and generally increase as the inter-correlations among test items increases. Therefore, the closer Cronbach's alpha coefficient is to 1 the greater the internal consistency of the items in the scale. George & Mallery (2003) provide the following rules of thumb for evaluating the Cronbach's alpha: "≥0.9 – Excellent; ≥0 .8 – Good; ≥ .7 – Acceptable; ≥0.6 –Questionable; ≥0 .5 – Poor; and <0.5 – Unacceptable" (p. 231). Table 22 reports the results of the reliability analysis for each construct under analysis, together with the number of items of each and the source it was taken from.

CONSTRUCT	# ITEMS	ALPHA	SOURCE
ENTREPRENEURIAL INTENTION	7	0.90	Linan & Chen (2009)
ENTREPRENEURIAL ORIENTATION	10	0.817	Bolton D.L. & Lane M.D. (2012)
AMBIDEXTERITY	4	0.808	Zhang et al. (2018)
DIGITAL SKILLS	59	0.965	Van Laar E. et al. (2018)

TABLE 22: CRONBACH'S ALPHA COEFFICIENTS

As a general rule of thumb, scales are deemed to be internally consistent when the Cronbach alpha is above 0.7 (Nunnally & Bernstein, 1994). Therefore, all the scales included in the research can be considered as reliable since the minimum value reported is 0.811.

Having validated the construct, it is possible to understand in a more detailed way the different constructs measured and to define even more the sample and set up the research analysis.
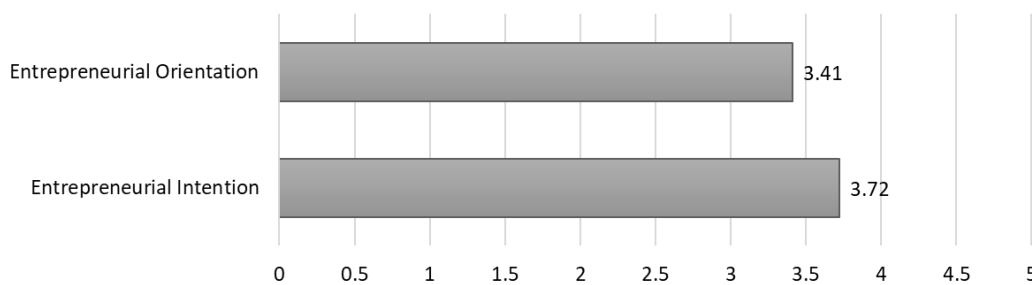
FIGURE 19: MEANS OF ENTREPRENEURIAL VARIABLES

Looking at the means of the entrepreneurial variables (in a scale from 1 to 5), it's possible to confront the results of the sample with the literature. Specifically, considering Entrepreneurial Orientation, the literature defines as mean values 2.94 Wiklund & Shepherd (2011) and 2.86 Anderson et al. (2009) on a sample of professionals in a multitude of industries. This means that the sample gathered performed over the average values found in the literature, with a mean of 3.41.

Considering the Entrepreneurial Intention, instead, benchmark values made on a population of students find that the mean is 2.85 (Hahn et al. 2018), therefore even in this case the sample performs better with an average of 3.72.

This means that the sample has a positive score of both Entrepreneurial Intention and Orientation. In terms of research this means that the sample has a positive performance in the target variables and that the analysis in this scenario should be aimed at understanding which among the measured variables is more responsible for the results.

Looking at the variables related to agile (Agile Breadth and Agile Depth), the sample means are reported in figure 20. In this case, however there is not an available benchmark because prior to this research, there is no use of the concepts of breadth and depth related to agile practices in the literature.

However, considering that both are measured in a scale from 0 to 25, the sample averages seems small relatively to their scale.
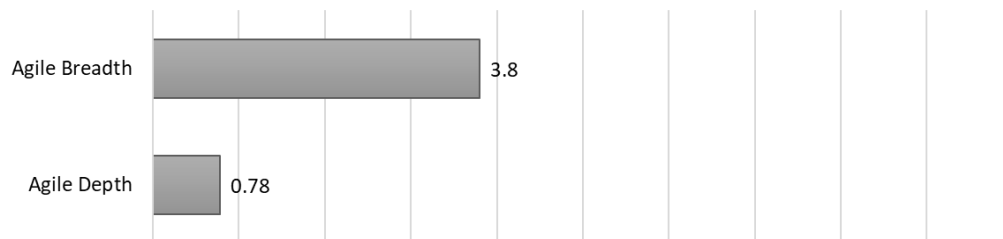
FIGURE 20: SAMPLE MEAN OF AGILE BREADTH AND AGILE DEPTH

A hypothetical reason for this behavior is the fact that the sample of respondents agile is less than the sample non-agile, hence the overall mean tends to decrease.

MODEL SPECIFICATION

In order to develop a mathematical model, multiple hierarchical regression analysis (Cohen et al., 1983) was used to test and verify the research questions. In this methodology of regression, starting from a base model including only the control variables, the remaining variables are added according certain criteria. Once variables are added, the effect on the model's R^2 and the significance are measured, and conclusions can be drawn about the impact of the new variables.

The first hypothesis is tested using Digital Skills as dependent variable. Control variables are entered in step 1 while the variables for Agile Breadth and Depth are

entered in step 2 to examine their effect on the model's R-squared. Similarly, the second and fourth hypothesis can be tested by using Entrepreneurial Orientation as dependent variable. First are inserted the control variables, then the variables related to Digital Skills and Ambidexterity one at a time. Finally, to test for the moderation, the interaction between Digital Skills and Ambidexterity is included to see if it is significant or not for the final model (Hayes, 2013). If the interaction variable is significant, moderation occurs.

In general, the hypothesis testing process follows a series of steps which can be synthesized as follows:

[HP1 STEP 1]

$$Digital\ Skills\ = B_0 + B_1(Age) + B_2(Gender) + B_3(Tenure) + B_4(Study\ Title) + B_5(Company\ Position) + B_6(Entrepreneurial\ Experience) + B_7(Familiy\ Background)$$

[HP1 STEP 2]

$$+B_8(Agile\ Breadth) + B_9(Agile\ Depth)$$

Similarly, the 2nd and 4th hypothesis were tested using the same approach. In fact, step 1 of this process is common to all the mentioned hypothesis, with the only difference of the target variable.

[HP2 AND HP4 STEP 1]

$$Entrepreneurial\ Orientation\ = B_0 + B_1(Age) + B_2(Gender) + B_3(Tenure) + B_4(Study\ Title) + B_5(Company\ Position) + B_6(Entrepreneurial\ Experience) + B_7(Familiy\ Background)$$

[HP2 AND HP4 STEP 2]

$$+B_7(Digital\ Skills)$$

[HP2 AND HP4 STEP 3]

$$+B_8(Ambidexterity)$$

[HP2 AND HP4 STEP 4]

$$+B_9(Digital\ Skills\ x\ Ambidexterity)$$

To test and validate the presence of mediators, it was strictly followed the conventional procedure (Baron & Kenny, 1986; Preacher & Hayes, 2004). In fact, this research aims at empirically defining the relationship between the use of agile practices and individuals' entrepreneurship in a digital context. Hence, in this setting, Digital Skills may represent a potential mediator of the relationship.

In general, the adoption of agile practices is something exogenous, meaning that it is decided by the organization and not by single individuals. On the other hand, digital skills can always be enhanced and improved in an endogenous way, since they represent the ability of people to take advantage of digital tools. For these reasons, the direction of the mediation, if it exists, could only be one way: digital skills mediate the use of agile and not the other way around.

A variable, or a set of variables, can be defined as "mediator" if it accounts for the relation between the predictor and the target variable (Baron & Kenny, 1986). Figure 21 represents both the effect of a causal variable (X) on a target variable (Y), and the simplest model of mediation where a variable (M) mediates the effect of X on Y.

In this setting, it is called "total effect" of variable X on variable Y the simple relationship denoted by path c (Direct Effect). The relationship denoted by path c', instead, represents the "direct effect" of variable X on variable Y after controlling for the mediation of variable M. The amount of mediation is called "indirect effect" and it come out of the multiplication of *path a* and *path b*. The relationship among direct effect, indirect effect, and total effect can be expressed by the equation:

$$total\ effect = direct\ effect + indirect\ effect\ (\textbf{\textit{OR in symbols}}\ )\ c = c' + ab$$

In order to verify the presence of mediation, four criteria have to be met (De Carolis et al., 2009):

- *Criterion 1*: the independent variable (X) must significantly affect the dependent variable (Y) when the mediator is not included in the equation (path c ≠ 0).

- *Criterion 2:* the mediator variable (M) must significantly affect the dependent variable (Y) (path b ≠ 0).

- *Criterion 3:* the independent variable (X) must significantly affect the mediator variable (M) (path a ≠ 0).

- *Criterion 4:* the effect of the independent variable (X) on the dependent variable (Y) controlling for the mediator variable (M) should be zero (path c′ = 0).

DIRECT EFFECT

MEDIATING EFFECT
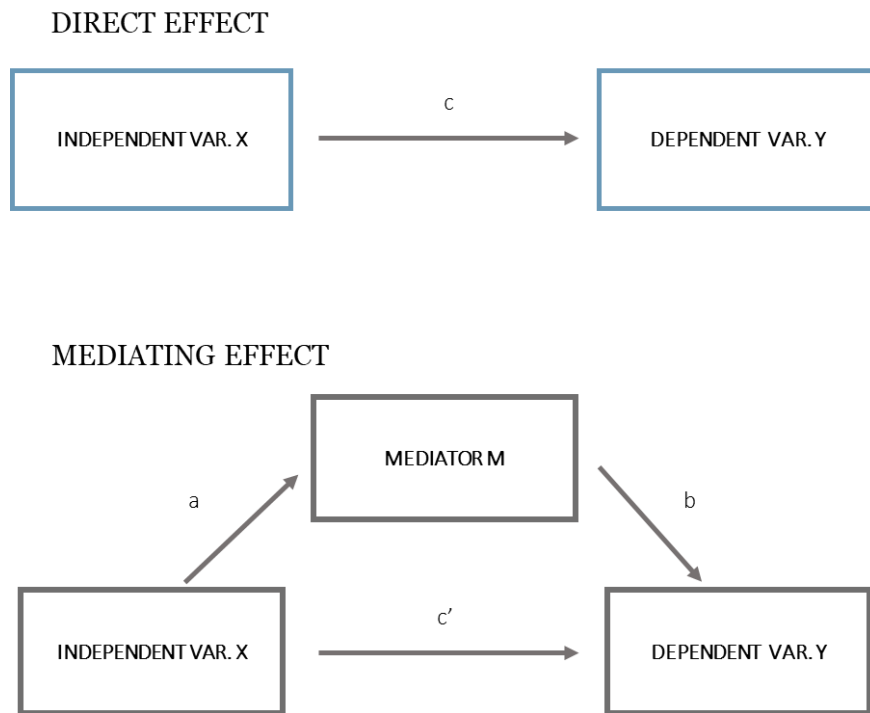
FIGURE 21: ILLUSTRATION OF DIRECT EFFECT AND MEDIATION

If all the four criteria are met, then the data are consistent with the hypothesis that variable M mediates the relationship between an independent variable X and a dependent variable Y. According to Baron & Kenny (1986) all these criteria have to be met to verify the mediation, however most contemporary scholars believe that criteria (2) and (3) are sufficient to establish the existence of mediation. In particular, if criterion (4) is verified (i.e. the inclusion of variable M reduces the effect of X on Y to zero), full mediation or perfect mediation (Preacher & Hayes, 2004) has occurred. However, this is not an essential condition, because even when the effect of X on Y decreases but not to zero, then partial mediation is said to have occurred. Moreover, criterion (1) has been argued not to be essential (Shrout & Bolger, 2002) since there could still be mediation if a consistent theoretical background about their relationship is proved.

Compared to a research that study whether and to what extent one variable affects another, adding mediators elevates the analysis by offering a deeper understanding of the entire process that produces the effect.

CHAPTER 8

RESULTS

This chapter presents the results obtained from the proposed empirical study. First, it presents a brief overview of the descriptive statics, highlighting correlations among the selected variables. Then are illustrated the results of the mediation test following the four steps discussed in the previous chapter. Finally, are discussed the main findings and contributions to the literature.

EMPIRICAL MODEL

The first results arise from the evaluation of table 23 that shows the mean, standard deviation, and correlation scores of the selected variables. In the table the variables are all reduced to a scale from 1 to 5 with exceptions of:

- **Age and tenure**: continuous numerical variables

- **Gender**: 1 = Male, 0 = Female

- **Study Title**: from 0 to 4, the higher the value, the higher the education level

- **Family Background**: 1 = having an entrepreneurial parent, 0 = otherwise

- **Entrepreneurial Experience**: 1 = previous entrepreneurial experience, 0 = otherwise

- **Position**: from 0 to 3. The higher the value, the higher the position in the company (0 represent employees and 3 represents top managers).

Looking at the entrepreneurial variables (both intention and orientation), there is a strong correlation between the two. Moreover, both seem to be correlated with Agile Breadth and Digital Skills.

Moreover, looking at the agile variables, there is a significant correlation of Breadth and Depth with Digital Skills. This calls for further validation and proof of the hypothesis that Digital Skills might be a mediator for the use of agile practices. It is also notable that both Agile Breadth and Depth seems to have significant standard deviations. However, this can be explained by what emerged in the preliminary analysis. Since the sample of respondents agile is less than the sample non-agile, the overall mean tends to decrease, and the standards deviation increases.

VARIABLES	MEAN	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13
ENTREPRENEURIAL ORIENTATION	3.40	0.58	1												
ENTREPRENEURIAL INTENTION	3.72	0.80	0.53**	1											
DIGITAL SKILLS	3.30	0.58	0.51**	0.33**	1										
AGILE BREADTH	3.80	5.80	0.18**	0.12**	0.27**	1									
AGILE DEPTH	0.78	2.67	0.11**	0.01	0.17**	0.46**	1								
AMBIDEXTERITY	3.41	0.95	0.59**	0.43**	0.49**	0.16**	-0.02	1							
AGE	46.26	9.48	0.007	-0.06	-0.1	-0.07	-0.04	0.01	1						
TENURE	12.29	9.08	-0.08	0.01	-0.18**	0.006	0.003	-0.09	0.41**	1					
STUDY TITLE	1.85	0.99	0.11**	0.04	0.17**	0.13**	0.001	0.11*	0.008	-0.13*	1				
GENDER	0.67	0.47	0.09	0.11*	0.18**	0.13*	0.08	0.10*	0.05	-0.08	-0.08	1			
POSITION	0.45	0.72	0.16**	0.12**	0.17**	0.06	-0.04	0.25**	0.38**	0.07	0.22**	0.020	1		
FAMILY BACKGROUND	0.15	0.36	0.07	0.01	0.13*	-0.07	-0.03	0.12*	0.003	-0.03	0.04	-0.08	0.06	1	
ENTREPRENEURIAL EXPERIENCE	0.11	0.31	0.09*	0.07	0.09	-0.06	-0.05	0.10*	0.24**	-0.10	-0.04	0.157*	0.20**	0.09	1

TABLE 23: MEAN, STANDARD DEVIATIONS AND CORRELATION OF THE VARIABLES

Having cleared that there is a significant relationship among the measured variables, it is necessary to verify the validity of the research questions. In this

sense, the first step would be to analyze the relationship between the use of agile practices and the individuals' digital skills testing the following hypothesis:

H1: *"The use of Agile practices is positively associated to individuals' Digital Skills"*

From a practical perspective, this means defining the relationship between Agile Breadth, Agile Depth and Digital skills through regression. The result of the multiple hierarchical regression is reported in table 24. In model 1 the target variable is predicted through the control variables, in model 2 only the variable of Agile Breadth is added, in model 3 only Agile Depth is considered and finally in model 4 both are inserted. This order has been taken since Agile Breadth measures the number of agile practices used and Agile Depth measures the number of agile practices used in a frequent way. This means that the second variable includes the first adding deeper mechanisms.

Comparing the various models, both Agile Breadth and Agile Depth are significant when considered separately. Considering models 2 and 3, in fact, there is an increase in R^2 with respect to the base model from 0.144 to 0.192. In the final model, however, the variable of Agile Depth is not statistically significant, but it instead reduces the significance of Agile Breadth since the increase in R^2 with respect to model 2 is almost null. Analyzing the control variables, the ones that show significance are the work position, the gender and the family background, which are significant at p<0.01.

Looking at the results, hypothesis 1 can be verified. However, results show that only Agile Breadth is significant, while Agile Depth isn't. This means that an individual's digital skills are positively affected by the number of agile practices used but not from how many practices are used frequently.

Having defined the relation between Agile practices and Digital Skills, it's important to clarify the relationship between the latter and the level of Entrepreneurial Orientation. In particular, the following hypothesis needs to be tested:

H2: *"Digital Skills have a positive impact on Entrepreneurial Orientation"*

RESULTS

VARIABLES	MODEL 1	MODEL 2	MODEL 3	MODEL 4
	B	B	B	B
CONSTANT	3.388*** (0.187)	3.291*** (0.183)	3.352*** (0.184)	3.291*** (0.183)
AGE	-0.009* (0.004)	-0.007 (0.004)	-0.008 (0.004)	-0.007 (0.004)
GENDER	0.232** (0.068)	0.188** (0.067)	0.212** (0.067)	0.186** (0.067)
TENURE	-0.006 (0.004)	-0.007 (0.004)	-0.006 (0.004)	-0.007 (0.004)
STUDY TITLE	0.078* (0.033)	0.060 (0.033)	0.077* (0.032)	0.063 (0.033)
POSITION	0.147** (0.049)	0.130** (0.048)	0.149*** (0.048)	0.134** (0.048)
ENTREPRENEURIAL EXPERIENCE	0.098 (0.109)	0.121 (0.106)	0.112 (0.107)	0.124 (0.106)
FAMILY BACKGROUND	0.204* (0.089)	0.227** (0.087)	0.209** (0.087)	0.226** (0.086)
AGILE BREADTH		0.023*** (0.005)		0.019** (0.006)
AGILE DEPTH			0.036*** (0.011)	0.018 (0.013)
R-SQUARED	0.144	0.192	0.172	0.198
R-SQUARED ADJ.	0.123	0.170	0.149	0.173

$*p<0.05$; $**p<0.01$; $***p<0.001$, Predicted Variable: **Digital Skills**

Standard errors in parentheses

TABLE 24: REGRESSION MODEL HYPOTHESIS 1

In order to test the second hypothesis, a similar approach is used. However, in this instance the predicted variable is the individuals' Entrepreneurial Orientation. Results of the different models are reported in table 25.

VARIABLES	MODEL 1	MODEL 2
	B	B
CONSTANT	3.393*** (0.198)	1.687*** (0.254)
AGE	-0.004 (0.004)	0 (0.004)
GENDER	0.113 (0.072)	-0.004 (0.065)
TENURE	-0.003 (0.004)	0 (0.004)
STUDY TITLE	0.043 (0.035)	0.004 (0.031)
POSITION	0.128* (0.052)	0.054 (0.047)
ENTREPRENEURIAL EXPERIENCE	0.104 (0.115)	0.055 (0.102)
FAMILY BACKGROUND	0.102 (0.094)	-0.001 (0.084)
DIGITAL SKILLS		0.503*** (0.055)
R-SQUARED	0.056	0.269
R-SQUARED ADJ.	0.033	0.249

*$p<0.05$; **$p<0.01$; ***$p<0.001$, Predicted Variable: **Entrepreneurial Orientation**

Standard errors in parentheses

TABLE 25: REGRESSION MODEL HYPOTHESIS 2

Similarly, model 1 presents a regression with control variables, while model 2 shows the effect of adding the variable related to Digital Skills as a predictor of Entrepreneurial Orientation.

Compared to the first model, the second shows a significant increase in R^2 from 0.056 to 0.269. An increase of R^2 equal to 0.213 can be considered as an important improvement in the prediction. Looking at the significance level of the predictors, Digital Skills have a confidence of p<0.001, while the remaining control variables have no significance.

The results therefore allow to confirm hypothesis 2, concluding that Digital Skills have a positive effect on individuals' Entrepreneurial Orientation.

Having validated the relationship between Entrepreneurial Orientation and Digital Skills, and the relationship between the latter and the use of agile practices, it is possible to test the third hypothesis:

H3: Digital Skills mediate the relationship between the use of agile practices and Entrepreneurial Orientation.

To check for mediation, the criteria illustrated in the previous chapter (De Carolis et al., 2009) will be analyzed. Among the two agile variables, given the previous results, the one of Agile Breadth will be the one tested as mediated variable.

The validity of criterion 1, according to which there must be a significant relationship between the independent variable (Agile Breadth in this case) and the dependent variable (Entrepreneurial Orientation), needs to be checked first. This criterion is not strictly required to be verified (Shrout & Bolger, 2002), however, since there is no prior work to this one investigating the relationship between the use of agile practices and Entrepreneurial Orientation, it becomes necessary. Table 26 shows the results related to criterion 1. In particular, the variable of Agile Breadth shows to be significantly and positively associated to the one of Entrepreneurial Orientation. This allows to confirm and validate criterion 1 of mediation.

VARIABLES	B
CONSTANT	3.324*** (0.197)
AGE	-0.003 (0.004)
GENDER	0.082 (0.072)
TENURE	-0.003 (0.004)
STUDY TITLE	0.030 (0.035)
POSITION	0.116* (0.052)
ENTREPRENEURIAL EXPERIENCE	0.121 (0.114)
FAMILY BACKGROUND	0.118 (0.093)
AGILE BREADTH	0.016** (0.006)
R-SQUARED	0.201
R-SQUARED ADJ.	0.176

*p<0.05; **p<0.01; ***p<0.001

Predicted Variable: **Entrepreneurial Orientation**

Standard errors in parentheses

TABLE 26: CRITERION 1: REGRESSION MODEL AGILE BREADTH ON ENTREPRENEURIAL ORIENTATION

On the other hand, the validity of criterion 2, according to which there needs to be a significant relationship between the mediator (Digital Skills) and the target variable (Entrepreneurial Orientation), has already been proven and it is reported on model 2 in table 25. In fact, the significance of the relationship between Digital Skills and Entrepreneurial Orientation has already been tested, giving validation to both hypothesis 1 of this research and criterion 2 of mediation.

Despite the positive results on the previous criteria, in order to prove the mediation, also criteria 3 and 4 need to be verified. Criterion 3, according to which there needs to be a significant relationship between the mediated variable (Agile Breadth or Depth) and its mediator (Digital Skills), has once again been already investigated and proven by testing hypothesis 2. Results of such analysis are reported in table 24. The regression model in this case confirms that only the variable Agile Breadth has high significance and explains a good portion of the variance of its alleged mediator.

At this point, only the last criterion needs to be verified. In particular, it is important that Digital Skills significantly reduce the effect of Agile Breadth when they are both used as predictors of Entrepreneurial Orientation.

If the effect of the mediated variable is reduced to zero, we refer to full mediation or perfect mediation (Preacher & Hayes, 2004). However, this is not an essential condition, because even if the effect decreases but not to zero, we can refer to partial mediation.

Table 27 shows the result of regression analysis in two cases: the first is Agile Breadth as only predictor of Entrepreneurial Orientation and the second is the same model with the addition of Digital Skills. It can be concluded that mediation occurs, since the effect of the variable Agile Breadth is significantly reduced.

A measure of the robustness of the model can be computed by dividing the indirect effect for the total effect which provides an approximation of how much the mediation explain the relationship between the dependent and the independent variable. To claim full mediation, this ratio must be greater than 0.8 (Kenny et al, 1998).

In general, the total effect of the mediation can be computed as:

$$Total\ Effect = Direct\ Effect + Indirect\ Effect$$

$$= 0.005 + \ 0.023 \times 0.503 = 0.016$$

VARIABLES	MODEL 1 B	MODEL 2 B
CONSTANT	3.324*** (0.197)	1.709*** (0.255)
AGE	-0.003 (0.004)	0.001 (0.004)
GENDER	0.082 (0.072)	-0.011 (0.065)
TENURE	-0.003 (0.004)	0 (0.004)
STUDY TITLE	0.030 (0.035)	0.001 (0.031)
POSITION	0.116* (0.052)	0.052 (0.047)
ENTREPRENEURIAL EXPERIENCE	0.121 (0.114)	0.062 (0.102)
FAMILY BACKGROUND	0.118 (0.093)	0.007 (0.084)
AGILE BREADTH	0.016** (0.006)	0.005 (0.005)
DIGITAL SKILLS		0.491*** (0.056)
R-SQUARED	0.080	0.271
R-SQUARED ADJ.	0.055	0.249

*p<0.05; **p<0.01; ***p<0.001, Predicted Variable: **Entrepreneurial Orientation**

Standard errors in parentheses

TABLE 27: CRITERION 4: REGRESSION AGILE BREADTH AND DIGITAL SKILLS ON EO

In this particular case:

$Effect\ of\ Digital\ Skills\ on\ Entrepreneurial\ Orientation = 0.503$

$Effect\ of\ Agile\ Breadth\ on\ Digital\ Skills = 0.023$

$Direct\ effect\ of\ Agile\ Breadth\ on\ Entrepreneurial\ Orientation = 0.005$

Given the results of the analysis it is possible to confirm hypothesis 3 stating the existence of a mediating effect of Digital Skills on Agile Breadth when predicting Entrepreneurial Orientation. In particular, the ratio between the indirect and the total effect is equal to 0.70, which suggests that partial mediation has occurred.

At this point, to conclude the analysis on the research hypothesis defined, the last step is to study the role of Ambidexterity as a predictor of Entrepreneurial Orientation. In particular, the following hypothesis will be tested:

H4: *"Individual Ambidexterity moderates the relationship between Digital Skills and Entrepreneurial Orientation"*

In order to test for the moderation, first there needs to be significance between the predicted variable (Entrepreneurial Orientation) and the independent variables (Digital Skills and Ambidexterity). Then, the interaction between Digital Skills and Ambidexterity must be included to check for its significance (Hayes, 2013). If the interaction variable is significant, moderation occurs.

Results of the analysis are reported in table 28. In particular, starting from model 1 with only control variables, both Digital Skills and Ambidexterity are added in models 2 and 3. The introduction of these variables shows a sensible increase in terms of R^2. From model 1 to 2, in fact, the R^2 increases by 0.213 and from model 2 to 3 the R^2 increases by 0.153. Moreover, both variables result to be very significant with p<0.001.

Passing from model 3 to model 4 the interaction variable is added. In particular, this variable is obtained by making the product between Digital Skills and Ambidexterity after they have both been standardized.

VARIABLES	MODEL 1	MODEL 2	MODEL 3	MODEL 4
	B	B	B	B
CONSTANT	3.393*** (0.198)	1.687*** (0.254)	1.467*** (0.230)	3.427*** (0.157)
AGE	-0.004 (0.004)	0 (0.004)	0.001 (0.003)	-0.001 (0.003)
GENDER	0.113 (0.072)	-0.004 (0.065)	-0.020 (0.058)	-0.026 (0.058)
TENURE	-0.003 (0.004)	0 (0.004)	0.001 (0.003)	0.001 (0.003)
STUDY TITLE	0.043 (0.035)	0.004 (0.031)	0.003 (0.028)	-0.002 (0.028)
POSITION	0.128* (0.052)	0.054 (0.047)	-0.012 (0.043)	-0.010 (0.042)
ENTREPRENEURIAL EXPERIENCE	0.104 (0.115)	0.055 (0.102)	0.050 (0.091)	0.052 (0.075)
FAMILY BACKGROUND	0.102 (0.094)	-0.001 (0.084)	-0.035 (0.075)	-0.056 (0.075)
DIGITAL SKILLS		0.503*** (0.055)	0.297*** (0.055)	0.177*** (0.032)
AMBIDEXTERITY			0.277*** (0.033)	0.268*** (0.031)
DIGITAL SKILLS * AMBIDEXTERITY				0.047* (0.023)
R-SQUARED	0.056	0.269	0.416	0.424
R-SQUARED ADJ.	0.033	0.249	0.397	0.404

*p<0.05; **p<0.01; ***p<0.001, Predicted Variable: **Entrepreneurial Orientation**

Standard errors in parentheses

TABLE 28: REGRESSION MODELS HYPOTHESIS 4

Looking at model 4, results show that the interaction variable is significant in the model at p<0.05. This result allows to confirm hypothesis 4 and state that individual Ambidexterity moderates Digital Skills. In particular, this means that the level of digital skills is much more relevant to those individuals who are also able to be ambidextrous.

After analyzing the hypothesis at the foundation of this research, a further analysis was performed on better defining the connection between an individual's entrepreneurial orientation and his intention to act upon that. This connection was first argued by Bolton & Lane (2012), without any empirical evidence, therefore in this context the author will try to empirically define this relationship with the available data evaluating the following hypothesis:

Post Hoc Analysis: *"Entrepreneurial Orientation is positively associated to Entrepreneurial Intention"*

Table 29 reports a hierarchical regression with Entrepreneurial Intention as target variable. In model 1 the dependent variable is predicted by means of control variables, while in model 2 the independent variable is introduced. Results show that there is a significant increase in R^2 between the first and second model, specifically from 0.049 to 0.300. Moreover, the variable measuring Entrepreneurial Orientation shows high significance with p<0.001. Looking at the control variables, Entrepreneurial Intention is negatively associated with age. This means that individuals tend to want to be more entrepreneurial when are still at an early age. It has to be considered that for this sample the mean age is about 46, therefore young age in this case can be considered from 20 to about 40 years old. Another important factor to highlight is that in model 1, the entrepreneurial experience and background don't show significance, contrary to what expected (Fayolle & Liñán, 2014).

These findings confirm what has been previously suggested by Bolton & Lane (2012), showing in a quantitative way that there is a positive relationship between an individual's orientation to entrepreneurship and his intention to act in an entrepreneurial way.

Even though results are relevant, not enough evidence can be provided here to deepen this relationship. It can be confirmed that the two variables are positively associated in an empirical way, but nothing more can be said about the way this relationship manifests or which factors may influence it. Still more evidence is, therefore required to empirically find a complete model that ties together both entrepreneurial orientation and intention.

VARIABLES	MODEL 1 B	MODEL 2 B
CONSTANT	4.066*** (0.271)	1.677*** (0.331)
AGE	-0.015* (0.006)	-0.012* (0.005)
GENDER	0.187 (0.099)	0.107 (0.086)
TENURE	0.006 (0.006)	0.008 (0.005)
STUDY TITLE	0.021 (0.048)	-0.010 (0.042)
POSITION	0.183* (0.072)	0.092 (0.062)
ENTREPRENEURIAL EXPERIENCE	0.190 (0.158)	0.116 (0.136)
FAMILY BACKGROUND	0.014 (0.129)	-0.058 (0.111)
ENTREPRENEURIAL ORIENTATION		0.704*** (0.069)
R-SQUARED	0.049	0.300
R-SQUARED ADJ.	0.026	0.280

*$p<0.05$; **$p<0.01$; ***$p<0.001$, Predicted Variable: **Entrepreneurial Intention**

Standard errors in parentheses

TABLE 29: REGRESSION MODELS POST HOC ANALYSIS

DISCUSSION

The aim of this analysis was to understand whether the use of agile practices and the individuals' digital skills have an impact in increasing the entrepreneurial level of employees and organizations. In particular, the entrepreneurial level was measured both as the individual intention to act entrepreneurially within the boundaries of a company, and through the individual characteristics that increase and individual's entrepreneurial orientation.

The development of the research questions was mainly driven by the intention to deepen the link between the use of practices based on the scientific method and the entrepreneurial level among individuals in organizations, a topic that lacks researches in the existing literature especially in a digital environment. In a context of digitalization, in fact, according to recent papers (Nambisan, 2017, Autio et al., 2018), some affordances are introduced, reshaping the experimentation cycles and the entire entrepreneurial process. Recent papers, in fact, show the importance of people's IT capabilities in the context of organizations (Van Laar et al., 2017; Ngoasong, 2018). In particular, IT skills have been shown to have an important role on entrepreneurship in a digital context (Steininger, 2019; Joshi, 2019) particularly since they behave as enablers of Corporate Entrepreneurship (Chen et al., 2015).

The first important finding of this research is that the use of agile practices and in particular the number of practices that are used by individuals, has a positive effect both on their Entrepreneurial Orientation and on their level of Digital Skills. This result is particularly important because the literature provides very few studies that make an effort to connect Agile Software Development with Digital Entrepreneurship. Moreover, the studies that exist are mainly concentrated on an organizational scale (Cavallo et al., 2019) rather than an individual one. Given the importance of digital skills in the context of organizations, having tools that companies can leverage on to foster individuals' capabilities is extremely important.

Moreover, since the intention of this paper is to show how organizations can foster entrepreneurship among employees, a further effort was made in showing how an experimental approach like Agile can create benefit to Corporate Entrepreneurship and specifically to Digital Corporate Entrepreneurship, which

in this context was measured through Entrepreneurial Orientation (Bolton & Lane, 2012). Given the close relationship between Entrepreneurial Orientation and performance (Rauch et al., 2009), it is important to define tools that firms can draw upon to improve it.

In this sense, results show that Digital Skills positively impacts the individuals' Entrepreneurial Orientation. This relationship, however, is not only a simple correlation, since digital skills also mediates for the interaction between the use of agile practices and Entrepreneurial Orientation. These results allow to clarify even more the mechanism among the different constructs. In fact, not only agile practices foster digital skills but, in turn, the latter creates a positive effect on entrepreneurial orientation. Since the introduction of agile practices is something exogeneous, firms may have the opportunity to pilot employees' capability and their entrepreneurial orientation.

Moreover, findings confirm the moderating role of individual's ambidexterity over digital skills proving the importance of balancing exploration and exploitation in an entrepreneurial context. Digital skills, in fact, can both be used to efficiently perform daily activities and to pursue new opportunity. The ability of individuals to balance both is critical for firms to ensure the maintenance of their current competitive advantage and the achievement of a new one. A characteristic that is fundamental in a digital context where the life cycle of products and services is shortening.

Finally, the post hoc analysis shows the existence of a positive relationship between individuals' Entrepreneurial Orientation and their intention to act in an entrepreneurial way. Even though this connection needs to be further validated and investigated, it may be a potential connection between individuals' Entrepreneurial Orientation and firms' Corporate Entrepreneurship. In fact, orientation is often described as an attitude of individuals. Intention however shows to be correlated with actual behavior. When individuals have both, and the necessary organizational conditions are met, people have the potential to create value for their firms through entrepreneurial acts.

This connection can potentially be considered as a missing link between individuals' EO and firms' EO. A link that is being investigated and required more and more (Covin & Wales, 2019).

CHAPTER 9

CONCLUSION

This chapter discusses the contribution that this study makes to applied research, and to theory. It further outlines the practical implications for organizations that are evaluating the introduction of agile practices or that are looking for ways to increase their entrepreneurial level. The chapter proceeds with a description of the limitations of the used methodology, dataset, and procedure. Finally, are explored possible improvements and further research trajectories that can enrich the findings.

THEORETICAL CONTRIBUTION

The research findings contribute to existing literature in four main ways. First, the findings extend our understanding of the role that experimental approaches plays in facilitating entrepreneurship. In this research, in fact, it is shown that the use of Agile practices has a positive effect on individuals' entrepreneurial orientation. The theoretical connection between entrepreneurship and experimentation is something of growing interest in the literature and, even though some conceptual contribution is provided (Kerr et al., 2014), the stream of research lacks empirical evidence.

Second, this research clarifies entrepreneurial concepts in a context of digitalization. Changes introduced by digital technologies are, in fact, fundamentally shaping markets and competition, offering new opportunities that have the potential of disrupting the way most traditional industries work (Autio et al., 2018). In this scenario, the role of the entrepreneur needs to be revisited (Nambisan, 2017). To cope with such shift, this research ties together the concept of Entrepreneurial Orientation, which is one of the most relevant constructs associated to Corporate Entrepreneurship, with the perspective of digital skills, intended as capabilities required in a context of digitalization.

Third, the results further develop the role of ambidexterity in relationship to entrepreneurship and digitalization. Such contribution in the literature can be consider as novel and relevant. In fact, many authors in this research stream have started to investigate the concepts of digital capabilities in relation to exploration and exploitation mainly through the concept of IT ambidexterity (Lee et al., 2015) in different ways. Some argue that IT ambidexterity fosters a firm's digital innovation capability (Tai et al., 2017), some focuses on the alignment between digital capabilities and business objectives (Bot & Renaud, 2012) and others focus on the role of ambidexterity as alignment between entrepreneurial agility and adaptive agility in a digital context (Röder et al., 2014). However, many of those researches are focusing on linking together organizational construct. This research, instead, offers a more empirical approach at an individual level of analysis, showing that there is a moderating effect of ambidexterity in the relationship between digital skills and entrepreneurial orientation. With respect to extend research this approach offers many more implications for practitioners.

The fourth important theoretical contribution is represented by the analysis around the concept of Entrepreneurial Intention. Findings show that there is a positive relationship between Entrepreneurial Orientation and the intention to pursue business opportunities. This link is potentially very important both for practitioners and conceptual researches. In fact, it has been shown that there is a connection between intention and action in the venturing process (Fayolle, 2014). Therefore, this relationship has much practical and theorical potential. However, at the current state of the research, more evidence is needed.

PRACTICAL IMPLICATIONS

Besides the theoretical contribution to the different streams of literature, this research has also many implications for practitioners and firms.

First, the research clarifies the benefits for firms in investing in experimental approaches such as Agile. In fact, besides the practical benefits of adopting agile practices to improve the processes of software development or project management, results show that the adoption of agile practices leads to positive effects in terms of digital skills and entrepreneurial orientation of individuals. In particular, the adoption of agile methodologies is something exogeneous for organizations, meaning that companies have the opportunity to guide their use and implementation. By leveraging this factor, firms can have multiple additional benefits which range from developing internal IT capabilities that allow them to survive in a digital context to fostering entrepreneurial attitude among employees that allows them to discover and pursue new opportunity to obtain a sustained competitive advantage over time.

Second, findings show the importance for companies of fostering individuals' ambidexterity. It is critical, in fact, that firms and employees deploy both exploitative and explorative behaviors. The investment in agile practices and the cultivation of digital skills, in fact, needs to be balanced. The immediate risk, in this sense, is to be stuck in a mechanism where capabilities and procedures inhibit individuals' creativity and attitude towards opportunity recognition. This idea is confirmed by the findings. The models, in fact, report that using agile practices is more significant than using practices with high frequency. Moreover, results show that being ambidextrous enhances both sides of the spectrum (exploration and exploitation), with a subsequent increase in performance.

Finally, an important contribution is made in explaining the process of venture creation starting from an individual level. The positive relationship between Entrepreneurial Orientation and Entrepreneurial Intention, in fact, demonstrates that peoples' attitude towards new opportunity is related to their intention to pursue them.

LIMITATIONS

Apart from the contributions made by this research, there are some limitations to discuss. In fact, despite methodological rigor has been devoted in the empirical analysis, this study suffers of some limitations due to the nature of the available data and the way they were operationalized. It is worthwhile then to go through them applying critical sense and independent judgement. First, it is important to introduce those limitations that are related to the methodology used. In fact, results of this paper are based on the analysis of data gathered by means of a survey issued to a company working in the IT sector. Even though the response rate (20%) is in line with extend researches and tests were made to ensure that the sample gathered is representative of the entire population, one important limit is the fact that data is referred to a single firm. To further validate the findings, in fact, a wider sample of firms should be considered.

Second, in relation to the methodology used, a potential limitation is the fact that the variables analyzed are all gathered through survey. While there is much evidence that the construct of Entrepreneurial Orientation is linked to performance (Rauch et. al, 2009) and researches validate the use of Entrepreneurial Intention as proxy for performance (Bolton & Lane, 2012), a real parameter of firm performance is lacking. Having an objective quantitative parameter not depending on individuals' responses, in fact, can be a way to validate the findings.

Finally, the cross-sectional design of the research limits the possibility of attributing further causality to the relationships highlighted by the empirical analysis of the data. This is given by the issue that data gathered in the form of survey usually describes the picture of a population in a specific moment in time. Therefore, obtaining full causality related to correlations is challenging.

FUTURE DIRECTIONS

The findings of this research, while answering some research questions and providing value to the literature, also open up new research opportunities. First,

it is important to acknowledge the limitation presented and encourage future researchers to fill the gap.

First, researchers could validate the findings by increasing the sample of firms and industries and by defining an objective parameter of performance not depending on the survey methodology. As previously illustrated, in fact, this research already explicates the relationship between the variable of Entrepreneurial Orientation and performance. Moreover, results are considered to be generalizable to different industries depending mainly on the dynamicity of the environment. However, these statements are mostly supported by studies in the literature (Rauch et. al, 2009; Bolton & Lane, 2012; Hampel et. al, 2020). Therefore, further researches with empirical evidence may be valuable to confirm the findings.

Moreover, to expand the perspective of this research, future scholars could integrate different methodologies to gather more insights, especially from a practical point of view. In this study, in fact, the perspective of quantitative data analysis is combined with theoretical consideration to provide a unique framework of causality. However, the additional use of case studies or interviews could allow to tie together the current perspectives with more organizational ones. They could allow to deepen the optimal organizational conditions to integrate the individual level with the firm one. This is particularly relevant since in all the literatures of reference the importance of organizational factors is critical. Regarding agile, it has been proven the importance of the context and the organizational culture (Tolfo et al.,2011; Misra et al., 2006). Similarly, for Corporate Entrepreneurship, factors like control systems (Morris et al., 2006), leadership styles (Dess, 2003), managerial practices (Barringer & Bluedorn, 1999) or organizational culture (Ireland et al., 2009) are fundamental. In this sense, studies that clearly link together individual quantitative results with data about firm level factors could be of much value. Such perspective can allow to further understand the link between individual level of abstraction with firm level (Covin & Wales, 2019). Moreover, to solve the limits created by the cross-sectional design nature of the research, experiments could be carried out to attribute further causality to the findings. In fact, this methodology is more and more used among management scholars since it allows to obtain targeted and precise insights to complement theoretical or empirical evidence.

An important direction that emerged from this research is the one linking Entrepreneurial Orientation with Entrepreneurial Intention. As mentioned, our findings show that the two constructs have a positive relation and previous literature shows that intention is further associated with entrepreneurial action. Further investigating this link has much value for both scholars and practitioners. From a theoretical perspective, in fact, this relationship could be a bridge between the individual level of analysis and the corporate one. In fact, if entrepreneurial orientation can be linked to entrepreneurial action in such way, it means that fostering individuals' attitude, is intrinsically linked to fostering a firm's Corporate Entrepreneurship in a sustained way over time. Moreover, from a practitioner perspective, proving this connection implies maximizing the probability of entrepreneurial behaviors, which in turns implies being able to have a sustained competitive advantage over time.

Finally, from a practical point of view, further research could be made in relationship to agile practices tailoring in a context of digitalization (Campanelli et al., 2018; Bass, 2012). In fact, this research treats agile practices in an aggregated way through the concepts of Agile Breadth and Agile Depth. However, investigating the effect of different clusters of practices is very important especially for practitioners deciding on which practices they should invest.

APPENDIX

SURVEY

In this appendix, is reported the full version of the survey used for the collection of data used in the empirical analysis of this research.

Please Provide the following information:

1.1 Your gender

☐ Male

☐ Female

1.2 Year of Birth

_____

1.3 How many years have you been working in the company for?

_____

1.4 What is your position in the company?

☐ Director

☐ Manager

☐ Employee

☐ Other (specify): _____

1.5 In which department of the organization do you work?

☐ Research

☐ Marketing

☐ Accounting and Control

☐ Software factory

☐ Solution factory

☐ Operations -Delivery

☐ Other (specify): _____

1.6 What is your highest study title?

☐ Postgraduate (e.g., PhD, MBA)

☐ Graduate or Master's Degree

☐ Bachelor's Degree

☐ Diploma

☐ Other (specify): _____

1.7 If your study title is "postgraduate", can you specify which kind?

_____

1.8 If your study title is "diploma", which kind is it?

☐ Classical High School

☐ Scientific High School

☐ Linguistic High School

☐ Artistic High School

☐ Commercial Technical Institute

☐ Industrial Technical Institute (ITIS)

☐ Professional Technical Institute

☐ Surveyor

☐ Socio-pedagogical

☐ Other (specify): _____

1.9 If your study title is either "Higher (ex. PhD, MBA)", "Graduate or Master's Degree" or "Bachelor's Degree", can you please specify the faculty or the area of your title?

☐ Business/Management

☐ Law

☐ Economics

☐ Social Sciences

☐ Art

☐ Engineering and Architecture

☐ Mathematics and Natural Sciences

☐ Computer Science/ IT

☐ Medicine and Health Sciences

☐ Agricultural, Forestry and Nutrition Sciences

☐ Linguistics and Cultural Studies (Psychology, Religion, Philosophy)

☐ Other (specify):

_____

1.10 Have your parents ever been entrepreneurs (excluding freelancers)?

☐ Yes

☐ No

1.11 Have you ever founded a business?

☐ Yes

☐ No

1.12 Before working for this company, have you ever been employed as a researcher?

☐ Yes. In a private company

☐ Yes. At university

☐ Yes. In public research institution

☐ No

ENTREPRENEURIAL INTENTION

Scenario:

"Your company has asked you and other select employees to participate in a new, innovative project that requires your special skills and expertise. The situation requires that you act quickly and change jobs to a new assignment. This new project, if successful, could grow into a new business unit within the company, or if appropriate, it may be spun out as a new independent company".

Based on the description of the entrepreneurial project above, how do you rate the likelihood that you would participate in the project? (1= strongly disagree, 7= strongly agree).

		Strongly disagree Agree						Strongly
2.1	I am ready to do whatever it takes to participate to the project	1	2	3	4	5	6	7
2.2	My professional objective is to participate to the project	1	2	3	4	5	6	7
2.3	I will give the maximum effort to start and manage the project	1	2	3	4	5	6	7
2.4	I am determined to contribute to the project in the future	1	2	3	4	5	6	7
2.5	I have seriously thought of starting such a project	1	2	3	4	5	6	7
2.6	I have the serious intention of starting such a project sooner or later	1	2	3	4	5	6	7
2.7	I would participate to the project	1	2	3	4	5	6	7

INDIVIDUAL AMBIDEXTERITY

Compared to other peers:	Never	Almost Never	Occasionally	About half of the time	Frequently	(almost) always	Always
3.1 I take the initiative and am alert to opportunities beyond the confines of my own job	☐	☐	☐	☐	☐	☐	☐
3.2 I am cooperative and seek out opportunities to combine my efforts with others	☐	☐	☐	☐	☐	☐	☐
3.3 I am a broker and always look to build internal linkages	☐	☐	☐	☐	☐	☐	☐
3.4 I am a multitasker and comfortable wearing more than one hat	☐	☐	☐	☐	☐	☐	☐

ENTREPRENEURIAL ORIENTATION

Please indicate your level of agreement with the following statements (1=strongly disagree, 7=strongly agree).

		Strongly disagree				Strongly Agree
3.5	I like to take bold action by venturing into the unknown	1	2	3	4	5
3.6	I am willing to invest a lot of time and/or money on something that might yield a high return	1	2	3	4	5
3.7	I tend to act "boldly" in situations where risk is involved	1	2	3	4	5
3.8	I often like to try new and unusual activities that are not typical but not necessarily risky	1	2	3	4	5
3.9	In general, I prefer a strong emphasis in projects on unique, one-of-a-kind approaches rather than revisiting tried and true approaches used before	1	2	3	4	5
3.10	I prefer to try my own unique way when learning new things rather than doing it like everyone else does	1	2	3	4	5
3.11	I favour experimentation and original approaches to problem solving rather than using methods others generally use for solving their problems	1	2	3	4	5
3.12	I usually act in anticipation of future problems, needs or changes	1	2	3	4	5
3.13	I tend to plan ahead on projects	1	2	3	4	5
3.14	I prefer to "step-up" and get things going on projects rather than sit and wait for someone else to do it	1	2	3	4	5

DIGITAL SKILLS

At work, how often		never	rarely	sometimes	often	(almost) always
1.	Are you consistent in the naming of digital files?	☐	☐	☐	☐	☐
2.	Do you organize digital files via a hierarchical folder structure?	☐	☐	☐	☐	☐
3.	Do you check the reliability of a website?	☐	☐	☐	☐	☐
4.	Do you check the information found on a different website?	☐	☐	☐	☐	☐
5.	Do you check if the information found is up to date?	☐	☐	☐	☐	☐
6.	Do you get what you want from interactions on the internet?	☐	☐	☐	☐	☐
7.	Are you via the internet effective in accomplishing what you want?	☐	☐	☐	☐	☐
8.	Do you know how to use the internet to express ideas clearly?	☐	☐	☐	☐	☐
9.	Do you post new messages on the internet?	☐	☐	☐	☐	☐
10.	Do you post a blog/article on the internet?	☐	☐	☐	☐	☐
11.	Do you share information on the internet to start a discussion?	☐	☐	☐	☐	☐
12.	Do new collaborations emerge by approaching online contacts?	☐	☐	☐	☐	☐
13.	Do you establish online contacts to collaborate with?	☐	☐	☐	☐	☐
14.	Do you find experts on the internet to start a project with?	☐	☐	☐	☐	☐
15.	Do you spend time and effort in online networking with people from your field?	☐	☐	☐	☐	☐
16.	Do you use your online network to benefit from it?	☐	☐	☐	☐	☐

At work, how often	never	rarely	sometimes	often	(almost) always
17. Do you use your online network to generate business?	☐	☐	☐	☐	☐
18. Do you build online relationships with people from your field?	☐	☐	☐	☐	☐
19. Does the internet help you approach new professional contacts?	☐	☐	☐	☐	☐
20. Do you use your online network to increase brand awareness?	☐	☐	☐	☐	☐
21. Do you start a conversation with other professionals via the internet?	☐	☐	☐	☐	☐
22. Do you use your online network to achieve policy goals?	☐	☐	☐	☐	☐
23. Do you share important information with your team via the company's information systems?	☐	☐	☐	☐	☐
24. Do you use the company's information systems to share information that supports the work of others?	☐	☐	☐	☐	☐
25. Do you use the company's information systems to share resources that help the team perform tasks?	☐	☐	☐	☐	☐
26. Do you use the company's information systems to provide each other with information that progresses work?	☐	☐	☐	☐	☐
27. Do the company's information systems help you get support from co-workers?	☐	☐	☐	☐	☐
28. Do you communicate via the company's information systems with co-workers from other disciplines?	☐	☐	☐	☐	☐
29. Do you share work-related knowledge with each other via the company's information systems?	☐	☐	☐	☐	☐

		never	rarely	sometimes	often	(almost) always
30.	Do you use the company's information systems to give feedback to co-workers?	☐	☐	☐	☐	☐
31.	Do the company's information systems help you carry out tasks according to the planning?	☐	☐	☐	☐	☐

At work, how often		never	rarely	sometimes	often	(almost) always
32.	Do you use the company's information systems to discuss your role and contributions with team members?	☐	☐	☐	☐	☐
33.	Do the company's information systems help you use other professionals' expertise?	☐	☐	☐	☐	☐
34.	Do you give substantiated arguments or reasoning?	☐	☐	☐	☐	☐
35.	Do you give proof or examples of arguments you give?	☐	☐	☐	☐	☐
36.	Do you give a justification for your point of view?	☐	☐	☐	☐	☐
37.	Are you able to put the discussion into a new perspective?	☐	☐	☐	☐	☐
38.	Do you ask questions to understand other people's viewpoint?	☐	☐	☐	☐	☐
39.	Do you consider various arguments to formulate your own point of view?	☐	☐	☐	☐	☐
40.	Do you connect viewpoints to give a new turn to the discussion?	☐	☐	☐	☐	☐
41.	Do you suggest new related points?	☐	☐	☐	☐	☐
42.	Do you filter the most important points from discussions?	☐	☐	☐	☐	☐

		never	rarely	sometimes	often	(almost) always
43.	Do you generate new input from a discussion?	☐	☐	☐	☐	☐
44.	Are you open for ideas that challenge some of your held beliefs?	☐	☐	☐	☐	☐
45.	Do you use the internet to justify your choices?	☐	☐	☐	☐	☐
46.	Do you give a creative turn to existing processes using the internet?	☐	☐	☐	☐	☐
47.	Do you use the internet to generate innovative ideas for your field?	☐	☐	☐	☐	☐

At work, how often		never	rarely	sometimes	often	(almost) always
48.	Do you show originality in your work using the internet?	☐	☐	☐	☐	☐
49.	Do you use the internet to execute your tasks creatively?	☐	☐	☐	☐	☐
50.	Do you follow trends on the internet to generate original ideas?	☐	☐	☐	☐	☐
51.	Do you use the internet to evaluate the usability of your ideas?	☐	☐	☐	☐	☐
52.	Does the internet help you find the best way to solve the problem?	☐	☐	☐	☐	☐
53.	Do you solve the problem using the internet?	☐	☐	☐	☐	☐
54.	Do you come up with solutions to the problem via the internet?	☐	☐	☐	☐	☐
55.	Does the internet help you find ways to solve problems?	☐	☐	☐	☐	☐

56.	Are you confronted with a problem that you are sure you can solve using the internet?	☐	☐	☐	☐	☐
57.	Do you make a decision using the internet that makes you feel happy afterwards?	☐	☐	☐	☐	☐
58.	Do you find the solution via the internet even though initially no solution is immediately apparent?	☐	☐	☐	☐	☐
59.	Does the actual outcome you achieved via the internet match what you expected?	☐	☐	☐	☐	☐

AGILE

5.1 Do you know agile methodologies (Scrum, Extreme Programming, Kanban...) and/or practices (Pair Programming, Backlog, Sprint...)?

☐ Yes

☐ No

5.2 Do you have any agile certification?

☐ Yes

☐ No

	Select the agile practices you use from the list below:	YES	NO	I DON'T KNOW THIS PRACTICE
5.1	Sprint			
	Sprint Backlog			
	Sprint Planning Meetings			
	Sprint Review Meetings			
	Sprint Retrospective Meetings			
	Daily Scrum Meetings			
	Sprint Burndown Chart			
	Product Backlog			
	Presence of Scrum Master			
	Presence of Product Owner			
	Timebox Iterations			
	User Stories			
	Metaphors			
	Planning Game or Planning Poker			
	Unit Tests			
	Acceptance Tests			
	Frequent Releases			
	Refactoring			
	Pair Programming			
	Continuous Integration			
	Collective Ownership			
	On-site Customer			
	40 hours week			
	Open Workspace			
	Coding Standards			
	No specific practice but I follow the agile principles			

	If you use some of the practices, please report the usage degree of each one you selected in the previous question, by indicating a number from 1 to 5. In particular: 1= if you use the agile practice in a very low degree 5= if you use the agile practice in a very high degree	from 1 to 5
5.2	Sprint	
	Sprint Backlog	
	Sprint Planning Meetings	
	Sprint Review Meetings	
	Sprint Retrospective Meetings	
	Daily Scrum Meetings	
	Sprint Burndown Chart	
	Product Backlog	
	Presence of Scrum Master	
	Presence of Product Owner	
	Timebox Iterations	
	User Stories	
	Metaphors	
	Planning Game or Planning Poker	
	Unit Tests	
	Acceptance Tests	
	Frequent Releases	
	Refactoring	
	Pair Programming	
	Continuous Integration	
	Collective Ownership	
	On-site Customer	
	40 hours week	
	Open Workspace	
	Coding Standards	

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